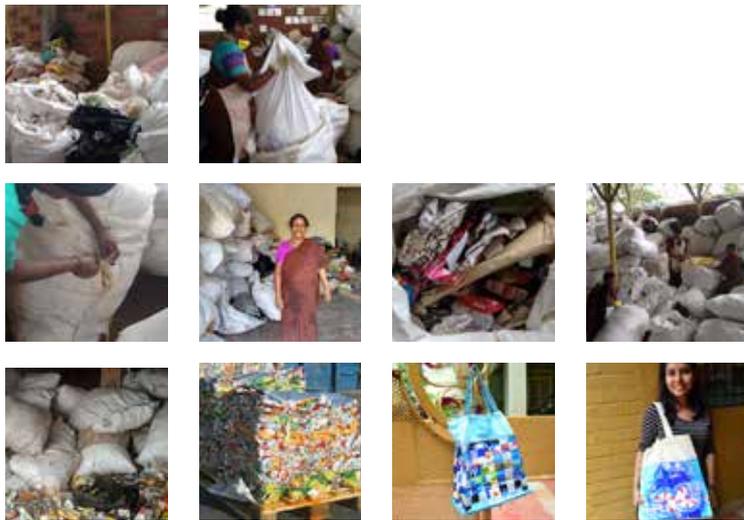




Closing the Loop

From Waste to Resource



Diploma Project 2015

Closing the Loop

From Waste to Resource

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College
D J Academy of Design

Client
Saahas

Approval page



D J ACADEMY OF DESIGN

Approval

The following document is duly examined and approved by the designated jury as credible work on the chosen subject, carried out and presented in a manner and at a level that is appropriate for acceptance as diploma project qualification of this Institute.

This approval however does not necessarily endorse any statements, comments or conclusions drawn in by the author in the document

This is a partial fulfillment for the award of the **Undergraduate / Postgraduate level Diploma in Industrial / Communication Design.**

This Project/Thesis study of 26 weeks duration in the curriculum has been completed in weeks.

Title of the Project :

.....

Student's Name & Signature :

Guide's Name & Signature :

.....

.....
Internal Jury
Name and Signature

.....
External Jury
Name and Signature

Place : Coimbatore

Date:

.....
Dean/ Jury Chairman
Name and Signature

Synopsis

Imagine throwing away an old product, and rather than it ending up left in landfill, each part of that old product is made into a brand new one. Moving from a traditional linear system to a circular system, otherwise known as closing the loop, is a growing idea in the world of sustainable design and manufacturing. Closing the loop means moving from traditional design, which looked at the linear model for design and production – make, use and dispose – to how the disposal stage could be fed back into the creation of a new product.

We have learned to dump trash and we have learned to get rid of the trash but we still need to learn how to do it right. The food we eat, the air we breathe and the water we drink are all polluted, thanks to our careless behavior. We see heaps and piles of waste lying on every street and the stink is unbearable! Even landfills are filling up and waste management is now a giant problem facing our nation. It is time for change and no government can bring this change without the support of the people. This untreated Waste is polluting the soil, water and in turn coming back to us in a harmful way. Waste segregation can make our streets cleaner, it can help us recycle things; reduce the use of certain raw materials and hence in making our planet a better place to live in.



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1 Introduction

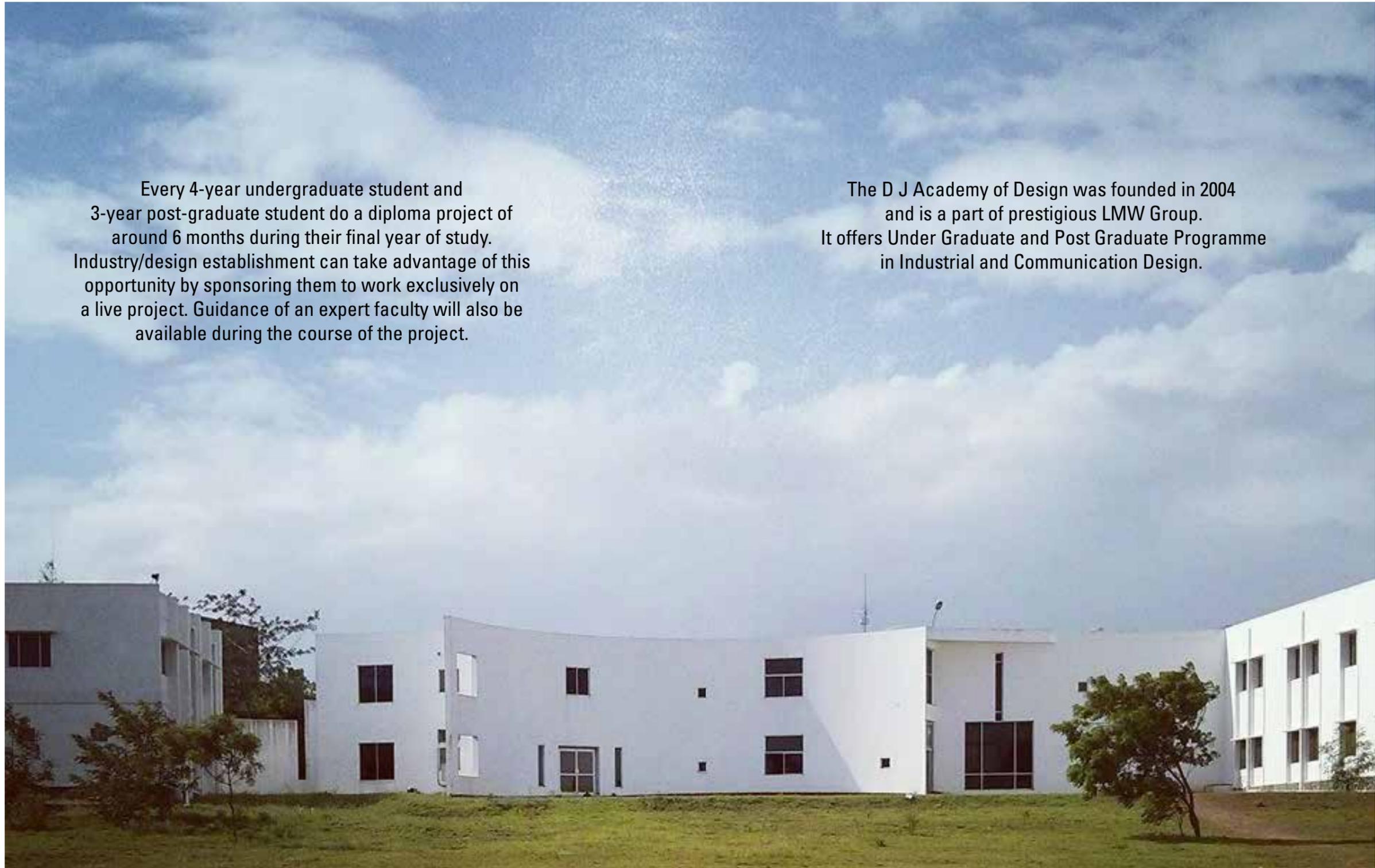
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Diploma Project

D J Academy of Design

Every 4-year undergraduate student and 3-year post-graduate student do a diploma project of around 6 months during their final year of study. Industry/design establishment can take advantage of this opportunity by sponsoring them to work exclusively on a live project. Guidance of an expert faculty will also be available during the course of the project.

The D J Academy of Design was founded in 2004 and is a part of prestigious LMW Group. It offers Under Graduate and Post Graduate Programme in Industrial and Communication Design.



Saahas



Saahas was registered as a not-for-profit under the Society's Act in 2001. It has a second entity, Saahas Waste Management Pvt Ltd which provides professional services to all waste generators, including companies, apartment complexes, institutions and communities. Both entities demonstrate how waste can be converted into resources. Saahas today manages 7 tons of waste per day. This includes wet/organic, dry/recyclable waste and e-Waste.

Kasa Rasa

Kasa Rasa is an initiative of Saahas NGO which is supported by BBMP (Bruhat Bangalore Mahanagara Palike) and KSPCB (Karnataka State Pollution Control Board). The Centre has wet and dry waste recovery area. The centre also aims to integrate waste pickers with the centre's activities and improve their working conditions and income.

It has a capacity of two tons per day. The centre supports waste collection from apartments and offices in Koramangala blocks I, III, VI and VII and Madiwala Market. The waste is collected by BBMP pourakarmikas and the staff of Kasa Rasa. For residences or offices serviced directly by the staff, there is a nominal fee to cover transportation and labour costs. Residents can also bring in waste directly to the center.



Project Brief



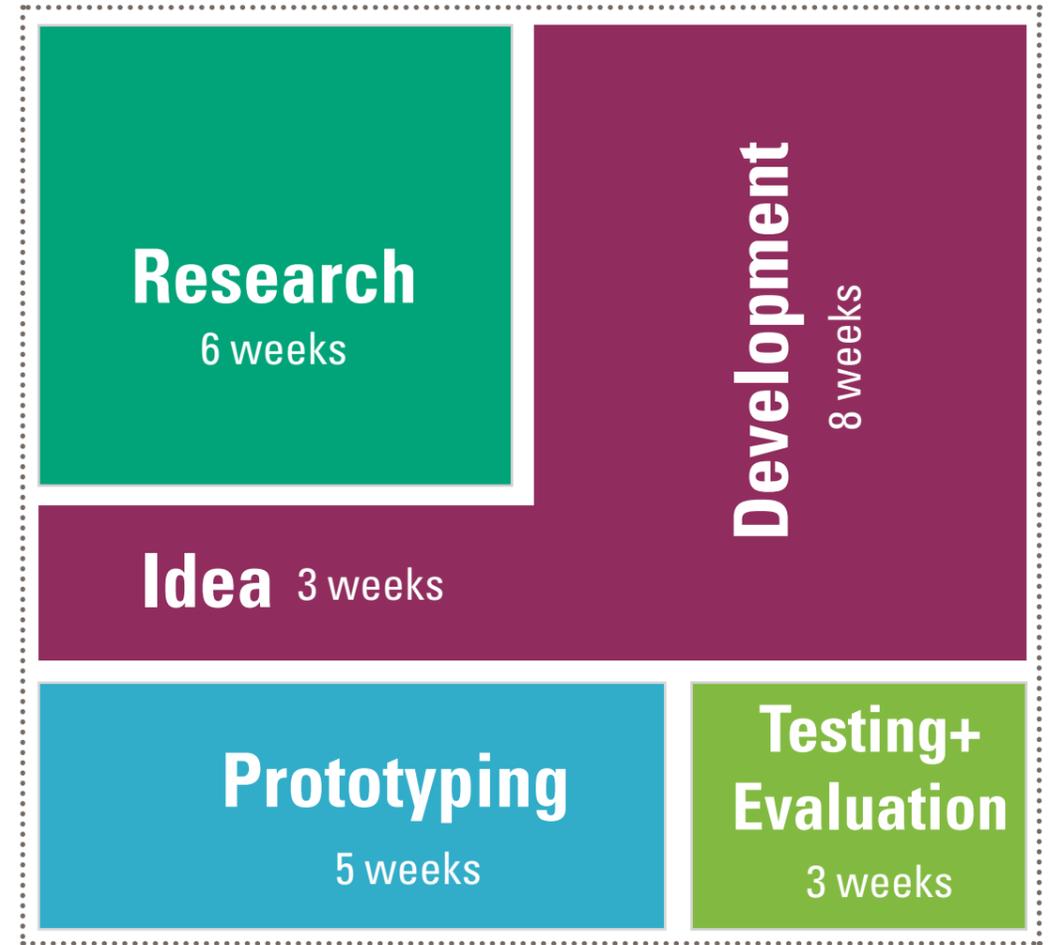
To understand the current system of waste in flow and out flow, segregation methods and storage.

To identify the gaps within the current system and suggest a more efficient and a sustainable way to segregate dry waste.

2 Planning

Design Process Structure

Design Process Structure



5 Month Module



3 Research

Literature review

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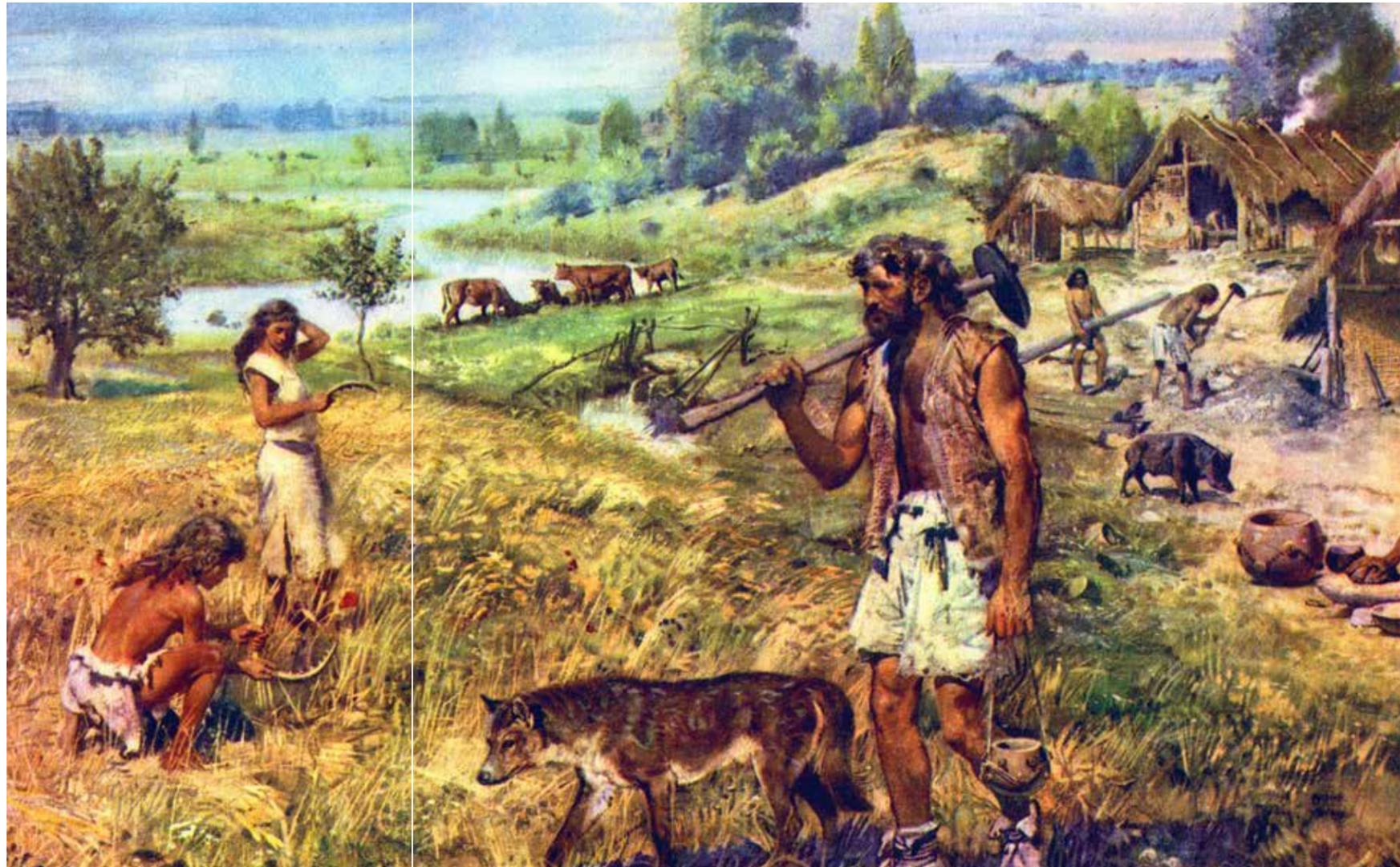


Literature review

Understanding Waste

Mankind long possessed the sense of scarcity, and recognized the limited nature of its resource compared with the extend of its need. Everything available had to be used and nothing or practically nothing – was ever discarded. Due to limited techniques, natural resources remained little exploited and all type of waste had to be recycled. This was the situation of traditional society in the past, and the traveller of today encounters a barely changed attitude in the most remote village of the developing countries.

“Everything has a value, a use and man still controls the cycle of materials.”



The industrial revolution that started at the end of the 18th century obliged mankind to adopt a new rationale - that of exploitation, predatory behaviour and consumption of resources, whether sustainable or not, with no apparent limits. Technical progress enabled to go further, quicker and deeper, adopting a philosophy of discover and exploit. Little by little, resources to be recovered and waste (increasing at a rate equal to that of urbanization) were seen as pollutants that had to be collected discretely, hidden or buried and, above all, destroyed.

The 21st century has begun with on a number of unbalanced situations: those of the mouths of the feed, starving populations which will need every acre of available land, fossil and mining resources on the road of extinction, or at least ever plex to manage. These examples of imbalance represents as many challenges but with one dimension common to all of them, regarded too often as problem and still far too infrequently as solution, namely waste, a source of production practically without limits of which mankind, more than ever before, must learn to identify the value in order to get back to the ancient ideal of the alchemists of completing the material cycle, transmuting waste into a resource, and reducing all form of predatory consumption to the greatest possible degree.

What is waste ?

“Waste is defined as any material that is not useful and does not represent any economic value to its owner, the owner being the waste generator.”



Where is the waste ?

The production of waste is perhaps the most natural act of life and of mankind in a society whether rural or urban. The more developed- and therefore the wealthier- an economy, the greater the quantity of waste it produces.

There are many source of waste. A distinction is currently made between:



Construction and Demolition



Industrial activities



Households

Types of waste

Depending on the physical state of waste, wastes are categorized into

Solid



Liquid



Gaseous

Solid Wastes are categorized into

Municipal wastes



Hazardous wastes



Medical wastes



Radioactive wastes



Municipal Solid Waste (MSW)

MSW is defined as any waste generated by household, commercial and/or institutional activities and is not hazardous.

Depending upon the source, MSW is categorized into three types:

Residential or household waste

- Individual houses

Commercial wastes

- Hotels
- Office buildings
- Schools

Municipal services wastes

- Streets
- Parks

MSW composition

Materials in MSW can be broadly categorized into three groups,

Compostable

- Food waste
- Vegetable market wastes
- Yard waste.

Recyclables

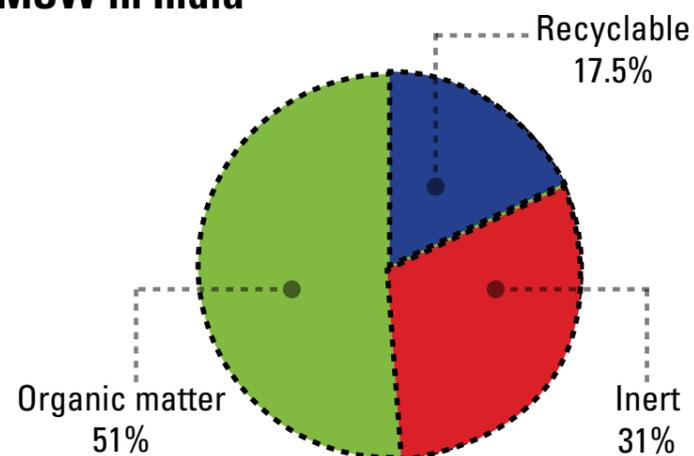
- Paper
- Plastic
- Metal
- Glass

Inerts

- Construction debris

Composition of urban MSW in India

A major fraction of urban MSW in India is organic matter (51%). Recyclables are 17.5 % of the MSW and the rest 31% is inert waste



Per capita MSW generation

Per capita waste generation is the amount of waste generated by one person in one day in a country or region.

Waste generation rate in Indian cities ranges between **200 - 870 grams/day**, depending upon the region's lifestyle and the size of the city. The per capita waste generation is increasing by about 1.3% per year in India



Economic growth, change in life style and effect on MSW

The waste generation rate generally increases with increase in GDP during the initial stages of economic development of a country, because increase in GDP increases the purchasing power of a country which in turn causes changes in lifestyle. Even a slight increase in income in urban areas of developing countries can cause a few changes in lifestyle, food habits and living standards and at the same time changes in consumption patterns. Therefore, high income countries generate more waste per person compared to low income countries due to the difference in lifestyles.

Categories of Household Waste

Household waste can be classified as:

Biodegradable waste(Wet waste)

Biodegradable waste is a type of waste which can be broken down, in a matter of week or few months, into its base compounds by micro-organism and other living things, regardless of what those compound may be.



Vegetable/Fruit peels



Left over food



Rotten vegetable/ fruits

Recyclable waste(dry waste)

Dry waste or recyclable waste are waste which can be treated or processed (used or waste materials) so as to make suitable for reuse.



Metal Cans



Paper



Plastic



Glass



Rubber

Hazardous waste (E- Waste)

Hazardous waste is waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can be liquids, solids, gases, or sludges. They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes.



Batteries



CFLS



Agrucultural Waste

Garden Waste

The waste collected from garden or park, such as grass or flower cuttings and hedge trimmings.



Dry Leaves



Pruning from Shrubs



Hedge Cuttings

Sanitary Waste

Waste which is contaminate with secretion of body fluids.



Sanitary Pad



Tissue Rolls



Used Ear Buds

Solid Waste Management(SWM)

Solid Waste Management may be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of solid wastes in a manner that is in accordance with the best principles of public health, economics, engineering, conservations , and that is also responsive to public attitudes.

Solid waste management (SWM) is a basic public necessity and this service is provided by respective urban local bodies (ULBs) in India.

Conventional Solid Waste Management

Conventional waste management focuses largely on

Collection



Treatment



Disposal

It only try to cope with ever-increasing amounts of waste through treatment and disposal. Also, collected waste is often disposed of through uncontrolled landfilling and processed through unsafe and informal recycling.



Collection

Waste is collected in a number of different ways, according to the country concerned and its level of development

In many cities in developing countries, collection rates remain low and the quality of collection services are poor. Waste collection services are generally non-existent in poorer neighborhoods such as slums.

System	Description	Advantages	Disadvantages
SHARED: Residents can bring out waste at any time			
Dumping at designated location	Residents and other generators are required to dump their waste at a specified location or in a masonry enclosure.	Low capital costs	Loading the waste into trucks is slow and unhygienic. Waste is scattered around the collection point. Adjacent residents and shopkeepers protest about the smell and appearance.
Shared container	Residents and other generators put their waste inside a container which is emptied or removed.	Low operating costs	If containers are not maintained they quickly corrode or are damaged. Adjacent residents complain about the smell and appearance



INDIVIDUAL: The generators need a suitable container and must store the waste on their property until it is collected			
Block collection	Collector sounds horn or rings bell and waits at specified locations for residents to bring waste to the collection vehicle.	Economical. Less waste on streets.	No permanent container or storage to cause complaints. If all family members are out when collector comes, waste must be left outside for collection. It may be scattered by wind, animals and waste pickers.
Curbside collection	Waste is left outside property in a container and picked up by passing vehicle, or swept up and collected by sweeper.	Convenient. No Permanent public storage.	Waste that is left out may be scattered by wind, animals, children or waste pickers. If collection service is delayed, waste may not be collected or some time, causing considerable nuisance.
Door to door collection	Waste collector knocks on each door or rings doorbell and waits for waste to be brought out by resident.	Convenient for resident. Little waste on street.	Residents must be available to hand waste over. Not suitable for apartment buildings because of the amount of walking required.
Yard collection	laborer enters property to remove waste.	Very convenient for residents. No waste in street.	The most expensive system, because of the walking involved. Cultural beliefs, security considerations or architectural styles may prevent laborers from entering properties.

Treatment

Waste treatment techniques seek to transform the waste into a form that is more manageable, reduce the volume or reduce the toxicity of the waste thus making the waste easier to dispose of. Treatment methods are selected based on the composition, quantity, and form of the waste material. Some waste treatment methods being used today include subjecting the waste to extremely high temperatures, dumping on land or land filling and use of biological processes to treat the waste.



Thermal treatment

This refers to processes that involve the use of heat to treat waste. Listed below are descriptions of some commonly utilized thermal treatment processes. In all these processes, besides net energy recovery, proper destruction of the waste is also ensured.

Incineration

This method, commonly used in developed countries is most suitable for high calorific value waste with a large component of paper, plastic, packaging material, pathological wastes, etc. It can reduce waste volumes by over 90 per cent and convert waste to innocuous material, with energy recovery.

**advantages**

- noiseless
- odourless
- method is relatively hygienic
- less cost of waste transportation
- minimal land requirement

disadvantages

- Least suitable for chlorinated and high moisture content waste
- Entails substantial operation and maintenance costs
- Large capital
- Skilled personnel are required for plant operation and maintenance

Pyrolysis/Gasification

Pyrolysis gasification processes are established for homogeneous organic matter like wood, pulp, etc., while plasma pyrolysis vitrification is a relatively new technology for disposal of particularly hazardous wastes, radioactive wastes, etc.

advantages

- Produces fuel gas/fuel oil, which replace fossil fuels
- no NO and SO gas emissions

disadvantages

- Capital and energy intensive process
- Not suitable for wastes with excessive moisture and inert content.
- High viscosity of Pyrolysis oil maybe problematic for its flammable nature

Open burning

Open burning is the burning of unwanted materials in a manner that causes smoke and other emissions to be released directly into the air without passing through a chimney or stack.

Garbage are burnt because of the ease and convenience of the method or because of the cheapness of the method. In countries where house holders are required to pay for garbage disposal, burning of waste in the backyard allows the householder to avoid paying the costs associated with collecting, hauling and dumping the waste

**advantages**

- Reduces the volume of refuse received at the dump
- Extends the life of the dump site

disadvantages

- Releases many pollutants like, dioxins, particulate matter, polycyclic aromatic compounds, volatile organic compounds, carbon monoxide, ash
- Negative effects on both human health and the environment

Biological waste treatment

Composting

Composting is the decomposition of organic matter by microorganism in warm, moist, aerobic and anaerobic environment. Farmers have been using compost made out of cow dung and other agro-waste. The compost made out of urban heterogeneous waste is found to be of higher nutrient value as compared to the compost made out of cow dung and agro-waste. Composting of MSW is, therefore, the most simple and cost effective technology for treating the organic fraction of MSW.



advantages

- improves the soil texture
- helps in maintaining soil health
- no large capital investment
- augment micro-nutrient deficient
- increases moisture-holding capacity of the soil

disadvantages

- not very suitable for wastes that may be too wet



Disposal

Landfilling of municipal solid waste (MSW) is a common waste management practice and one of the cheapest methods for organized waste management in many parts of the world

There are two types of landfills:

Unsanitary landfilling (dumping)

Dumping is an act of depositing solid waste at a dump-yard situated within or outside the city haphazardly and do not bother to spread and cover the waste with inert material.



disadvantages

- become breeding grounds for flies, rodent, and pests. : emanate foul smell : Liquid seeping through the rotting organic waste called leachate pollutes underground water
- release landfill gas with 50 to 60 per cent methane by volume : occupies precious land resources near urban areas : degrades the quality of land and soil

Sanitary Landfills

Sanitary landfills are the ultimate means of disposal of all types of residual, residential, commercial and institutional waste as well as unutilized municipal solid waste from waste processing facilities and other types of inorganic waste and inerts that cannot be reused or recycled in the foreseeable future.

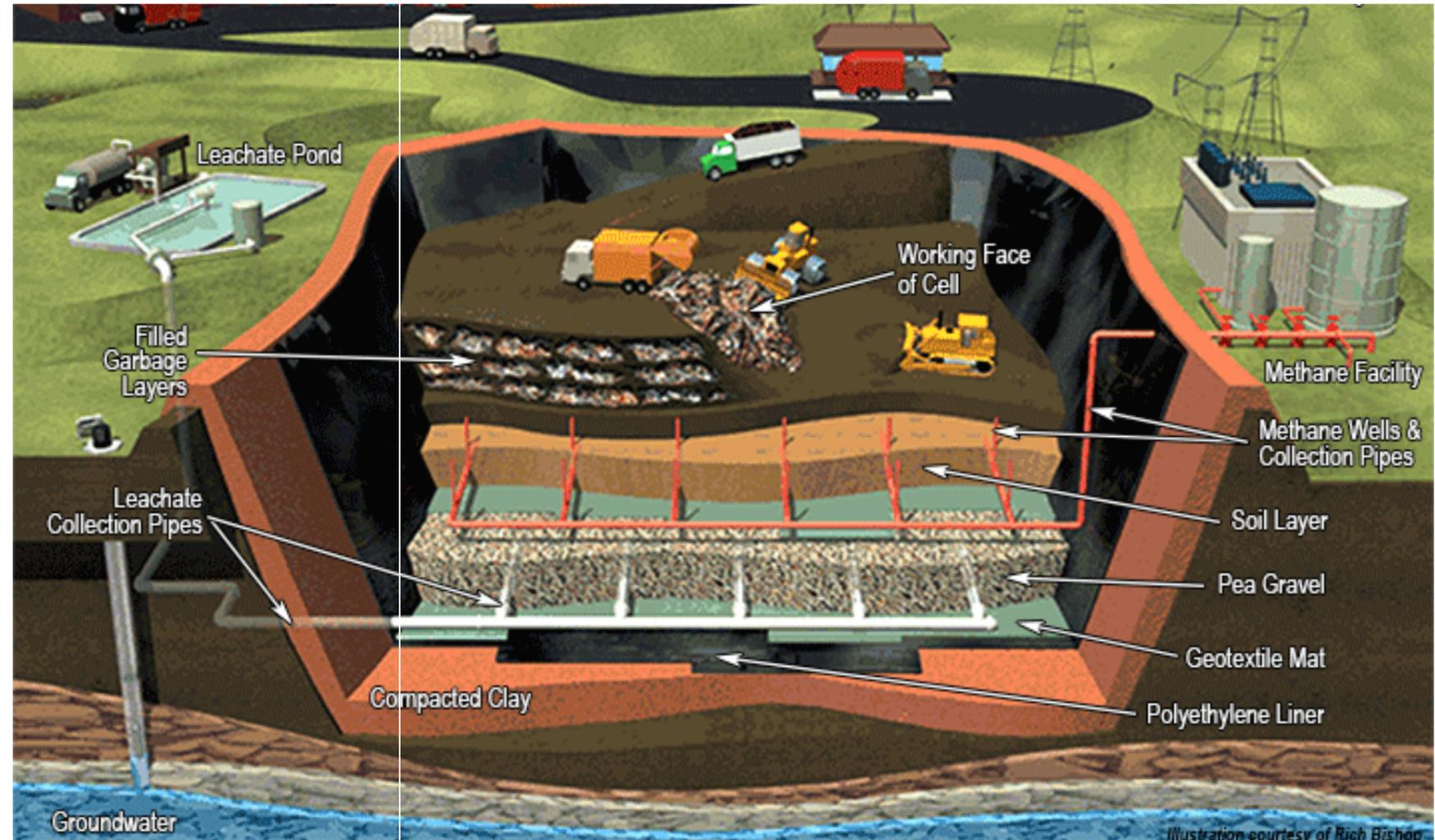
advantages

Least cost option for waste disposal

Recovery of landfill gas as a source of energy

Landfill gas can be utilized for power generation or as domestic fuel for direct thermal application.

Highly skilled personnel are not required to operate a sanitary landfill.



disadvantage

An inefficient gas recovery process emits two major green house gases, carbon dioxide and methane, into the atmosphere.

The cost of per-treatment to upgrade the gas quality and leachate treatment is high.

Costly transportation cost for far away landfill sites

A risk of spontaneous ignition/explosion due to possible build up of methane concentrations in air within the landfill or surrounding enclosures if proper gas ventilation is not constructed.

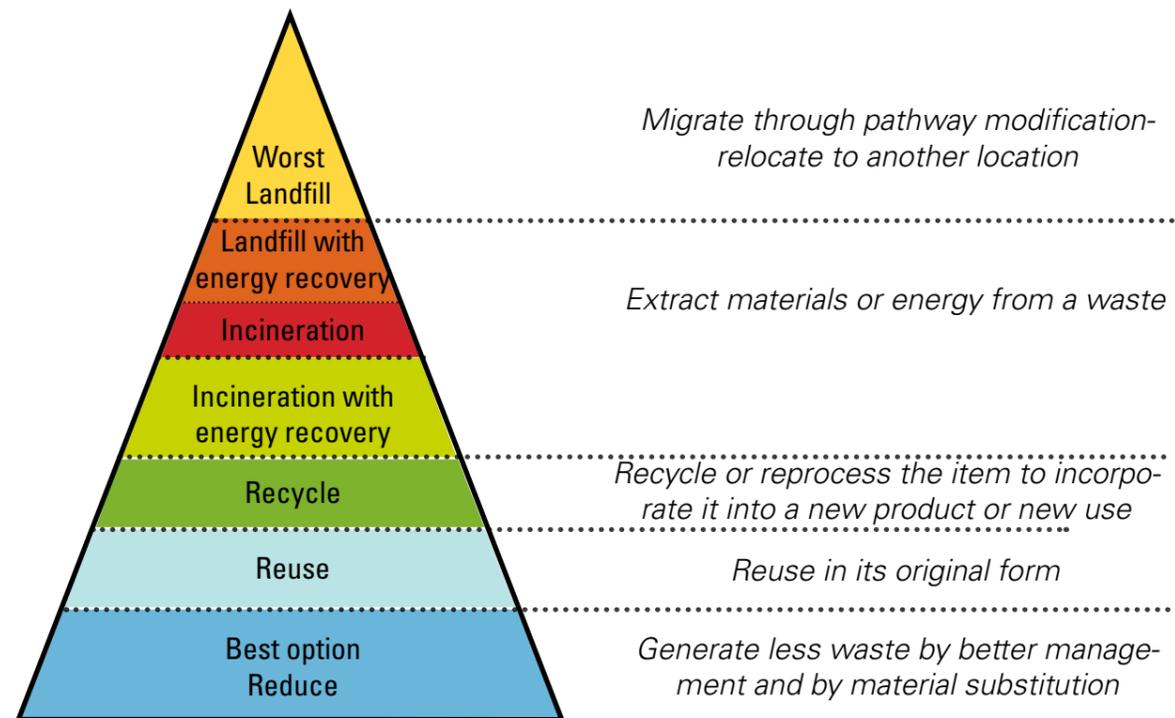
Groundwater get contaminated by polluted leachate in the absence of a proper leachate Collection and treatment system.

Integrated Solid Waste Management

Integrated Solid Waste Management (ISWM) takes an overall approach to creating sustainable systems that are economically affordable, socially acceptable and environmentally effective.

ISWM is a comprehensive of

Waste Prevention **Recycling** **Composting** **Disposal Programme**



Waste Hierarchy in ISWM

An effective ISWM system considers how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment. ISWM involves evaluating local needs and conditions, and then selecting and combining the most appropriate waste management activities for those conditions.

It is important to note that no one single treatment method can manage all the waste materials in an environmentally effective way.

Reduce, Reuse, Recycle

Methods of waste reduction, waste reuse and recycling are the preferred options when managing waste. There are many environmental benefits that can be derived from the use of these methods. They reduce or prevent green house gas emissions, reduce the release of pollutants, conserve resources, save energy and reduce the demand for waste treatment technology and landfill space.

Waste reduction and reuse

Waste reduction and reuse of products are both methods of waste prevention. They eliminate the production of waste at the source of usual generation and reduce the demands for large scale treatment and disposal facilities. Methods of waste reduction include manufacturing products with less packaging, encouraging customers to bring their own reusable bags for packaging, encouraging the public to choose reusable products such as cloth napkins and reusable plastic and glass containers, backyard composting and sharing and donating any unwanted items rather than discarding them.



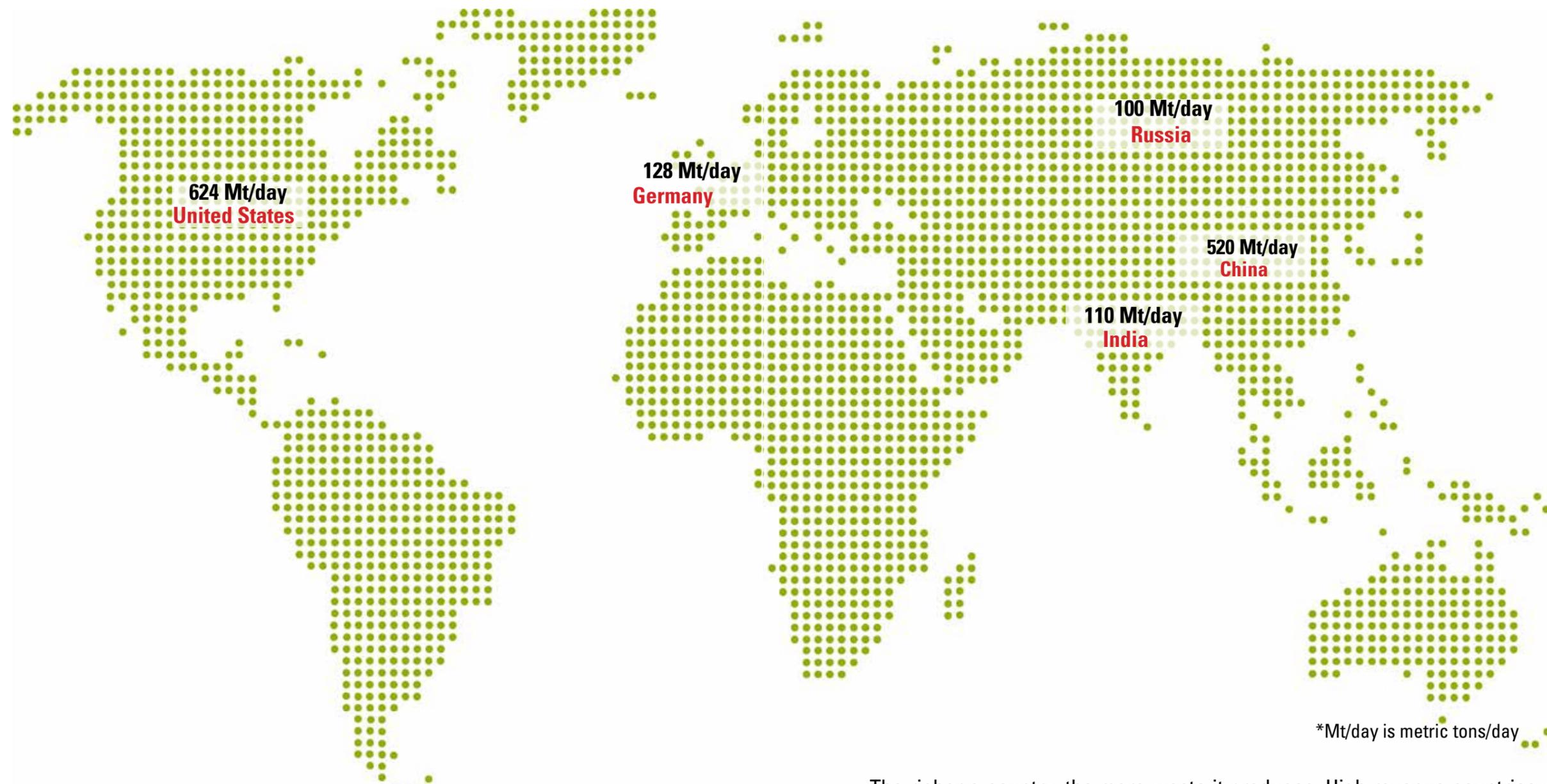
Recycling

Recycling refers to the removal of items from the waste stream to be used as raw materials in the manufacture of new products. Thus from this definition recycling occurs in three phases: first the waste is sorted and recyclables collected, the recyclables are used to create raw materials. These raw materials are then used in the production of new products. The sorting of recyclables may be done at the source (i.e. within the household or office) for selective collection by the municipality or to be dropped off by the waste producer at a recycling centre.



Current scenario

Across Globe



Source: *What A Waste: A Global Review of Solid Waste Management*, World Bank, 2012

Cities are at the nexus of a further threat to the environment, namely the production of and increasing quantity and complexity of wastes.

The richer a country, the more waste it produces. High revenue countries produce 500kg and more municipal per inhabitant per year. Also, the richer a country, the more is its waste contains packaging materials and sophisticated products, and less food waste and consequently less organic and fermentable waste.

As for the developing countries where data are available, and in particular for the urban area, the figure is around 150kg.

In India

Being second most populous country in the world, India continuously keeps on adding waste material within its geographical boundaries.

India has about

16% of the world population and 2.5% of world's land area.

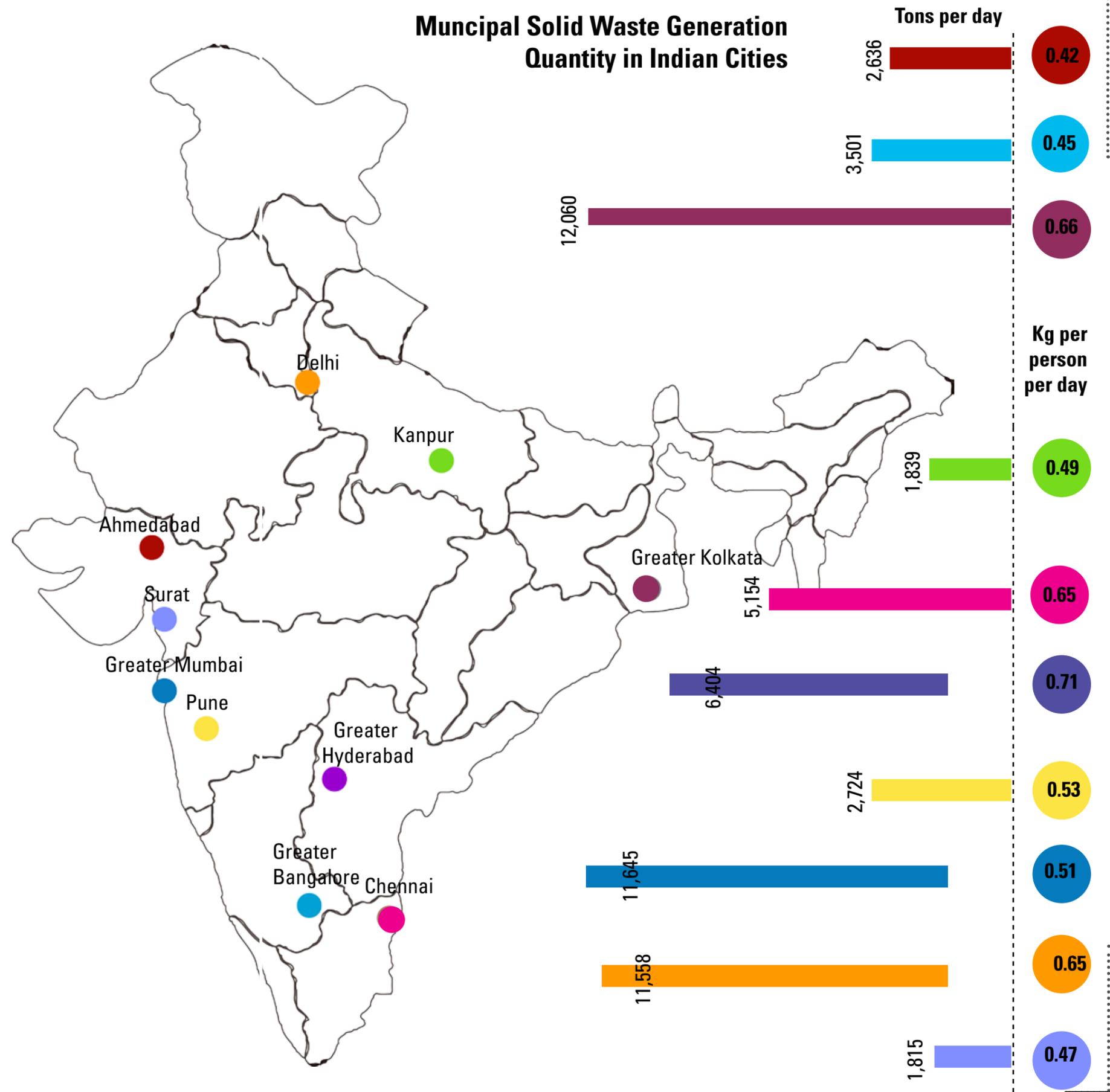
In a already densely populated country with even more densely packed urban centers, land for proper waste treatment, disposal and overfall management is scarce. Recent and sustained economic growth increasing living standards of the people, increased manufacturing and production activities has led to increased to rapid rise in the waste generation rated.

India produces around

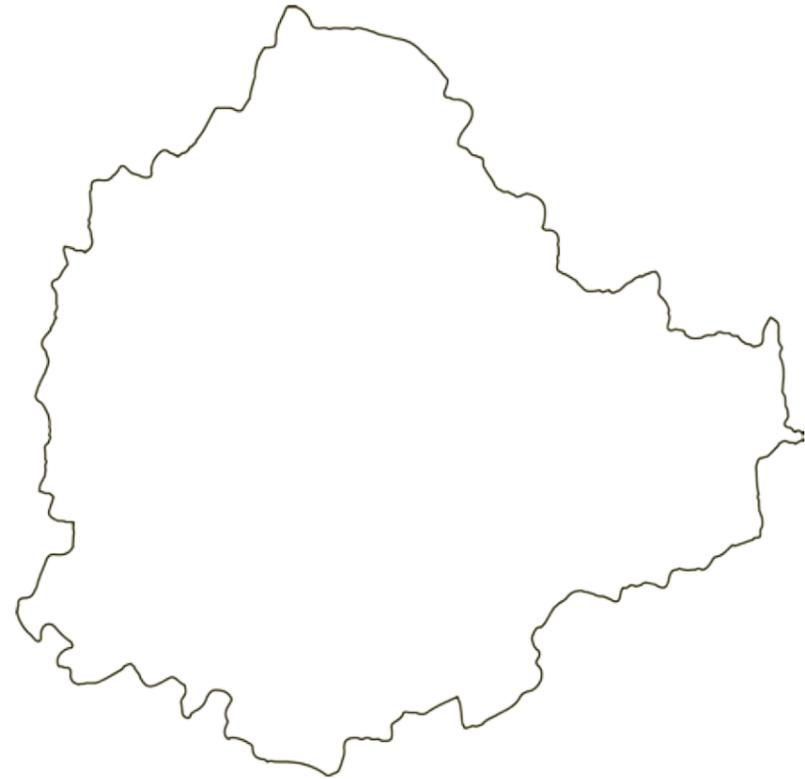
68.8 Million tons of solid waste annually.

There is wide difference in the waste generation rates in rural and urban areas. Even within the urban areas, the composition includes more paper and inert material and less of organic and compostable material as the city population and size increases. The per capita generation rate increases and the overall calorific value of the waste drops with increase in the size of the city. [Study by NEERI.]

Municipal Solid Waste Generation Quantity in Indian Cities



In Bangalore



The 2011 Census recorded a **population of around 95 lakh spread over 800 sq kilometres with an average density of 4,300 people per square kilometre in Bangalore**. Bangalore produces between **4000-6000 tonnes of waste per day**. The responsibility for the proper handling, collection, transportation and disposal of waste in the city lies with the **Bruhat Bengaluru Mahanagara Palike (BBMP)**. The predominant method of disposal is dumping in open landfills, which has tremendously detrimental impacts on the quality of air, water and soil. The **BBMP has a sanctioned staff of 12,000** for waste management in the city, but only 7000 are on the rolls. **The citizen to staff ratio is a paltry 401:1**. (The Times of India, May 2012). The present formal system of waste collection is thoroughly inadequate with many areas left uncovered, resulting in garbage piling up on street corners.



Trucks carrying garbage to Mandur landfilling Bangalore



Centralized waste management

In the face of overflowing dumping yards and the unavailability of space for new dumping sites, the city is resorting to short-cut methods of centralised waste disposal, that have significant negative impacts on the waste pickers livelihood and environment.

Directives of the BBMP

In the third week of October, 2012, the BBMP issued two important directives on waste management policy in the city.

The first directive concerns segregation and collection of waste at the individual and household level. It outlines the parameters for the segregation of waste into different categories; it also describes the disposal process for each type of waste.

The second directive gives directions to bulk generators of waste for the proper segregation and disposal of their wastes. Bulk generators include hotels and restaurants, malls, residential apartments or any other residential, commercial or public entity which generates more than 100 kg of wet waste per day.

Bulk generators are mandated to maintain composting facilities that should handle the entire amount of wet waste generated.

Current focus

Segregation at Source

Segregation at source is the key of managing any kind of waste produced. If done well, can cause a huge impact in later phases of the flow. Waste that is not segregated is difficult to recycle. Hence its our responsibility to seegate waste into its basic categories



Decentralized waste management

Decentralized processing plants

Some of the areas where Residential Welfare Associations (RWA's)are performing Door to Door collection, the waste is segregated at source & the organic waste is composted in the community in a small scale.

BBMP has setup a 15 ton capacity decentralized plant to process organic waste as well as recycle the plastic, metal etc

Dry Waste Collection Centre

The BBMP is gradually moving towards the decentralization of collection, aggregation and processing of waste in the city. Dry Waste Collection Centres (DWCC) are being established around the city.

Need of Material Recovery

Finite Land Surface / Infinite volume of Waste

The total MSW generated in urban India at 68.8 million tons per year (TPY) or 188,500 tons per day (TPD). The land limit is getting extended so the free land is reducing.

Hence retrieval helps to greatly reduce the volume of Waste, and therefore reduce the need for land for land filling .



Content of Waste causes for Air, Water Soil pollution, cause for climate change

Biodegradable waste will eventually break down and become part of the earth and soil, like food scraps and paper. When it is disposed of in landfills, it breaks down under uncontrolled anaerobic conditions. This produces landfill gas which, if not harnessed, escapes into the atmosphere. Landfill gas contains methane, a more potent greenhouse gas than carbon dioxide which causes global warming.



Non-biodegradable waste will not break down (or won't for many many years). When they end up in a landfill they produce harmful leaching of toxins into the earth.

Halting depletion of our finite natural resources

Extraction(Natural resource exploitation) -> Production -> Distribution -> Consumption-> Disposal

This is a linear System which cannot run with Finite natural resources indefinitely. We are extracting precious raw materials and burning precious energy to produce material for our consumption which we then dispose off in a landfill when our use for the product is over, even though the material of which the product is made could be used several times over.

Retrieval from Waste stops the Materials Economy from being a one way street – Enter-Exit, into a loop of Enter – Exit – Renter

Materials made out of Plastic and Metal take hundreds of years to break down. Production from virgin material consumes energy many times over as compared to production from recycled material . However the cost higher, simply because the costs of retrieval are higher.

Making available' to the production processes readily Retrieved material from waste would greatly cut costs and incentive production from recycled material, thereby conserving energy and raw materials.

Concept of Zero Waste

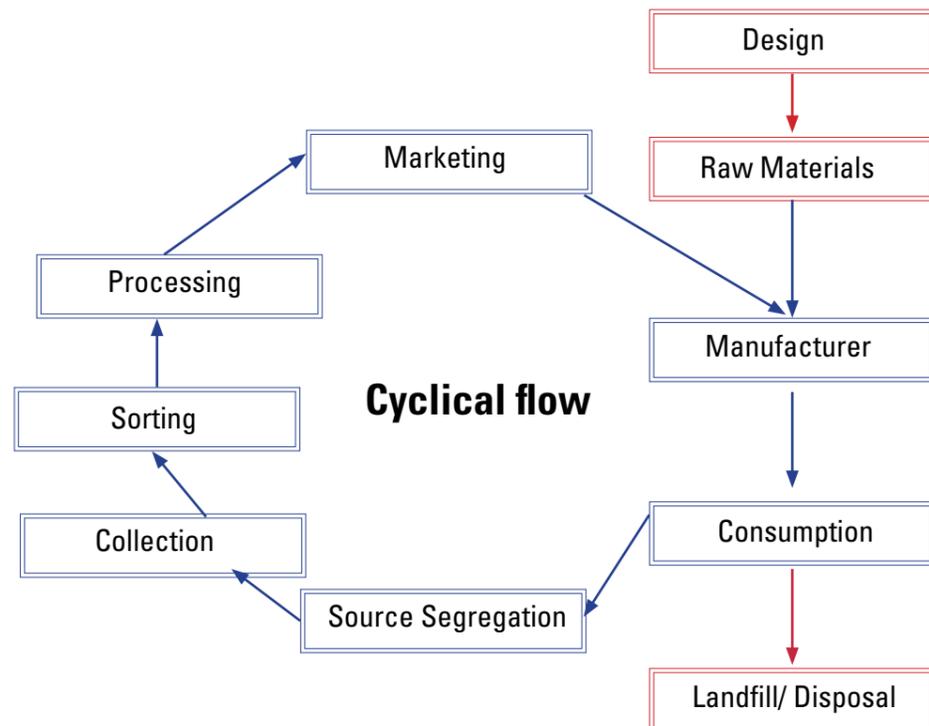
Zero waste is a unifying concept for a range of measures aimed at eliminating waste and allowing us to challenge old way of thinking. It is a whole system approach that aims to eliminate rather than manage waste. As well as encouraging waste diversion from landfill and incineration, it is a philosophy for eliminating waste at source and at all points down the supply chain.

definition

Zero Waste is a goal that is ethical, economical, efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use.

Targeting the whole system means striving for:

- Zero waste of resources: energy, materials, human;
- Zero emissions: air, soil, water
- Zero waste in activities: administration, production
- Zero waste in product life: transportation, use, end of life; and
- Zero uses of toxics: processes and products



Zero Waste Lifestyle



Market Analysis

Best practices of waste management

The future of waste management on an overcrowded planet Even the best waste management system in the world has shown that it cannot withstand the test of a global financial downturn; and with the global population, GDP per capita – and therefore the amount of waste – increasing globally we must become aware of the consequences and do something about it...

Daily Dump

One question that you would perhaps like to answer is “How do I reduce my contribution to the city’s garbage system without altering my lifestyle too much?” Well, let Daily Dump answer that for you. Daily Dump provides a commercial compost ‘pit’ that you can have at your home. All your leftovers and other organic waste can be dumped into these pits. Within a few months this becomes manure and you can use it for your garden or just sell it off to a needy farmer maybe



Daily Dump has designed a product with which anyone can convert kitchen waste into compost at home. The product, made of terra-cotta, is sourced from village potters. It is marketed through word-of-mouth referrals, media awareness, and their website. It is sold through channels including individuals, retail stores, and societies. The designs are ‘open source’, so individuals in other locations can replicate, adapt, build on, sell and use – for wide and rapid propagation of the idea.

Plastic Waste Bitumin Road



An unique patented technique by Prof Vasudevan effectively uses discarded plastic to build roads. A professor of chemistry at Thiagarajar College of Engineering, near Madurai, he insists that plastic gets a bad rap. Rather than an incipient environmental calamity, plastic, in Vasudevan’s opinion, is a “gift from the gods”; it’s up to humans to use it wisely. And he’s devised a way to transform common plastic litter—not only thicker acrylics and bottles but also grocery bags and wrappers—into a partial substitute for bitumen in asphalt.

To date, more than 5,000 kilometers (3,000 miles) of plastic roads have been laid in at least 11 states. The Central Pollution Control Board and the Indian Roads Congress, two leading government bodies, have endorsed the method.



A zero-waste town

Mountains of food scraps end up in landfills every day. While northern countries glorify attempts to facilitate this trash-to-treasure process using state-of-the-art technologies, **Bobbili**, a town in Andhra Pradesh India, adopts a tech-free solution – a park using animals for solid waste management.

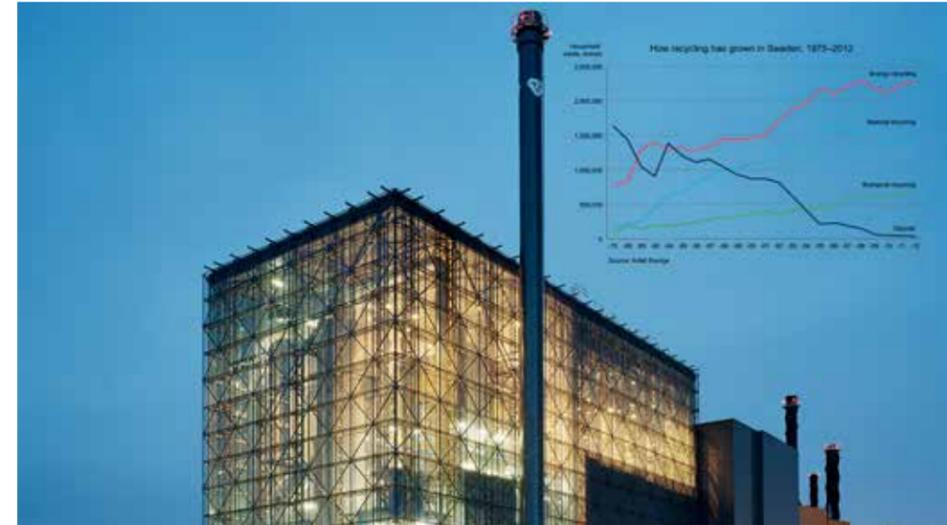


Lowly as it may seem, Bobbili prides itself on its zero-waste zone with a comprehensive recycling system that ensures nothing goes to the landfill. Their unique solution involves door-to-door collection of household waste strictly separated as dry and wet, and the 2010 ban on plastic. The spotlight of the scheme is the Municipal Solid Waste Park – a 8.5-acre site comprising a bio-compost yard handling 2.5 to 3 tonnes of organic waste a day. The most innovative part is the utilisation of livestock.

By 2012 the park kept 4 chickens, 21 ducks, 6 pigs and other animals for different functions. Chickens are benefited from the insects in the waste, whilst pigs would gulp the food waste collected from hotels. Ducks take care of the leftovers collected from the fish market. Dogs are in charge of domestic leftovers. The 'park farm' is probably the first in the world to implement animal feed on a municipal level.



The Swedish recycling revolution



There's a "recycling revolution" happening in Sweden – one that has pushed the country closer to zero waste than ever before. In fact, less than one per cent of Sweden's household garbage ends up in landfills today.

Every year, the average Swede produces 461 kilograms of waste, a figure that's slightly below the half-ton European average. But what makes Sweden different is its use of a somewhat controversial program incinerating over two million tons of trash per year.

It's also a process responsible for converting half the country's garbage into energy.

The Scandinavian country has become so good at managing waste, they have to import garbage from the UK, Italy, Norway and Ireland to feed the country's 32 waste-to-energy (WTE) plants, a practice that has been in place for years.

Technology

ArrowBio Process for Unsorted Municipal Solid Waste

ArrowBio© is an integrated solution for the treatment of municipal solid waste, and is a product of ArrowEcology. The ArrowBio facilities and process provide unique hydromechanical separation and preparation process, recovering 70%-90% of recoverable materials and producing high methane (CH₄) content biogas for several green energy uses. By-products such as various plastics, cardboard, wood and metals are suitable for recycling, and some of them also for RDF (Refuse-Derived Fuel) treatment. At the end of the anaerobic process, the organic remains are used as soil improver for agriculture, and also for bio-drying systems.



Smart Sensors



Sensors installed inside containers to monitor the fill level. This data is sent in real time to a control Centre, which enables optimal management of collection. EV (Electric Vehicles) charging stations, sensors on trash and recycling bins to minimize costs and the environmental footprint for city waste and recycling collectors.

Automated Vacuum Collection

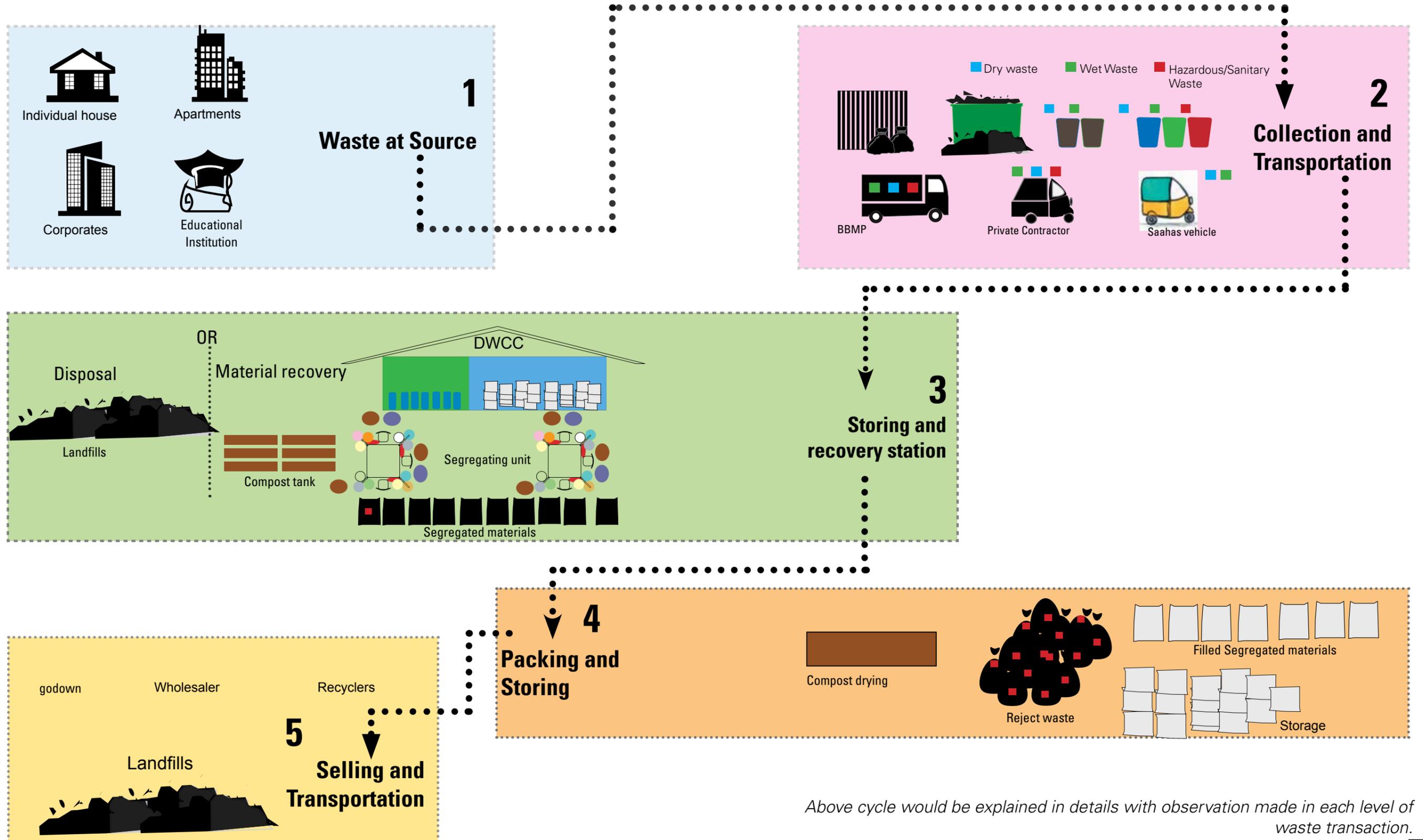


Mechanical waste collection, Stationary underground vacuum system

Users of the pneumatic waste collection system deposit their refuse into waste inlets, located around the chosen operating area. Waste collection points are placed outdoors or indoors and are accessible 24 hours a day. There is one waste inlet for each type of refuse (which will typically be divided into mixed waste, organic waste and paper waste). The refuse is temporarily stored by the waste inlets until the next emptying cycle. The refuse is then transported along the pipelines into containers at the waste station. When full, the containers are sent away for further processing using, for example, the city's existing underground railway network.

Field research

Waste Handling in Bangalore



Above cycle would be explained in details with observation made in each level of waste transaction.

Observations



Waste at Source

- Every household has their own ways of treating waste.
- Most dustbins are kept in the kitchen with a liner of plastic in it.
- Since its a single mouth dustbin the dry waste like (plastic pouch, plastic film, multilayer packaging) goes in with the wet waste.
- Dust bin are kept in toilet to collect the sanitary waste. Not many dispose sanitary pad in a wrapped paper.
- Few houses dont invest on dustbins and throw all the waste item in a plastic cover.
- For kitchen waste most of them prefer a paddle operated lid dustbin.
- Most people have a notion that even if they segregate BBMP dumps all the waste in one as mixed.
- Handing over the waste is generally either in a plastic cover or a thin micron garbage bag.
- Wet waste is generated more in quantity compared to dry waste
- High value waste like magazine and newspaper are collected and stored in-house and in the end of the month its sold to a radiwalla.
- Majority of the people are unaware of e-Waste collection Centre, hence it keeps pilling in the house. But e-Waste like batteries and CDs are disposed in the dustbin along with other waste.
- Average waste generated at household is half a kilo.
- Food packaging are not washed before disposal.



Mixed waste



Sanitary waste



Segregated wet Bins

Collection and Transportation



Dumping on the road side



Wet and dry waste dustbin



Colour coded Wet dry and hazardous waste dustbin

- Most of the individual houses and restaurants near by tend to throw garbage bag on the road side as they feel its not auspicious to keep garbage outside house.
- Due to the garbage on road, abandoned animals like Cows, dog and pigs in search of food tend to feed on it and ingest plastic too.
- Since its mandatory that segregation should happen at source, some apartments for the name sake keeps two bins which says dry and wet waste but most of the residence mix both dry and wet waste and puts it in any bin.
- Few apartments follows the concept of colour coded bins at the source but when the BBMP vehicle arrives all the waste is taken together and dumped in landfills.
- Many a times primary segregation happens in the BBMP vehicle and high value waste which is been collected is sold to the recycle waste vendors.
- And all the low value waste is bought to the Kasa Rasa Centre.
- BBMP primary collection happens in a three wheel cart and then transferred in a bigger vehicle.

Collection and Transportation

- In many locality BBMP collection is not regular and happens on alternative days.
- In gated communities or apartments house keeping staff does door to door collection and the waste is collected in community bin.
- The location where Saahas vehicle has to collect the dry waste, waste is been transferred and collected in HDPE woven sacks.
- Once the sacks get filled , sacks are been stitched with nylon rope .
- In a day the vehicle goes to various location for collection.
- Very few individual comes to drop their waste to the collection Centre if the collection does not take place that particular day.
- Not many people are aware of a Dry waste collection Centre at the Saahas office premises.
- No proper allocation is given to drop in waste at the collection Centre
- Dropped in waste is taken to Kasa rasa center in the Saahas vehicle.
- Pourkarmikars collect waste from the street in which dirt and other waste is dumped and dry leaves is mostly burned.



Drop in Dry waste Collection Centre at saahas



Dumping waste on street



Collection and sorting of high value waste



A garbage bag, bucket or the dustbin bag kept outside the gate



Collection of waste from the clients source



Storage and Sorting

- Segregated waste from the source is brought to the Kasa Rasa Centre where further sorting take place.
- In flow of unsorted dry waste is more compared to the amount of waste sorted in a week
- Storage of waste coming in, cannot be kept for too many days because of the rodent problem.
- When the waste is bought, the new waste is kept in front of the existing sack.
- The ladies start segregating the new waste leaving back already stored waste.
- It is difficult to pile up waste sacks on top of each other when the sack weight exceeds 70 kgs.
- Inflow of dry waste by the private contractors happens weekly twice.
- Each contractor gets roughly around 170kgs to 200kgs of dry waste.
- Daily both dry waste and wet waste is brought by Saahas vehicle from various location.
- Sacks are weighed before its been stacked.
- Supervisor notes down the weight of the sack in a register.
- Since the storage of waste sack is in the end of the room the floor path is congested to transfer the waste sack till there.



Kasa Rasa Community Centre



DryWaste bought to the Centre



Sack are weighed before stacking



Dry waste bought in carton boxes



Unsorted waste storage

Storage and Sorting

- When there are more than 3 ladies, not everyone can work on the same table.
- Maximum three ladies can use the table and one side is kept for the waste sack.
- Ladies find it difficult to transfer the waste sack to the sorting table.
- Provision made for collecting coloured paper and plastic material while sorting is not sufficient to fit the ring structures provided with the table.
- The ladies working on the table sort what come in their hand and collect it in bags kept around them.
- Ladies get confused with what plastic is what as there are wide range of plastic types to be sorted.
- There are 14 variety of waste which has to be sorted. That are :
White Paper, Colour Paper, News Paper, Magazine, Corrugated box(Flattened), Milk Pouch, LDPE, Hard Plastic, HDPE, Virgin plastic, Glass, Aluminum can, Metal,PET bottle.
- Ladies prefer wearing one glove on right hand while working.
- Ladies dont prefer wearing nose mask since its suffocating and becomes wet because of sweat
- When the waste is on the floor ladies prefer sitting down and segregating.
- They feel segregation happens faster when they sit down and segregate.



Collection of sorted material in black liner



Sorting done on Table



Sorting done on Floor



Arranging the sack before sorting starts

Packing and Storing

- Once the segregation ends for the day, the filled bag is transferred in a bigger woven sack.
- Manual baling is done to compress paper material.
- The sack has to be stitched if it is torn from the side, also when it is filled.
- All the segregated material is filled in woven HDPE sacks. one sack costs approximately rupees 20.
- No allocation is given to different segregated material.
- It becomes difficult to remove a particular sack of material when a vendor comes to buy or when it has to be taken to a vendor.



Tying the filled sack



Filling the sorted material in sack



Baling the paper



Storage of sorted material

Observation

Selling and Transporting

Material	Sorted in Kg	Trading
White Paper	500 kg	Weekly once
Colour Paper	1000 kg	Once in two weeks
News Paper	100kg	Once in two weeks
Tissue Paper		
Magazine	100kg	Once in two weeks
Corrugated Carton box	150	Weekly once
Plastic		
Milk Pouch	50	Once in two weeks
Pet Bottle	50	Once in two weeks
Virgin Plastic	50	Once in two week
LDPE	500	Once in two week
Hard Plastic	200	Once in two week
Foam and Thermo-coal		
Metal		
Aluminum can	10	Once in a month
Glass	300	weekly once

- Paper and plastics is sold separately to different vendors
- Tetra Pak are collected and stored at a separate godown. Once it attains 15 Tons its been bailed and transported to a recycling unit directly.
- Before selling the sack, it's been weighed and noted by the supervisor.
- For Colour paper the trader atleast- expects 1 ton of load per week.
- Trading happens with the woven sack. The cost of the sack has never been considered while selling the material.



Vendor's vehicle for Collection of sorted material



Weighing the sack before loading in truck



Supervisor making bill for the trade



Loaded truck with recovered material

Environmental Analysis

The environment can be classified as Micro Environment and Macro Environment.

Micro Environment

Infrastructure

Brick wall
Grills
Tetra pak roofing
MS Poles
Red oxdies flooring
Signage
Price list Board
CFL bulb
Fan
Electricity meter board
Computer

Bio gas plant
Compost Tank
Induction stove
Compost
Water tank
Squat toilet
Mirror
Wash Basin

Furniture

Sorting table
Supervisor's table
Chairs
Locker
Stand
Cupboard

Staff's belongings

Cloths
Tiffin box
Water bottle
Mobile Phone
Chappel

Safety gears

Apron
Gloves
Shoes
Mask



Stationaries

Pen
Attendance book
Bill book
Calculator
Carbon Paper
Paper

Materials Recovered

Milk Pouch
LDPE packaging flims
Hard Plastic
HDPE containers
PET bottle
Smooth Packaging
Colour Paper
Virgin/white paper
News Paper
Magazine
Carton boxes
Tetra Pak
Aluminum cans
Glass bottle
Smooth Packaging
Metal
E-Waste

Living Organism

Humans
Rat
Mosquitoes
Ladies
Tiny flies
Maggots
Street dogs

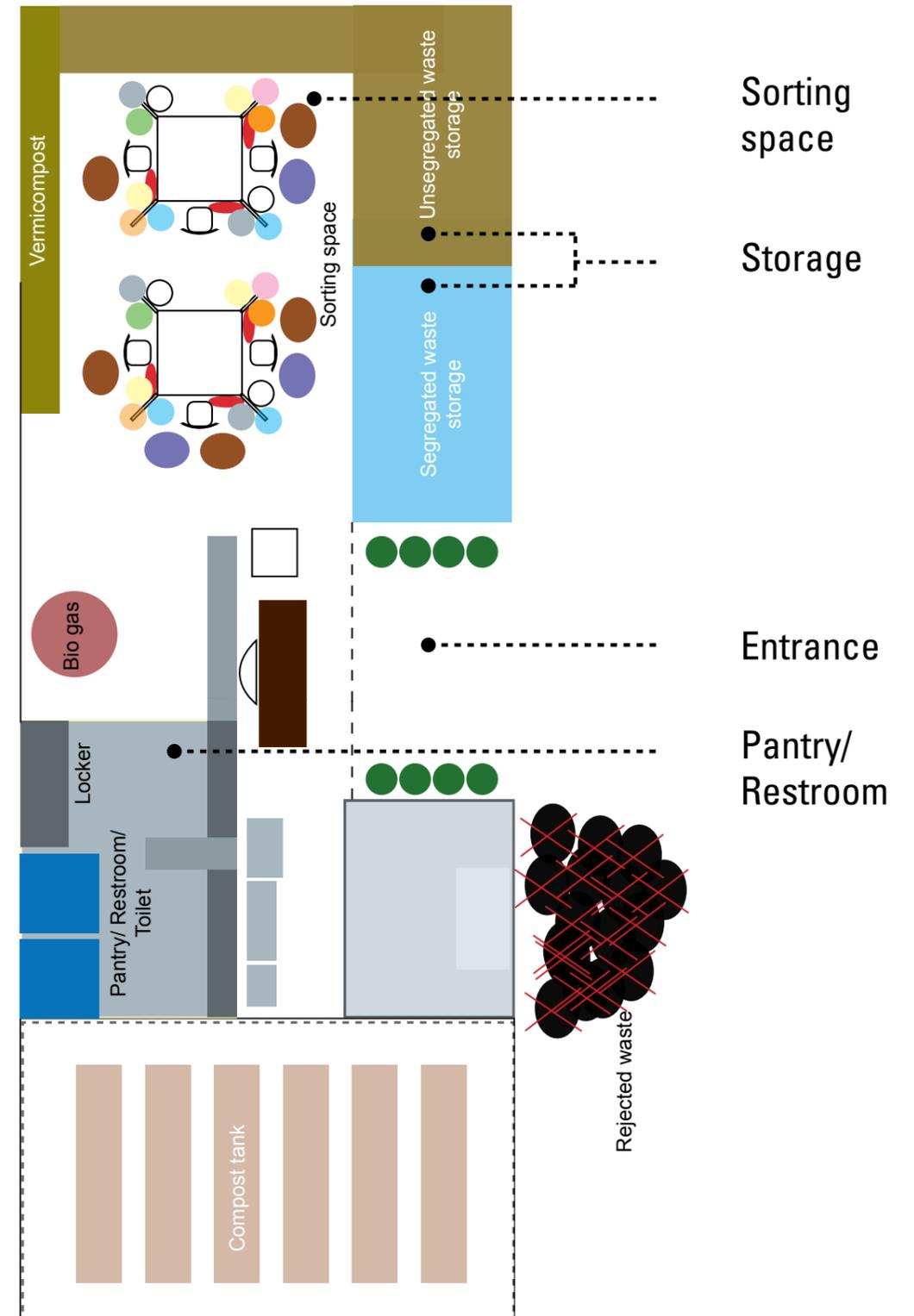
Tools and Equipments

Needle
Knife
Rope
Thread
HDPE sack
Sorted material
Weighing machine
Shredder
OWC machine

Macro environment

Temperature
Wind
Rain
Dust
Heat

Floor plan of Kasa Rasa unit



Sorting
space

Storage

Entrance

Pantry/
Restroom

Rejected waste

The space is divided into 4 parts :

Entrance
Sorting space
Storage
Pantry and Restroom

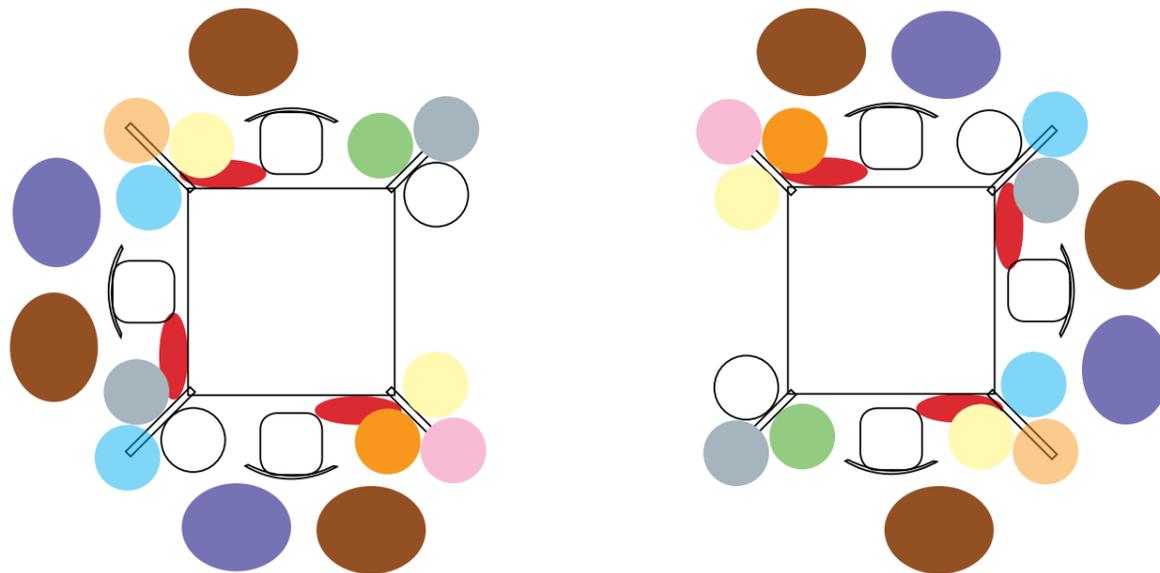
Entrance

- Attendance is taken
- In flow of waste and out flow of recovered material happens
- Weighing of the sack
- Supervisor monitors all the activities of the unit
- Selling the recovered material takes place at supervisors desk
- Reject waste is disposed at the entrance
- Material Price list is displayed



Sorting Space

It consists of two sorting table with sack kept for collecting different material



Different colour represents different materials sorted:

- | | | |
|--|--|--|
|  Tetra paks |  PET bottles |  Hard Plastic(Puga) |
|  Milk packets |  HDPE(kaddha) |  Polyethylene/super |
|  White papers |  Glass and Cans |  Coloured paper |
|  Reject waste | | |

- The space is occupied with sacks all around.
- While dropping the dry waste on table there is lot of dust accumulated on the table.
- Also, if there is food and liquid content in the package or container, it tend to smell and maggots starts growing.

Storage



- The unit is not rodent proof, rats tend to live in the dry waste sack., Eventually most of the sacks gets hole as they bite it.
- Since there is rat, Cats also tend to live inside the collection Centre.
- Street dogs also tend to come inside unit to fetch some food.

Pantry and Restroom



- The area is generally wet since the water from the wash basin falls on the floor while washing utensils.
- Platform is kept dry where they prepare tea.

Task analysis

Morning 10 am

- 1) Seven ladies work in Kasa Rasa. They reach center by 10 carrying packed breakfast and lunch.
- 2) Sign in the attendance book
- 3) Keeps the tiffin box in and take out the uniform from their respective locker.
- 4) Wears the uniform (saree for ladies and kurta for young girls) near the compost tank.
- 5) Keeps the belongings in their respective lockers.
- 6) Each one takes the broomsticks which is kept in one of the corner of the compost tank space.
- 7) Sweeps the floor near kitchen and segregation space.
- 8) Wash hands.
- 9) Removes the tiffin boxes from the locker
- 10) Sits down on the floor and eats the breakfast.
- 11) Chats for sometime with each other.
- 12) At 10:30, they start wearing the gloves, apron and shoes.
- 13) Wears gloves in one hand only.
- 14) Black disposal bags are placed in all the rings of the segregating table by puncturing the bag at its mouth from three side.
- 15) Two ladies (sometimes 3 ladies) lift unsegregated dry waste kept inside white plastic sacks and put it on the segregation table.
- 16) Single sack weighs from (30kgs to 80kgs)
- 17) Takes a knife.
- 18) Cuts the knots of the bag.
- 19) Empties quarter of the dry waste on the table.
- 20) While sorting different dry waste is kept in the respective bins.
- 21) e-Waste such as battery, cd, cassetts are placed on the table only.
- 22) Once one portion is segregated, the rejected waste is put in the black bag.
- 23) The segregation process continues for an hour, after that tea is prepared by one of the ladies.



Women behind Kasa Rasa

Tea break 11:20am to 11:25am

- 24) Around 12, Private contractor collects HDPE plastic from the (twice a week)
- 25) Once one sack of waste is segregated it is kept separately and another sack of unsegregated waste is brought in.
- 26) Before breaking for lunch they tend to finish segregating 2 sacks from respective tables.

Lunch break 2pm to 2:30pm

- 27) Removes the apron, mask, gloves and shoe..
- 28) Washes hand and legs.
- 29) Uses the loo
- 30) Removes tiffin box from the locker.

- 31) Sits down on the floor near the wash-room.
- 32) Eat with hands.
- 33) Once finished eating, ladies sits for some extra time till 2:30.
- 34) Washes hand, wear the apron, mask and the gloves.
- 35) Removes the sack from the stack.
- 36) Puts it on table and starts segregation.
- 37) Around 3, Private contractor comes in tipper auto and unloads the unsegregated waste. (Mostly three to Four sacks)
- 38) The supervisor makes the bill and pays the contractor by cash.
- Tea Break 3:45 to 3:50**
- 39) Segregation ends by 5 pm
- 40) Fills the recovered material in a bigger sack

- 41) For paper and plastic bailing, a lady goes inside the sack and press it by standing on it and jump.
- 42) After the sack is filled its stiched with plastic thread
- 43) Further the sack is stacked and stored for a month.
- 44) Reject waste is put outside the facility as soon as black bag gets filled.
- 45) In the end ladies sweep the whole working space.
- 50) Removes the mask, apron and gloves and change back to there orginal costumes.
- 51) Refresh themselves.
- 52) Signs and mentions outgoing time in the book.
- 53) Leaves the unit 6 pm.
- 54) From 6 pm to 9:30 am, Security takes in charge.

Task at a Glance on Pre and Post Sorting



Placing the Black liner in each rings



The sack is dragged from the stack



Placing the sack on the table



Trying to lift the sack



Positioning the sack in one side



Cutting the knot of the sack



Pushing the sack towards the sorting table



Sorting starts



Clears the dust after sorting one sack



Mixed waste is tipped at the entrance



The sack is carried inside



Sack is weighed



It is further carried inside the room



Ladies help in stacking the sack



Fallen waste from the sack has to be immediately cleared by the worker



Sorted material are transferred in a bigger sacks



Materials are compressed with hand



Paper are baled manually by leg



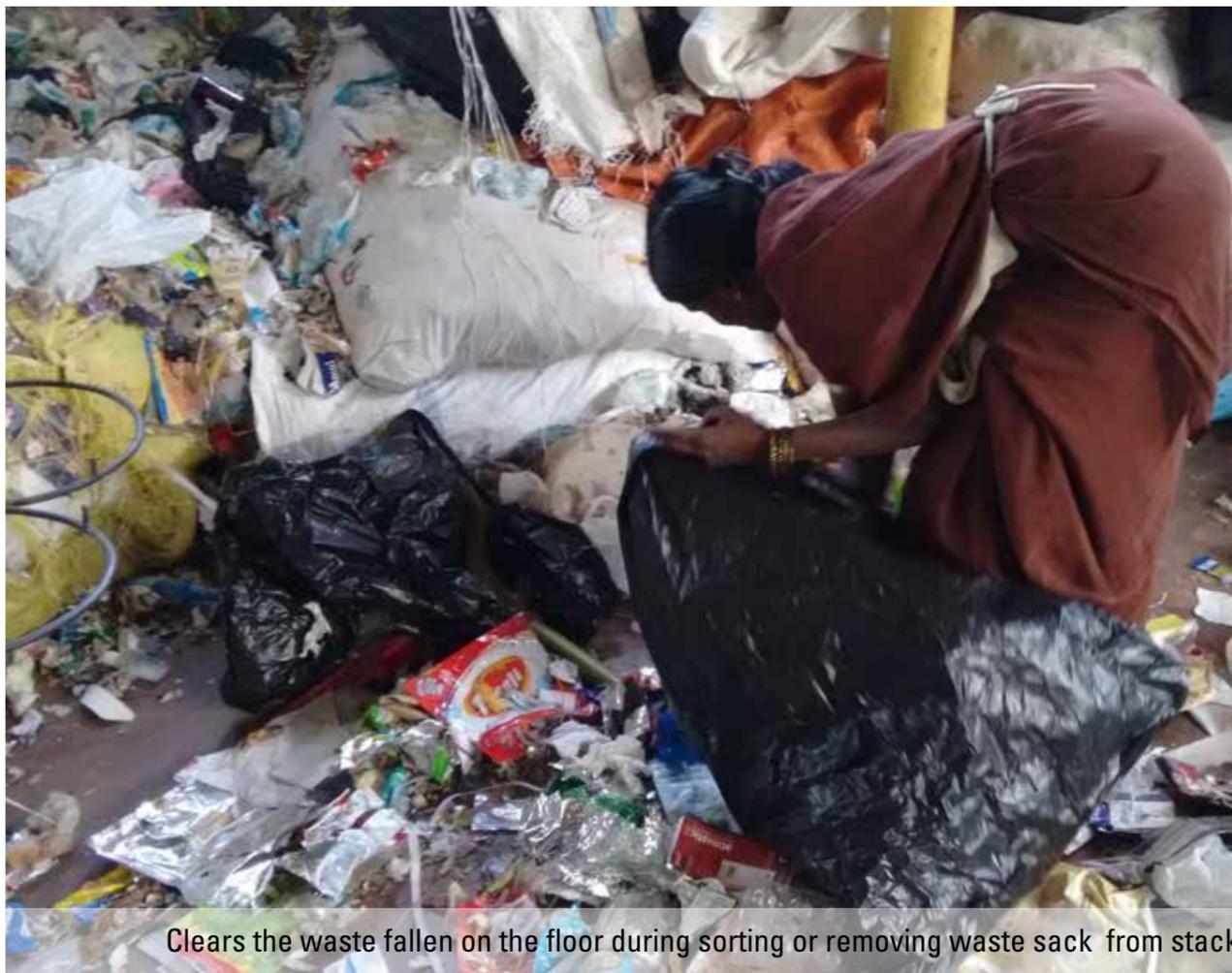
Filled material sack are stitched



All the sack are stacked at the end



Reject waste are kept at the entrance



Clears the waste fallen on the floor during sorting or removing waste sack from stack



The last task is to piles up all the material from the floor to the table

Observation

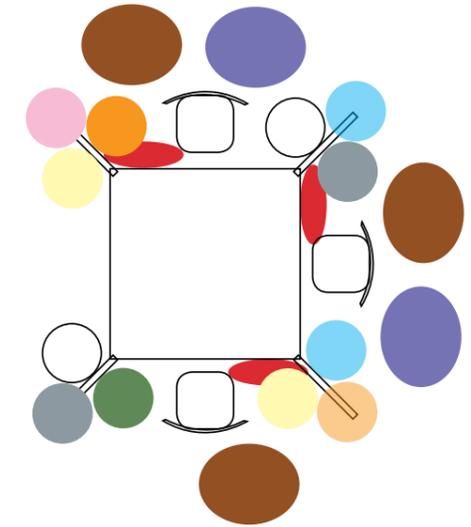
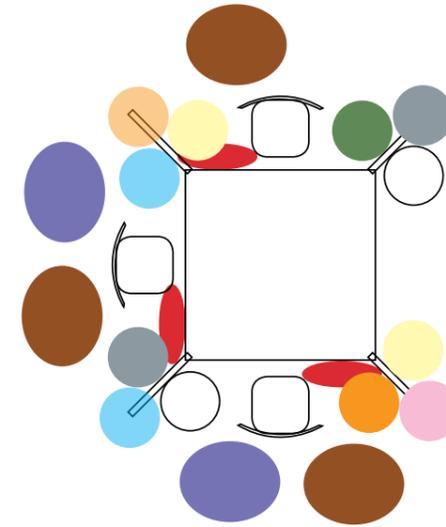
Timings

In time	10:00 am
Pre sorting preparation	10:30 am - 11 am
First sorting	11:00 am - 1:45 pm
Tea break	11:40 am - 11:50 am
Lunch break	1:45 pm - 2:30 pm
Second sorting	2:30 pm - 4:45 pm
Tea break	3:30 pm - 3:40 pm
Post sorting arrangement	4:45 pm - 5:45 pm
Out time	6:00 pm

Total time spend in unit	-	8 hrs
Time spend on sorting	-	4 hrs

This excludes the time taken :
to stack the mixed waste brought by our vehicle ,
for clearing the waste on other site
for treating wet waste
For going out to buy grocery item for preparation of tea

Pros and cons of sorting task



Top view

PROS

- .No rigid structure**
Any worker can start segregating at any time
- . Independent**
Sorting happens individually

CONS

- . No time value**
Takes their own time to sort the waste.
- .Use of black bag**
Used for sorting different material
- .Space consumed is more around the table**
- .Tranfering the material**
Sorted material in black bag is transfered to a bigger sack.
- .Material falling**
While sorting things fall from the table to the ground.

User analysis



Persona

- Age *Between 18 to 55*
- Gender *90% of all the field staff are women. All the sorting work is done by them.*
- Monthly Income: *Between Rs 6000 - Rs 7500*
- Regular Working Hours: *9:30 am to 6:00 pm*
- No. Of Working Days In a Week: *6 days a week*
- Weekly Off (Days, No.): *Unpredictable(takes leave often due to health issue and functions to attenent)*
- Frequency Of Lifting: *minimum 3 to 4 times the unsorted waste sack has to be taken from the stack*
- Loads Lifted: *Sack weigh between 10 to 70 kg.*
- Lifting Behaviour: *minimum two to three are required to lift the sack*
- Years of Experience: *5 to 6 years*
- No. Of breaks in a day *Takes two break: 15 mins tea break and 1 hour lunch break.*

Common Characteristic :

All the field staff were found **Anemic in nature**. Generally observed here, people coming from economically deprived background do not give much importance towards health and hygiene. Also there is a lack of nutrients in the diet. Intake of Carbohydrate is more.

(Told by the doctor from the occupational health department, Bangalore when they visited Kasa Rasa Centre.)



Physical Analysis

Anthropometry

Measurement of human dimensions

Staff	height
1 Lakshmi	4'11"
2 Rose Merry	4'6"
3 Asha	4'9 1/2"
4 Merry	5'1"
5 Manjula	4'8"
6 Lakshmi .c	4'9"
7 Selvi	4'7"

Working Posture



Posture on sorting table



Pre Sorting Posture



Hand Action



Post Sorting Posture

- Ladies sits at stretch for 2 to 3 hours continuously while sorting.
- The space around sorting table does not allow ladies to have enough body movement.
- While sitting down for sorting, ladies go beyond the optimal level of reach to sort things.

Material Handling



- Two to three people are required to drag the waste to the sorting table.
- Sack is pushed, pulled, dragged and lifted to place the sac on table



- Stress is felt to the shoulder and lower back bone while lifting the sack because

Work-Related Health Hazards



Field staff often get

- Shoulder pains.
- Back Pain
- Common cold
- Headache
- Fever
- Allergy and rashes on the hand and feet

Behavioural Aspect

Field staff, which are the front runners of the waste management system at times are witnessed in taking many days off, which in return also has an impact on the efficiency of the work.

Because of the social economic conditions, work for them is just left to money and there is less interest which comes in for the work. Probably they are also unaware about the part, that the work they do is beyond capacity of an ordinary man.



Product analysis

Sorting Table



Material: Table top : ploy-aluminum board
Frame : MS pipe

Dimension: 4ft x 4ft x 2ft (l x b x h)

Joints : Ploy-aluminum board is screwed to the MS frame.
MS pipe is welded to each part.

Cost : Frame cost- Rs 22,900
Board- Rs 500

Insights

1. The general notion of citizens is “Its BBMP’s responsibility to handle the waste I generate, as I pay the tax to the government”
2. Not many people see waste as resource thus the efforts to do the initial step of segregation at source are minimal.
3. Since waste sorting does not seem as a laborious task and also for a daily wage of maximum Rs.200, most of the field staff and the Pourkarmikars in waste management domain are found to be ladies who are migrated from Tamil Nadu.
4. The amount of physical work the field staff does in waste management domain, also the conditions in which they work, is something which is most of the time ignored or given least priority.
5. Most of the women field staff who works in the waste domain especially the one who handles the wet and dry waste manually, does not reveal the work they do to the family members. If so, they won’t be allowed to come for work and also society will look down upon them.
6. Though the salary at Kasa Rasa is lower compared to other place, the women field staff still prefers working at Kasa Rasa since they find it more safe and secure.
7. Saahas provides all their field staff with Personal Protective Equipments like gloves, mask, shoe, apron and a uniform (saree or churidar) which is compulsory for them to wear while working. In spite of the compulsion, field staffs prefer wearing just one glove on hand and mask while sorting until there is a higher authority visit or capturing of photo or video is happening.
8. Field staff get their tiffin boxes to the Centre which most of the time consists of rice and rasam or tomato curry. They generally split the rice and curry and eat the same food for morning breakfast and afternoon lunch.
9. Waste is equivalent to a resource when it is recovered, since there is no proper record of waste recovered or sold, there is a huge amount of waste which exists in our country.

Problems Identified

Waste at source

1. Individuals mentality and Less awareness regarding waste segregation at source
2. Since dry waste generated in each household is very less, no one invests in buying more than one dustbin.

Collection and Transportation

1. Irregular collection system.
2. No dustbin/collection centre is installed in localities where there are individual houses.
3. Loading and unloading the waste in the vehicle is a tedious task
4. No proper record/ marking is done on the waste collected.

Storing and Segregation

1. Sorting does not happen on a first come first basis, which eventually piles up and degrades the quality of waste.
2. Difficult task to remove the sack from the stack.
3. Sorting space remains too congested with sorted material all around
4. Collection of reject happens in black garbage bag and has to be kept frequently outside.
5. No space is allotted for tipping of waste.

Packing and Selling

1. Recovered materials have to be further transferred to a bigger sack
2. More space is occupied when material is not compressed/baled.
3. Each sack has to be stitched manually once it is filled
4. Storage of all the sorted material is kept together at corner.
5. Since there are no buyers for laminates, it goes out as reject.

Problems Prioritised

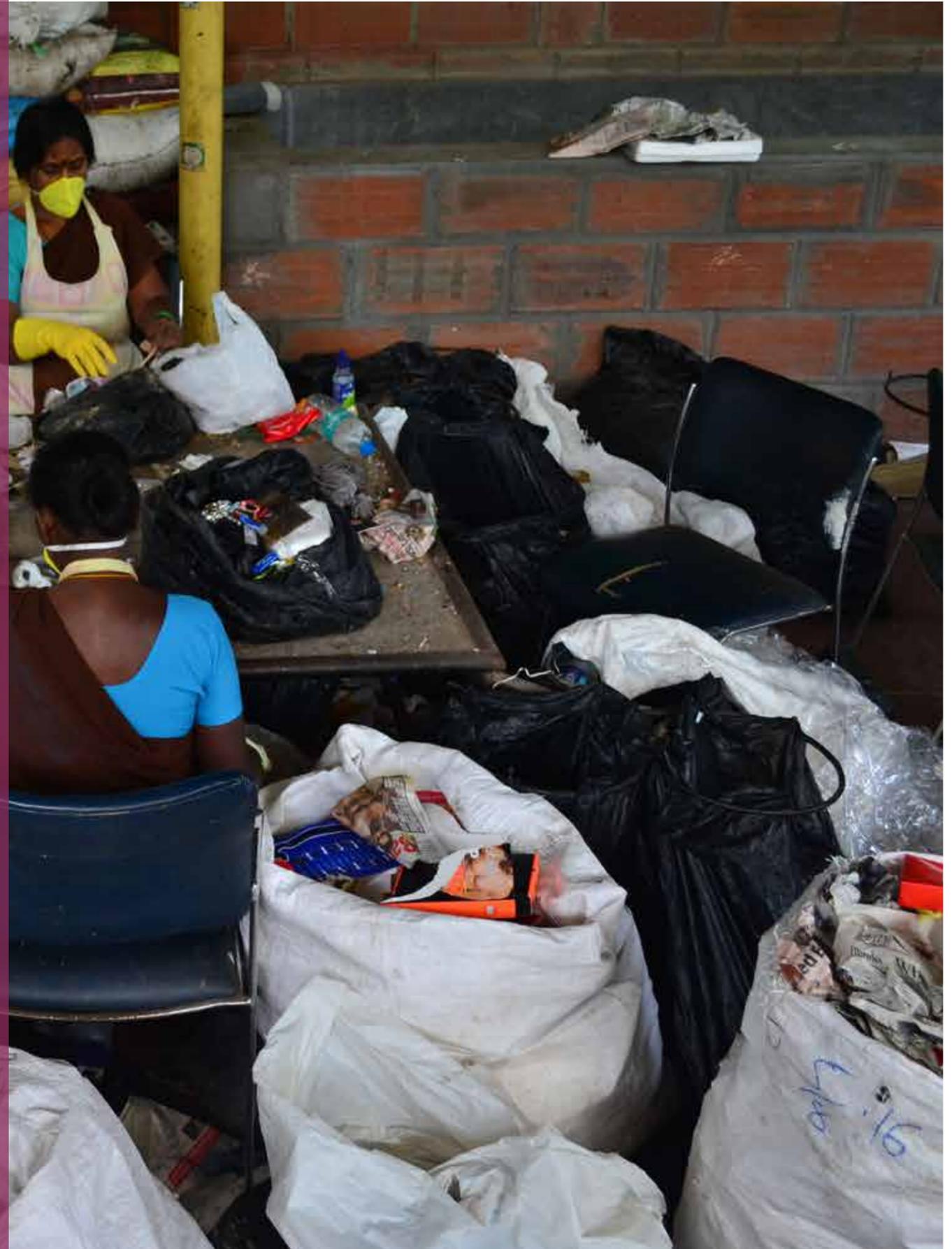
- 1) Inefficient waste segregation at source results in less resource recovery.
- 2) Irregular collection system and unavailability of dry waste collection Centre in close vicinity gives people scope of throwing their waste in black spots or handing it over as mixed waste.
- 3) Handling of waste in 'Last In and First Out' order results in piling up of old waste which results in degradation of quality of waste, eventually ending as a reject.
- 3) Congestion of space while sorting puts constraints on ladies of having free movement.
- 4) Pre and Post Sorting task is more tedious and time consuming.
- 5) Material like laminates keep coming in huge quantities and occupy a lot of space, as they are part of non-recyclable waste stream.
- 6) Lack of proper tracking waste inflow and outflow after getting sorted, makes difficult to reach the sorting target.



4 Idea + Development

Redefine Brief
Brain storming
Concepts

Ergonomics
Material
Technology

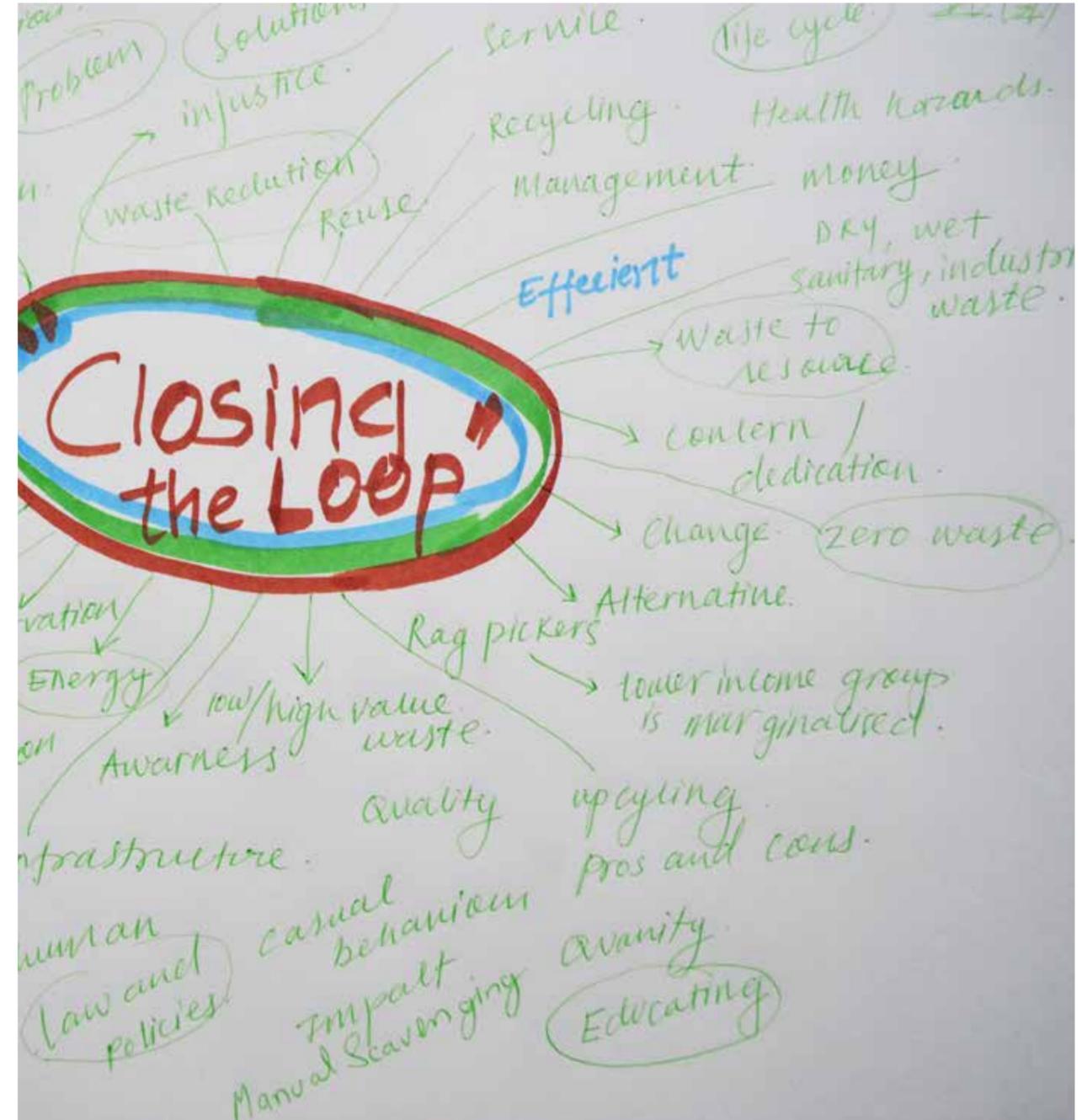


Redefine Brief

To develop a closed loop" system in current scenario of waste management, by step wise intervention at each level of Waste handling and closing the loop by developing up-cycled products with materials which are non - recyclable.



Brainstorming



Brainstorming is a technique which was used to gather spontaneous insights and solution for this project 'Closing the Loop'. While doing brainstorming it not only give a diverse ideas but also helps in developing a better solution for the problems.

Concepts

Dry waste collection bag



Introducing to
2 BIN AND ONE



Material

PVC Flex



As the city seems to have no control over usage of flex banners, their numbers are increasing by the day and could easily be estimated to be a few lakhs.

Problem

Burning flex is a cheap option, many do so without considering the harmful results. Neither BBMP nor the Pollution Control Board have succeeded in preventing people from burning these flex banners.

Not bio-degradable
Emit toxic fumes when burnt
Toxins released is carcinogenic
Recycling post-consumer PVC is difficult.

Solution

Saahas takes these problem as a solution for reusing post consumed Flex banners to make Dry waste collection bag.

Graphics

Graphics on all four sides of the bag.



Back Side

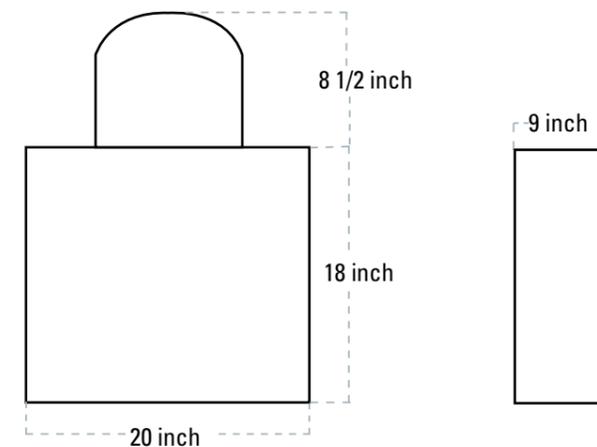
Both sides

OR

Graphics on one sides of the bag.



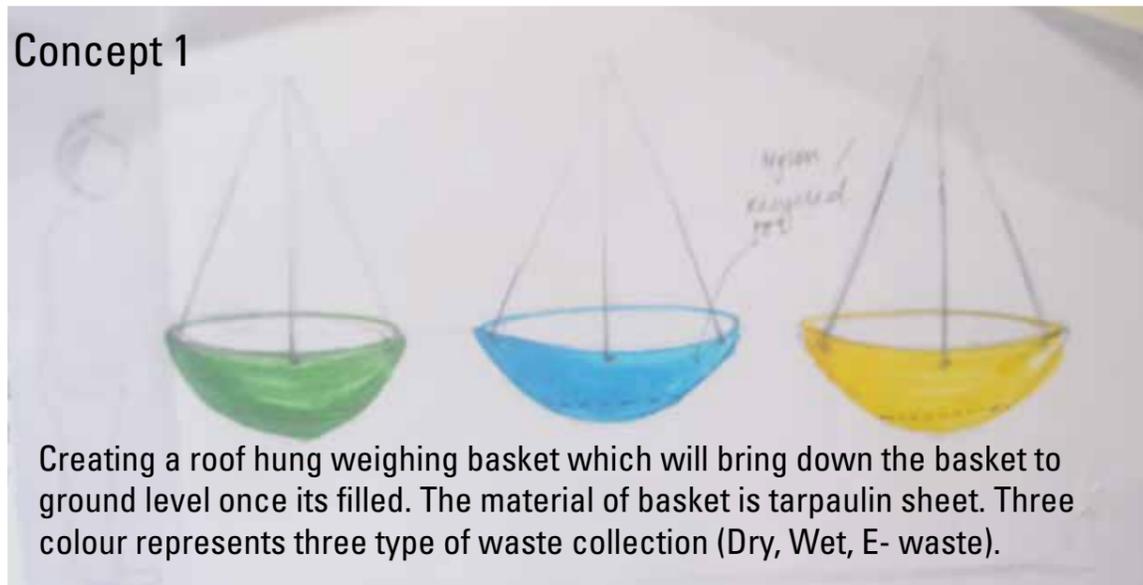
Measurement



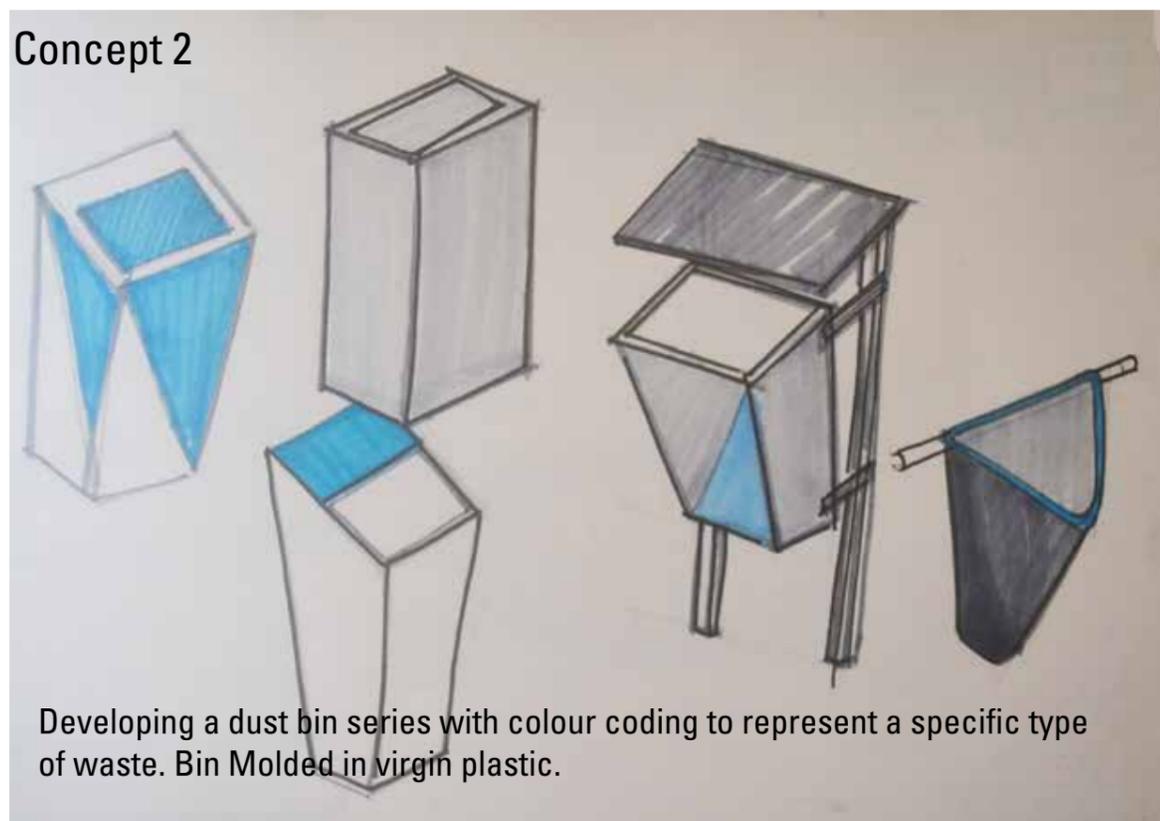
Dry Waste Collection Point

Dust Bin

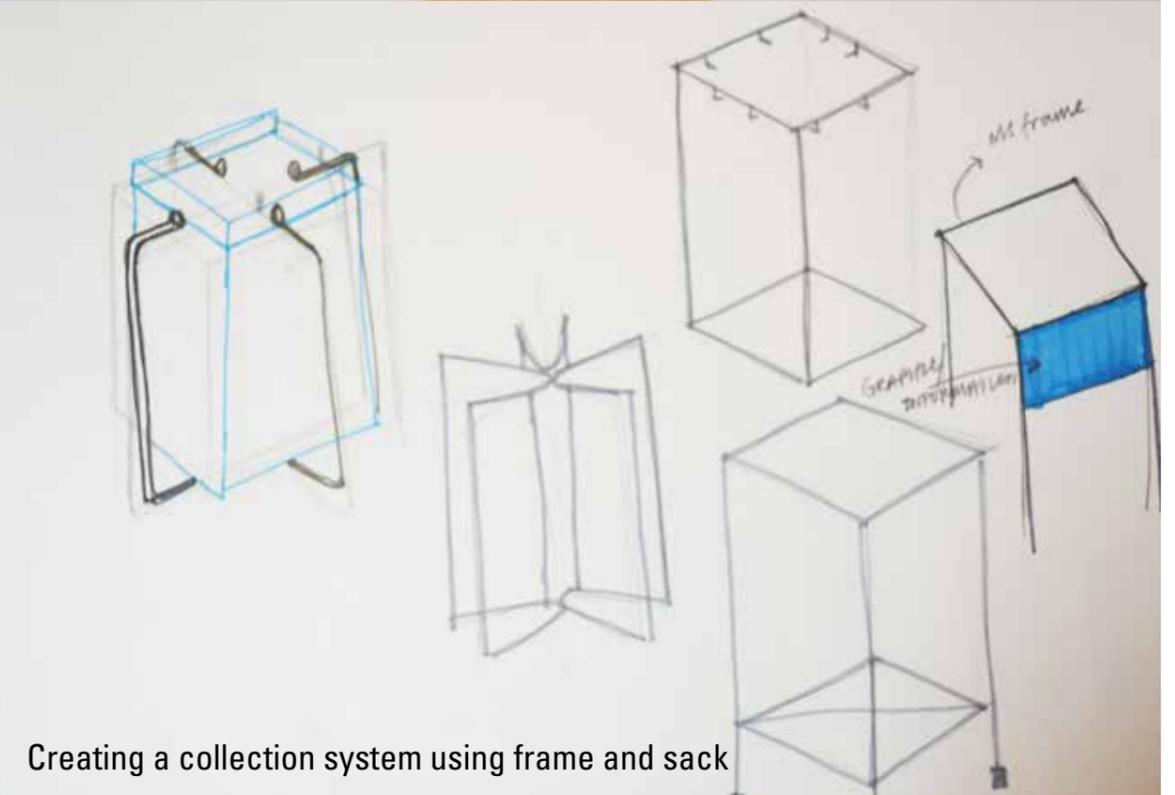
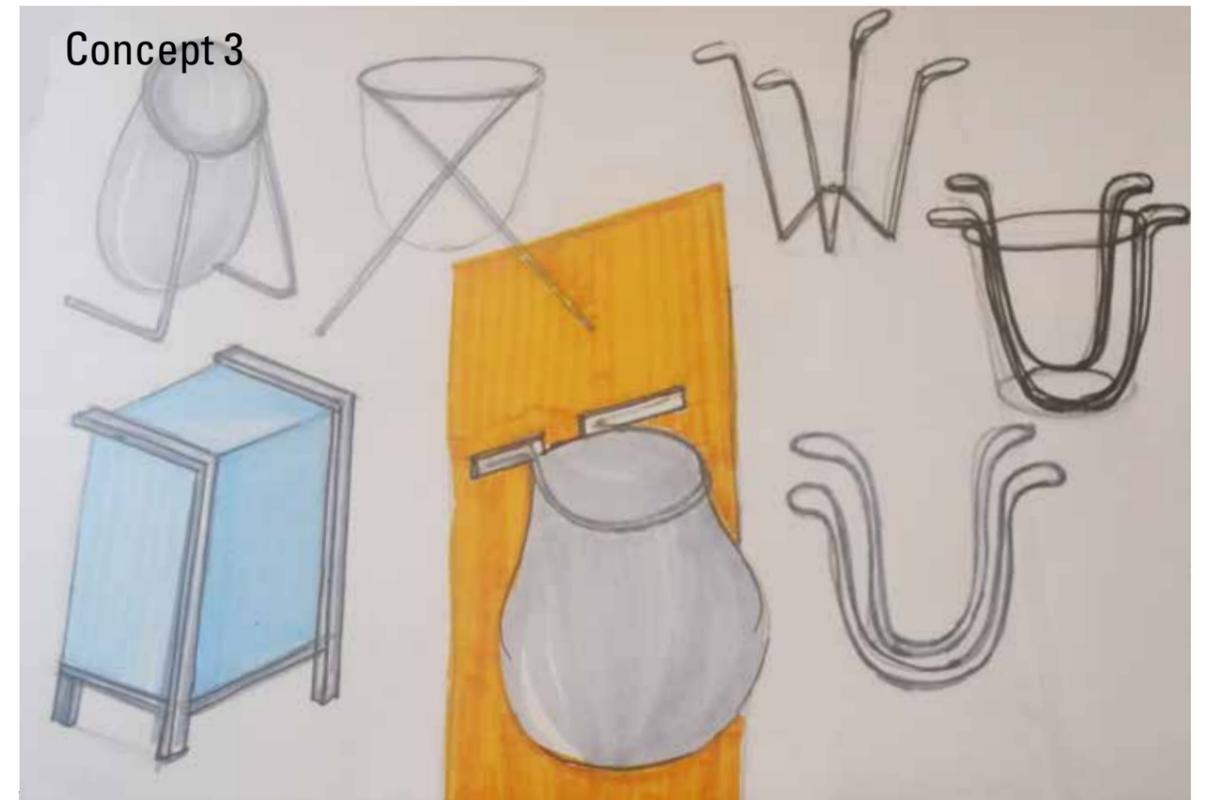
Concept 1



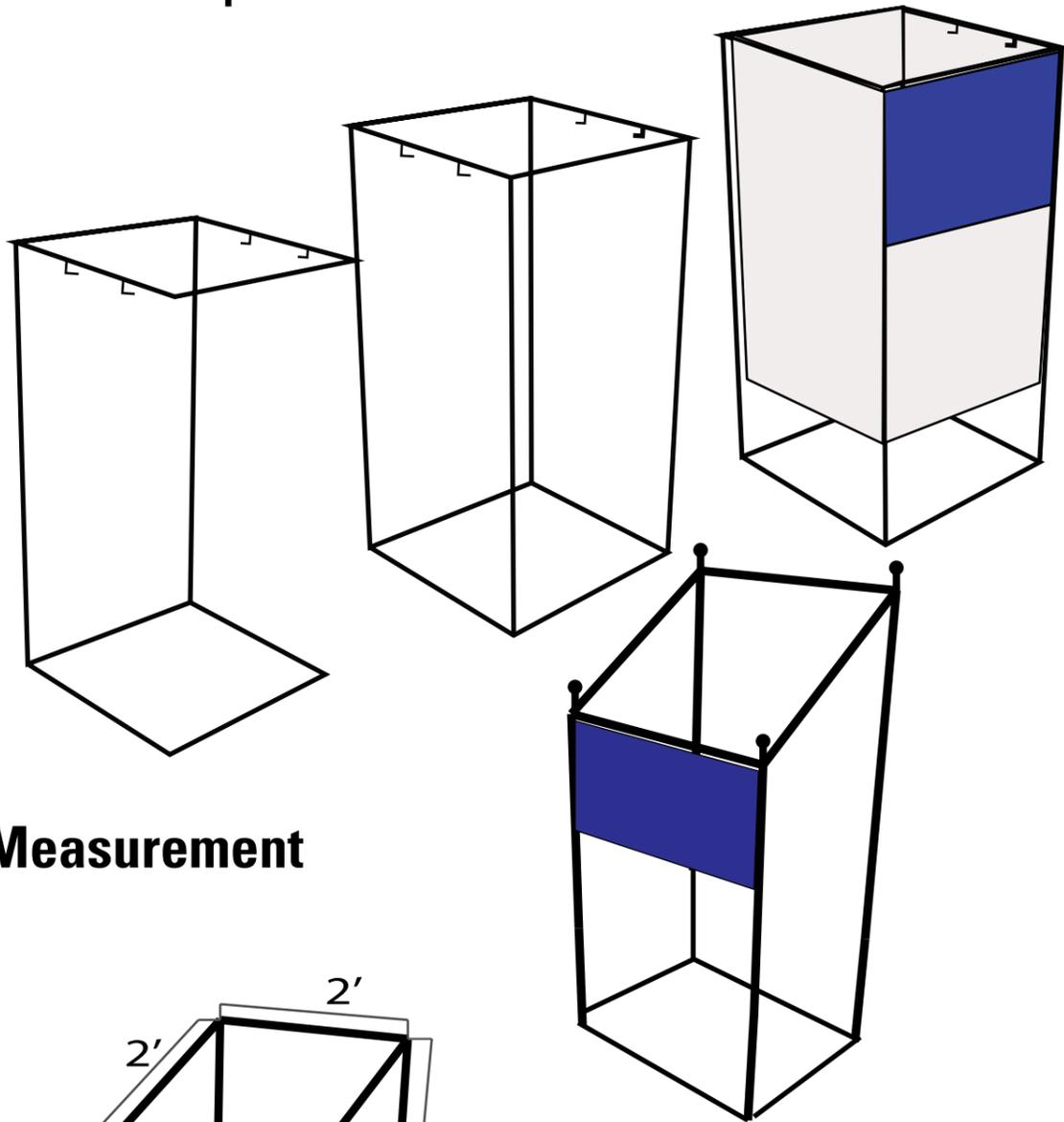
Concept 2



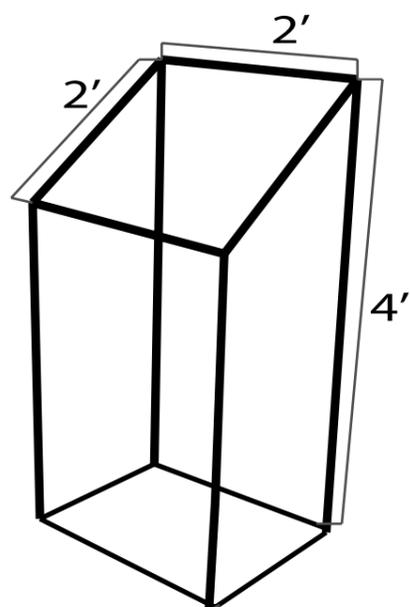
Concept 3



Frame development



Measurement



Material

Frame : MS C-shape channel

Bag : Flex

Graphics



Information Panel



List of dry waste and e-Waste



Paper

white paper
colored paper
newspaper
magazines
catalogue
paperboard
files/folders
food packaging
shredded paper
tetra pak cartons
books
paper cups
corrugated cardboard
box board(i.e. shoe boxes, gift boxes)

Plastic

all plastics number 1 to 7
food and beverage containers
plastic jars
plastic cups
water bottles
soap bottles
retail plastic bags
plastic films
Styrofoam
flex

Glass

all color glass bottles and jars
glass food containers
beer and wine bottles

Metals

aluminum beverage cans
food cans
aluminum foil
containers

No

sanitary napkins
tissue paper
light bulbs/ tubes
mirror glass
window glass
ceramic or stone
crystals
cloth fabric
wood
thermocols

e-Waste

chargers
pen drives
mouse
keyboards
printers
cartridges
monitors
laptops
mobile phones
electronic toys
calculators
dry cell batteries
CDs
floppies
video and audio cassettes
speakers
wires

toasters
radio sets
television sets
hand-held video games
digital clocks
watches, Iron
video cameras
digital cameras
sports equipment with electric
or electronic components etc
fridge
washing machine
lamps
UPS
inverters,
headphones

note:

The items in the **NO** list cannot be dropped in the collection bin.

Please clean all soiled items before disposal.

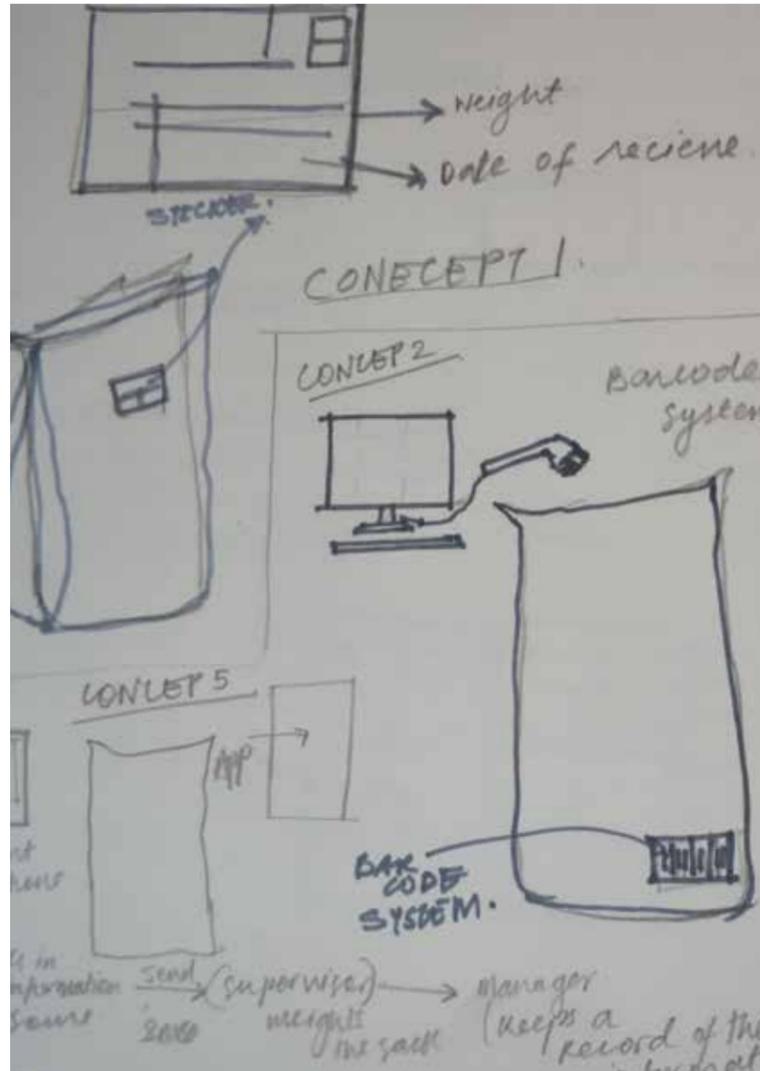
All cardboard boxes must be folded.

If you need us to arrange a pick up vehicle for collection of e-Waste, kindly contact us **080-41689889**.



Poster for Segregation at Source

Tracking Waste and Efficiency Check for Sorting



Concept 1

Sticker system where the sticker is stuck on each bag brought to the unit.

Concept 2

Each bag has a bar code which when brought to the unit is scanned and feeds the system all the data automatically.



Concept 3

Tagging each bag at source, then supervisor feeds the data in the tag and end of the day after sorting that bag, field staff hands over the tag to the supervisor.

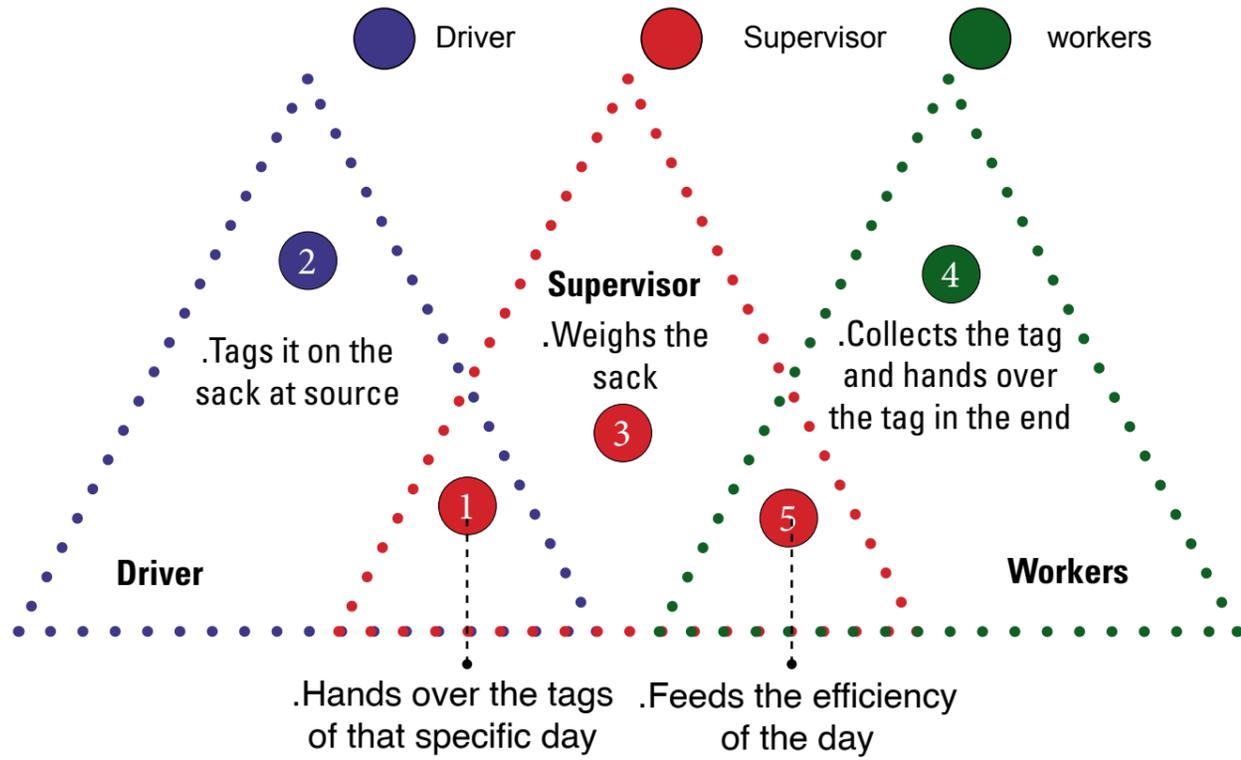
Concept 4

Colour coding the sack with specific color of that source and filling the data on the sack itself.

Concept 5

Colour coding the sack with specific color of that source and filling the data on the sack itself.

Tagging system



Features

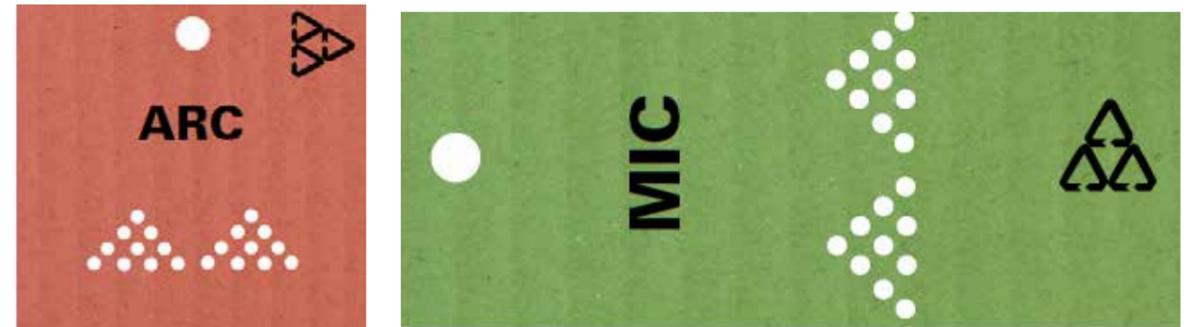
- Weight** Denotes the weight of the sack

- Location** Denotes the name of the source from which the waste is bought

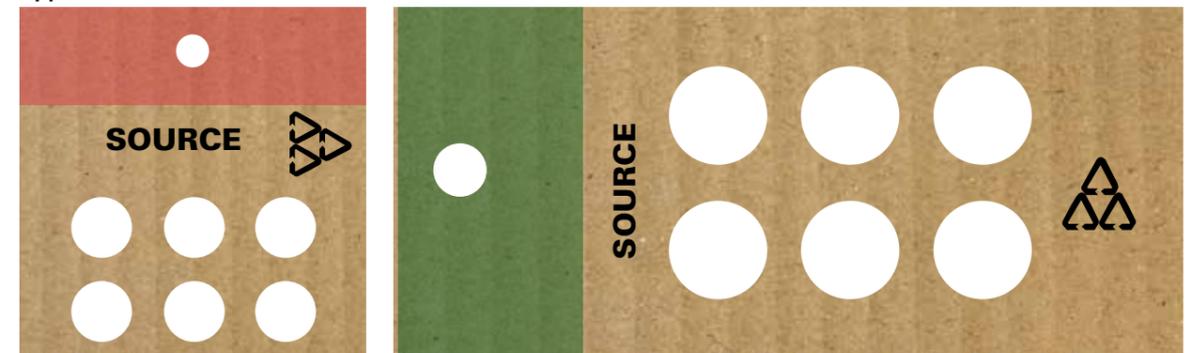
- Date** Denotes the date of receive of the sack and completion of the sack

- Week (emergency)** Denotes the week in which the sack was bought

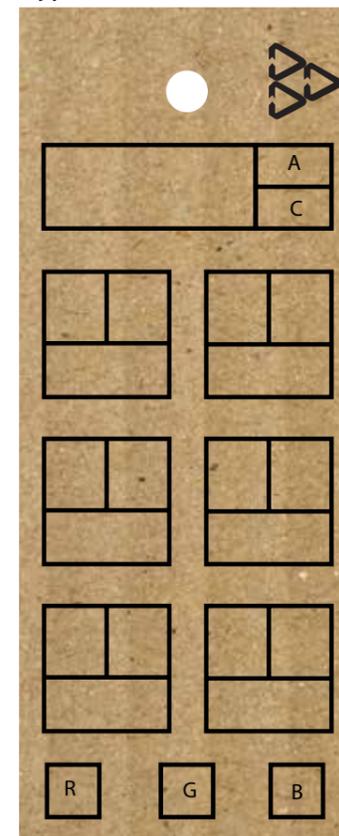
Type 1



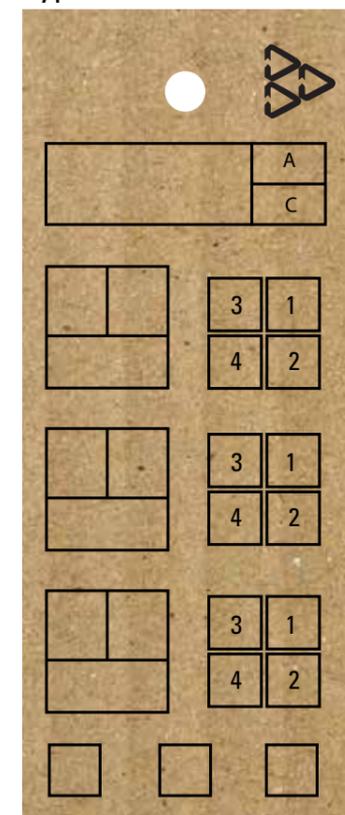
Type 2



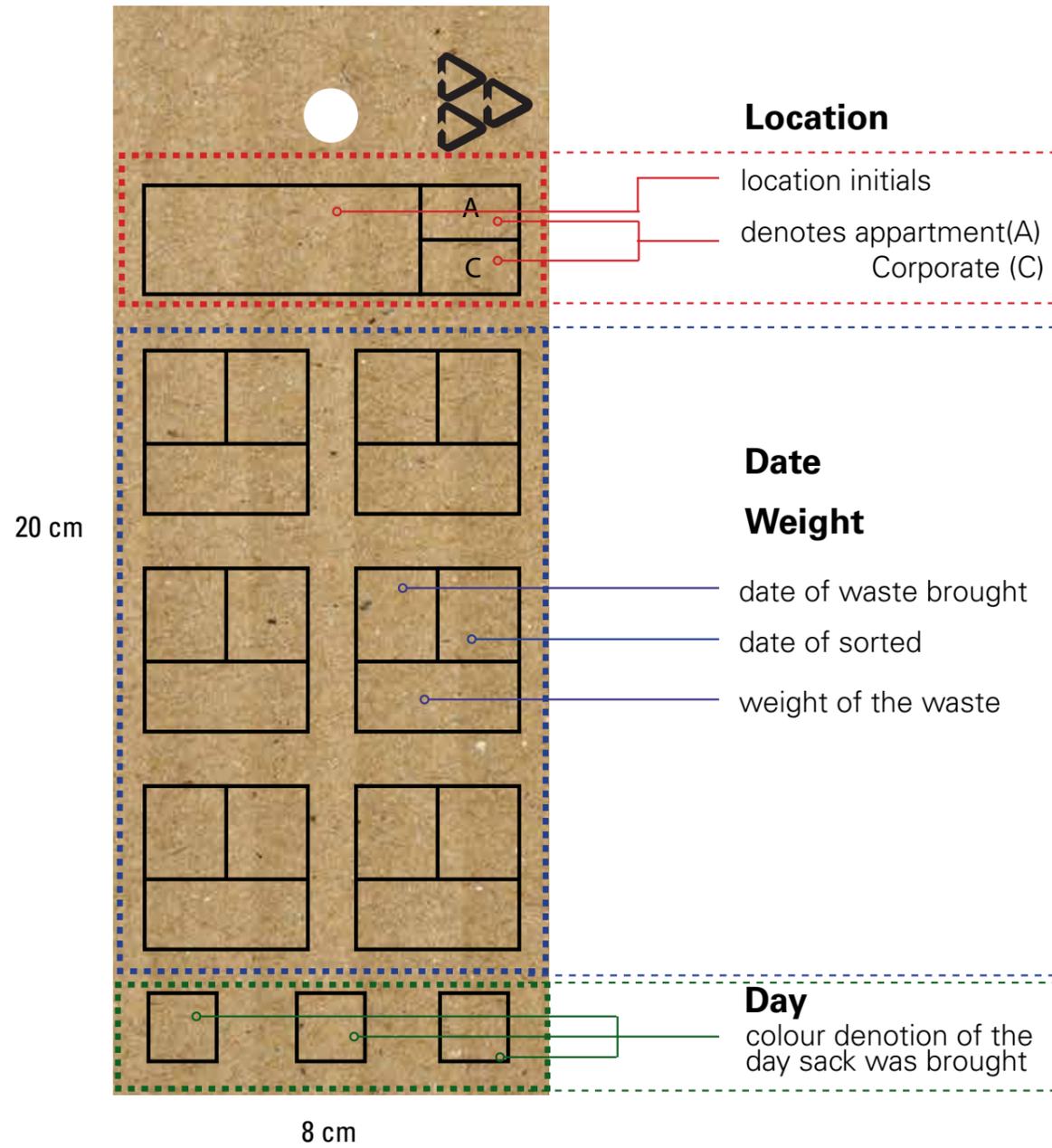
Type 3



Type 4



Measurement and Specification



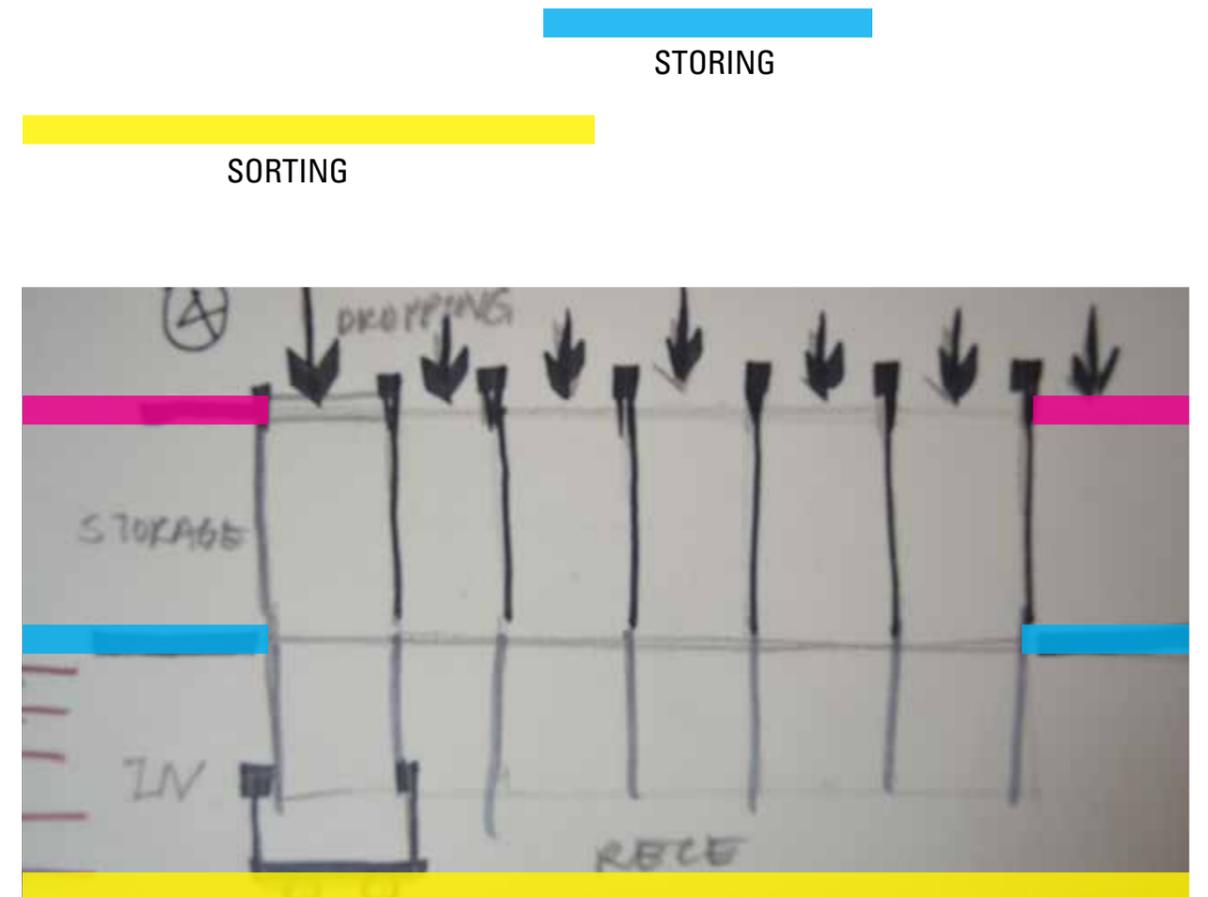
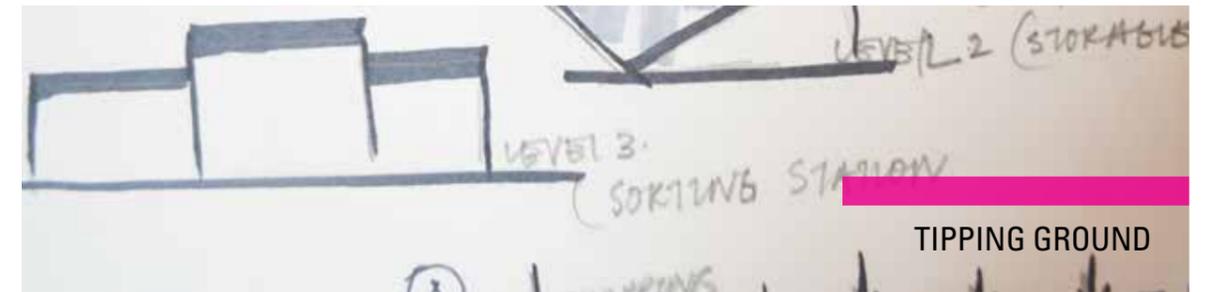
Material

Since Corrugated board is readily available in the Dry Waste Unit, the tags would be printed on these board.



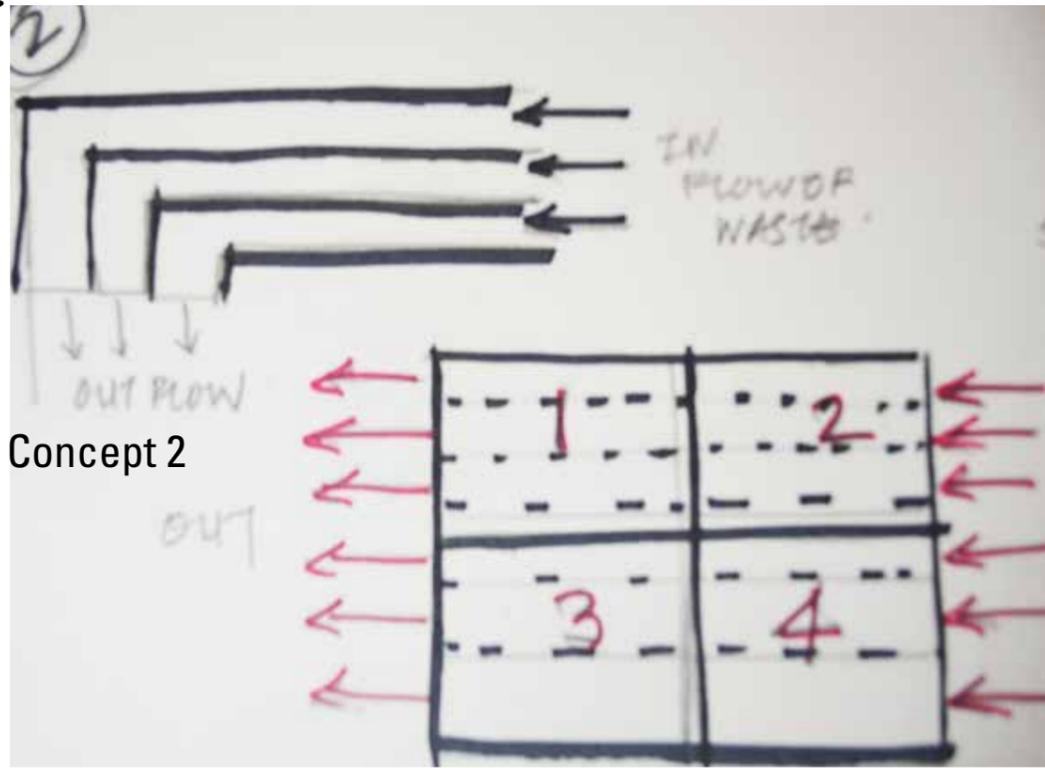
Storage space for unsorted waste

Concept 1



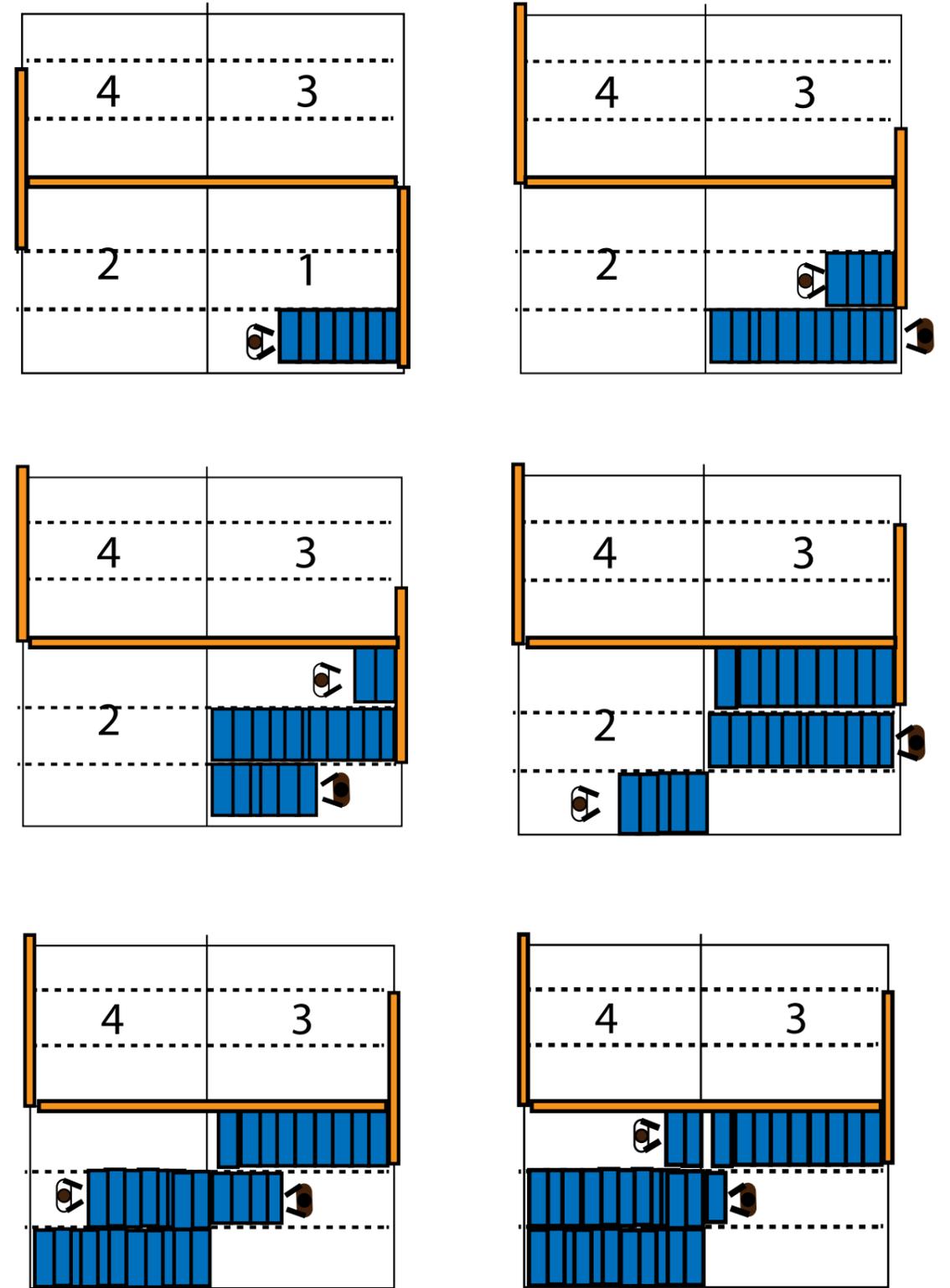
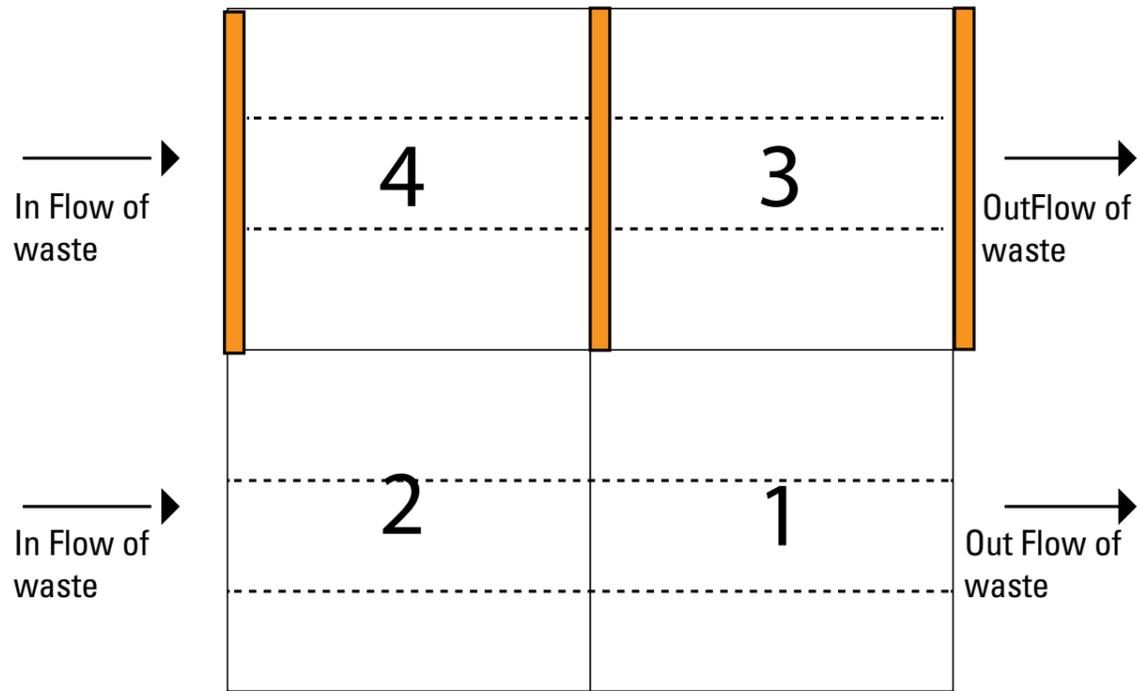
Unit divided into three level where each level has a different role to play. It has seven opening where each days waste is dropped in the specific opening.

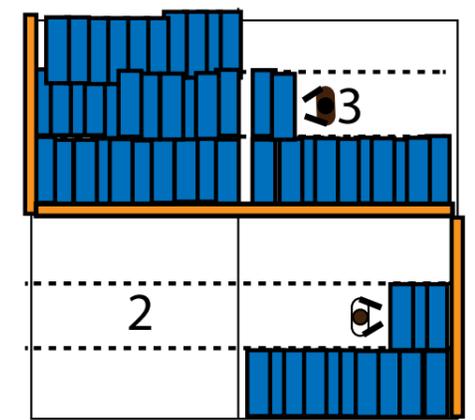
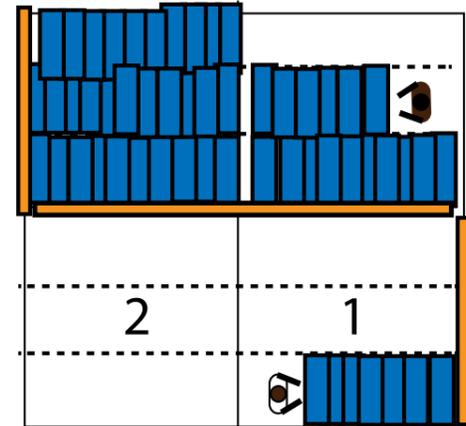
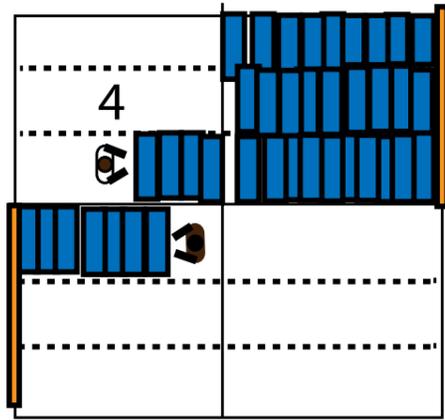
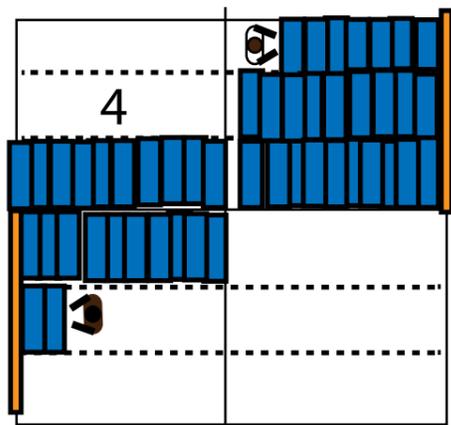
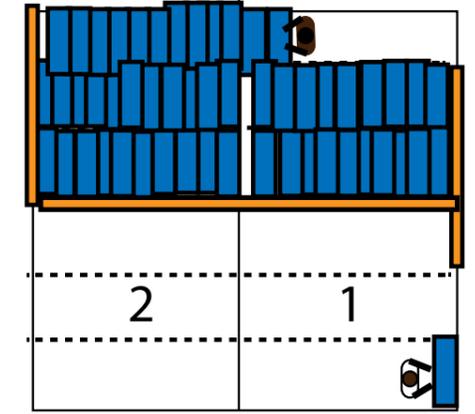
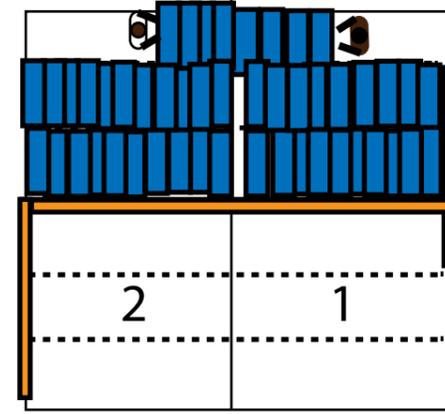
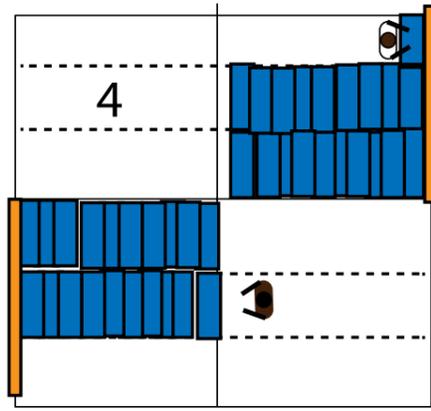
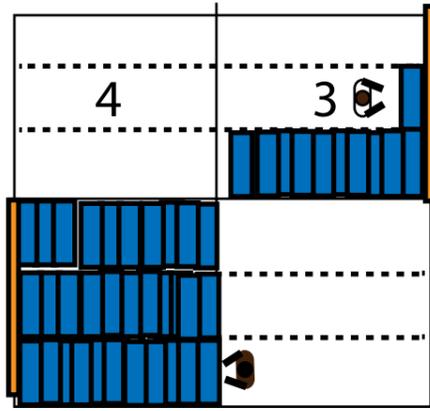
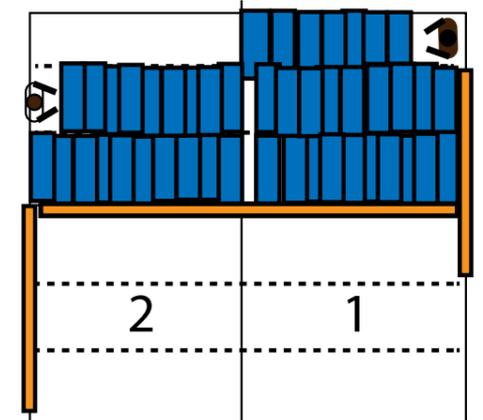
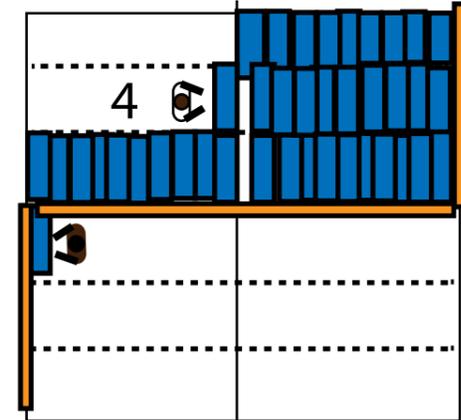
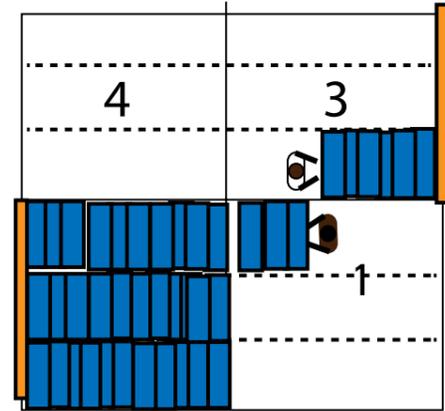
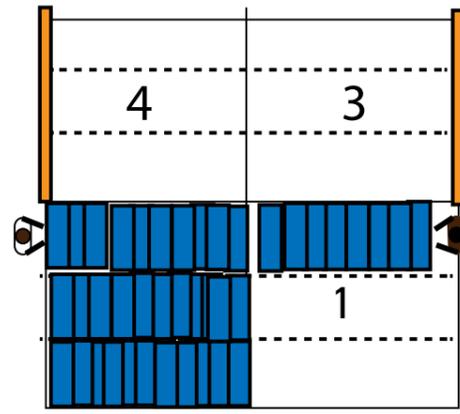
Concepts



Concept 2

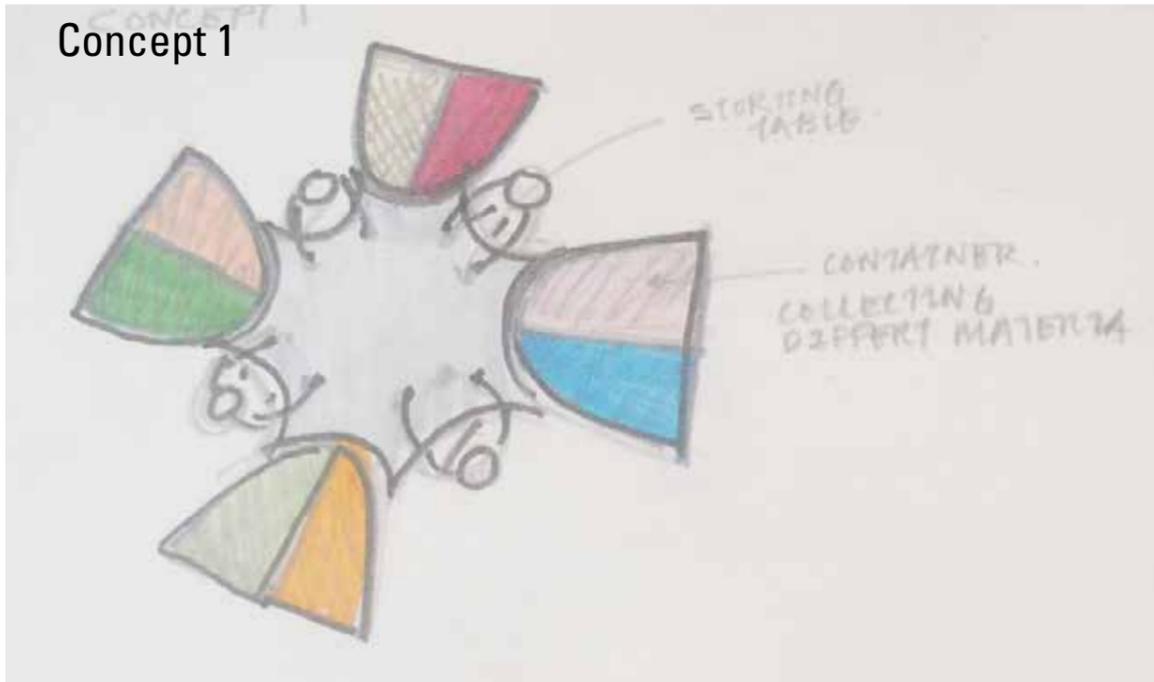
Linear or square storage where one side is for waste in flow and another side is to take away the waste . It can be further sub divided into linear segment. Idea was to sort the first come first





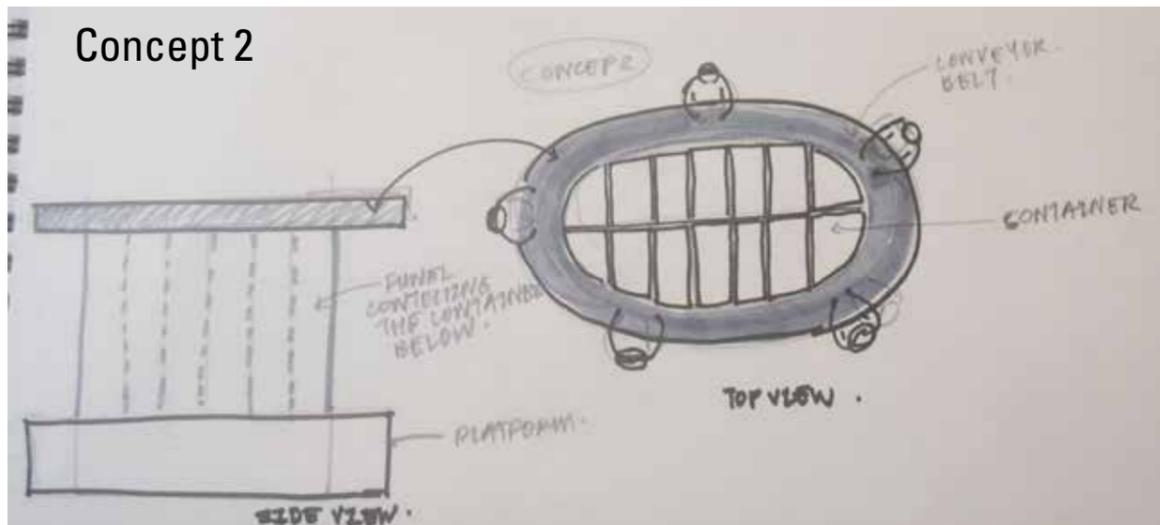
Sorting Table

Concept 1



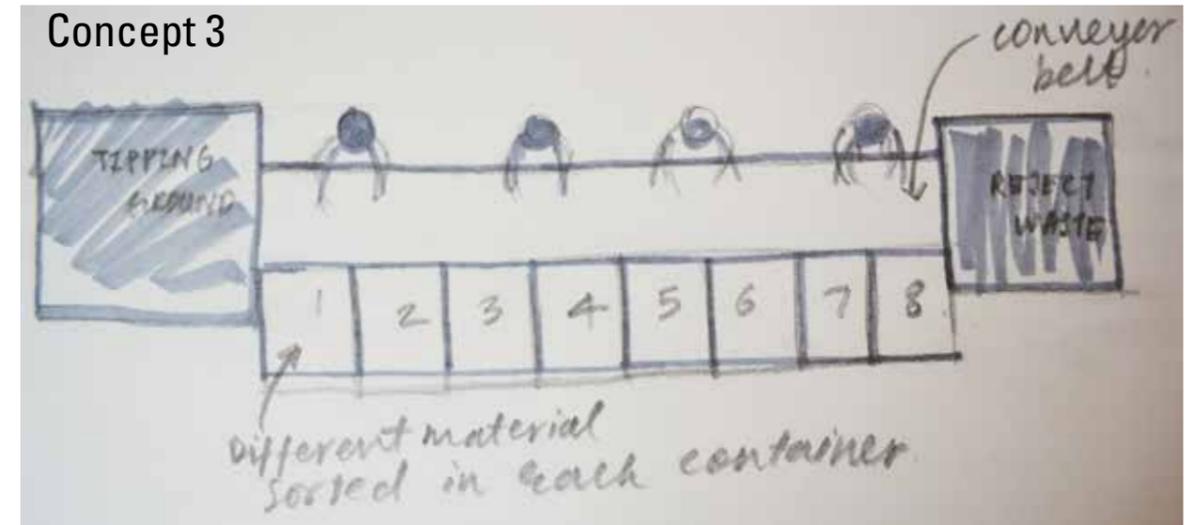
Storing table in hexagonal shape with a concave working space for the staff. And each staff sorting two different material.

Concept 2



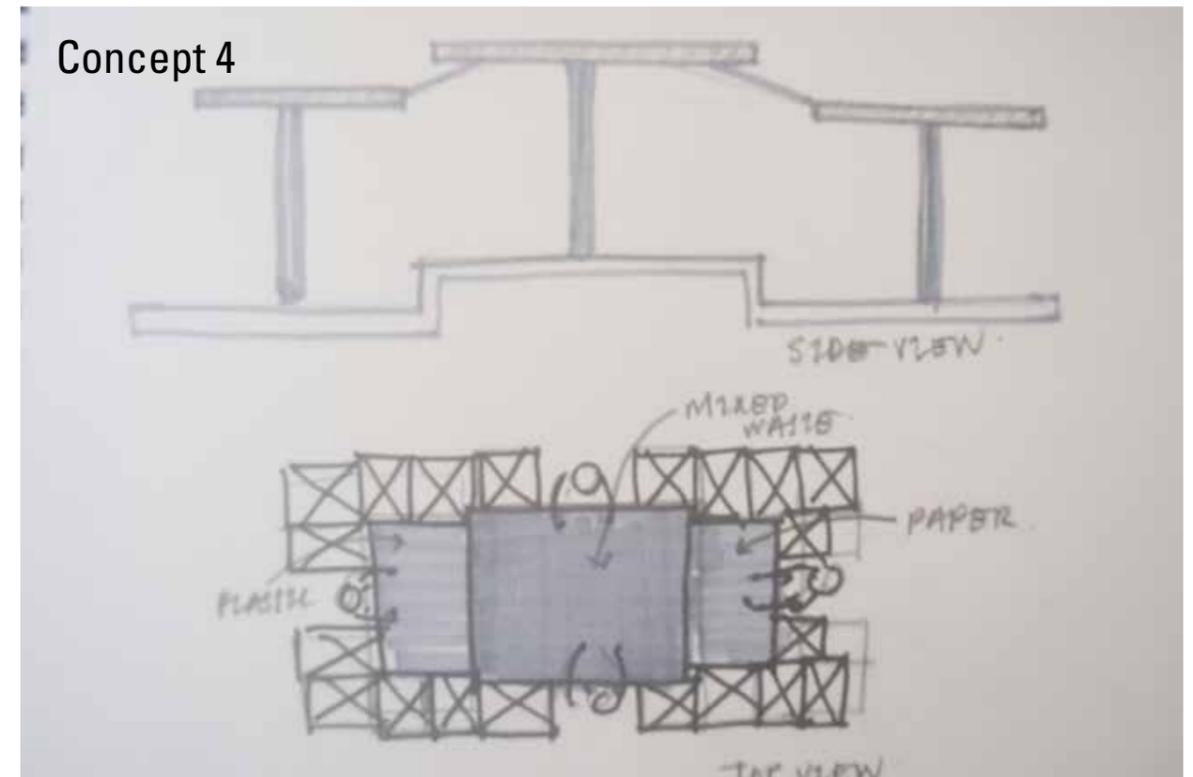
A Conveyor belt table with the containers placed in between.

Concept 3



From the Tipping Container the waste flows in a conveyor belt. The field staff sorts the waste coming in liner manner. In the end the Reject waste is collected in a container kept in the other end.

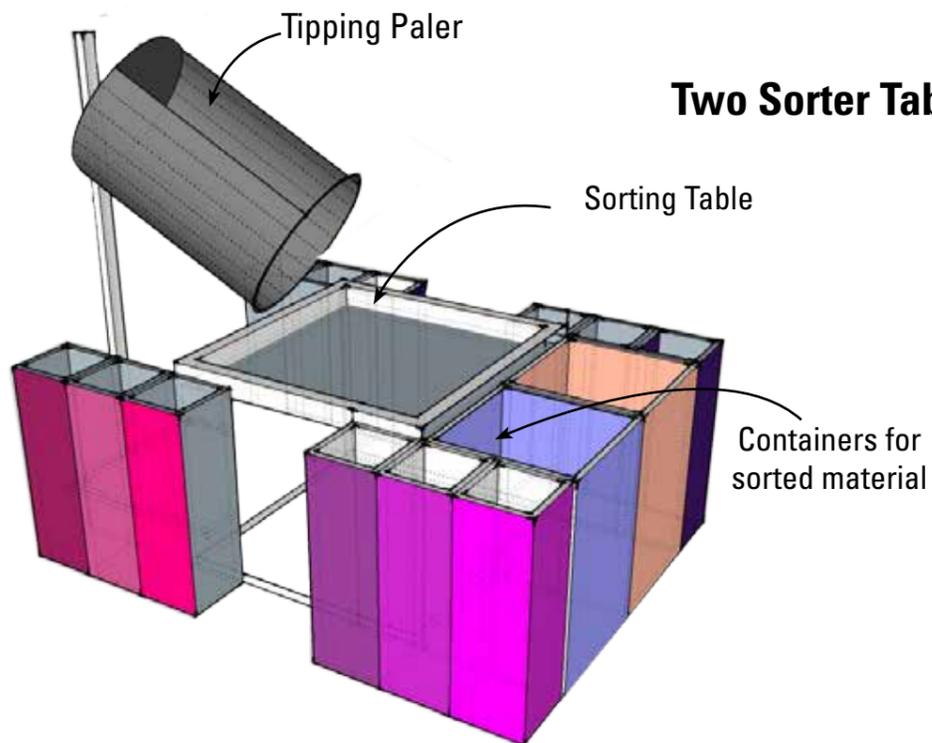
Concept 4



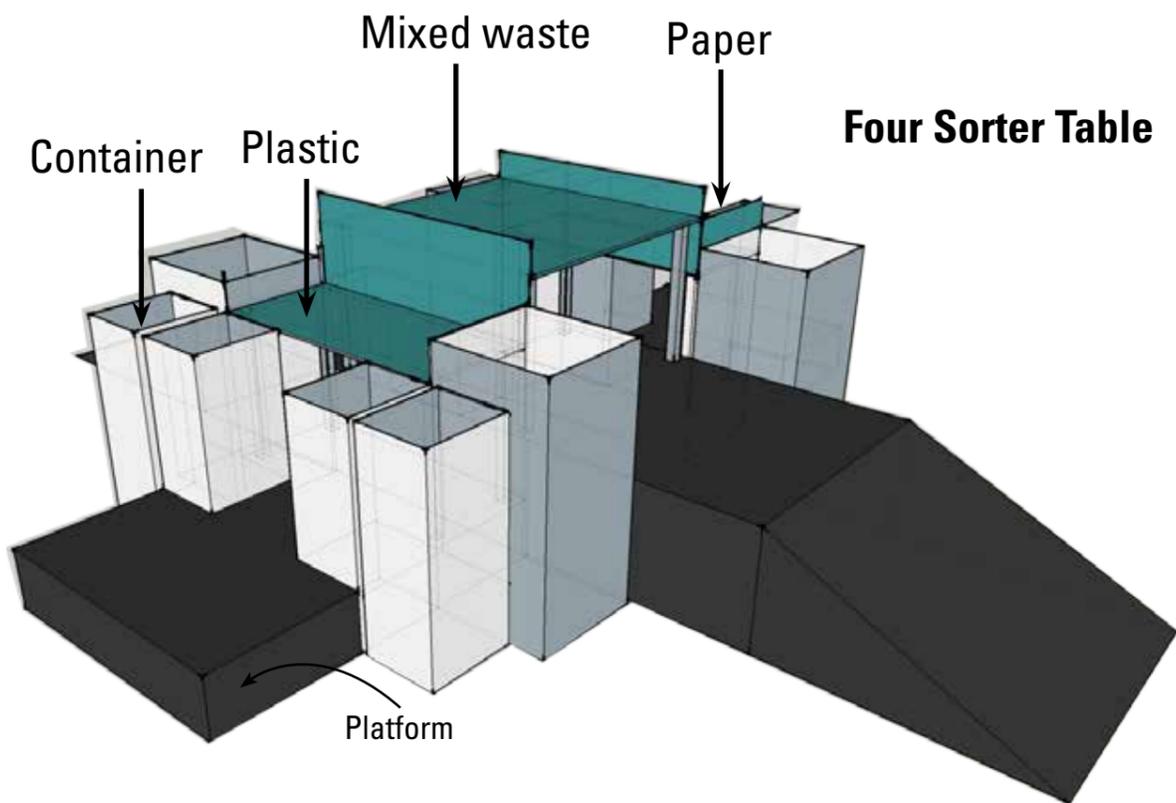
Three Table Sorting where the main table will have all the mixed dry waste falling. The other two table will have paper and plastic material falling on a different table respectively

Final Concept

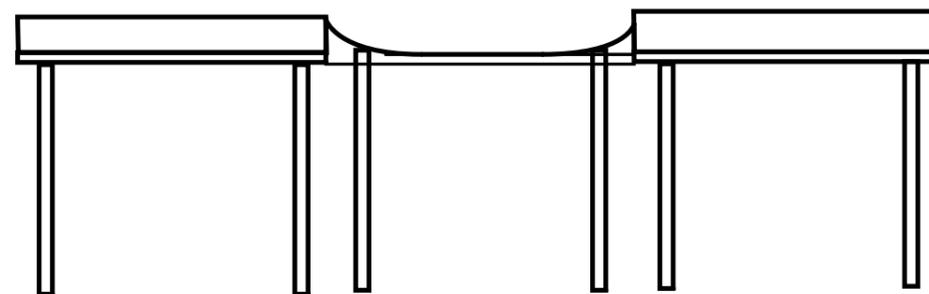
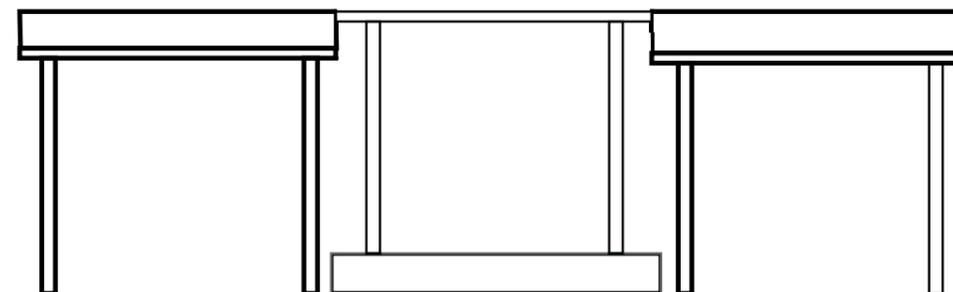
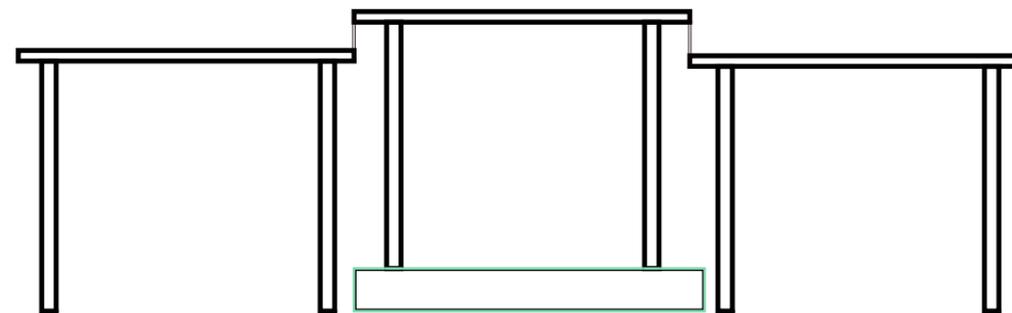
Two Sorter Table

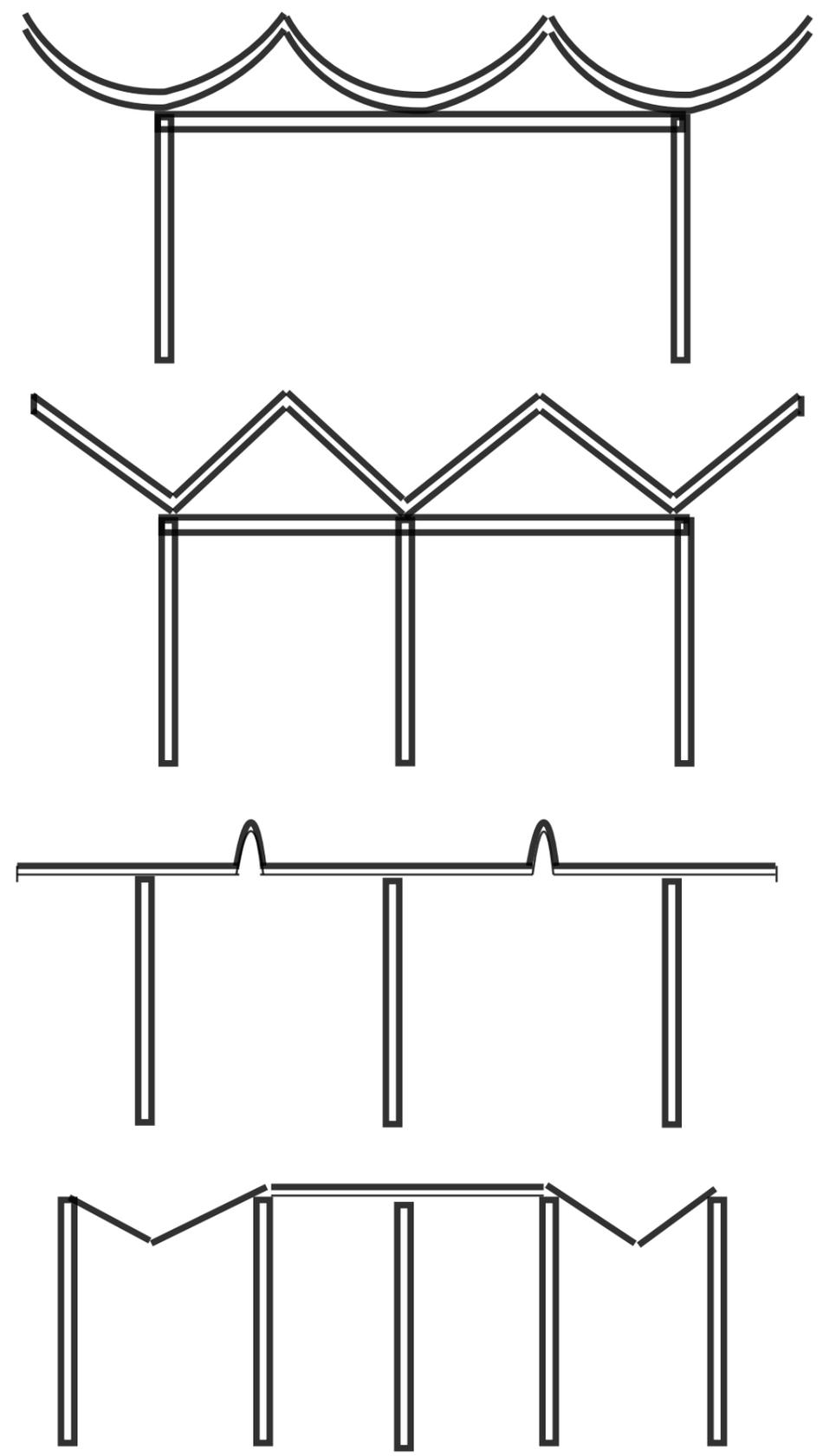
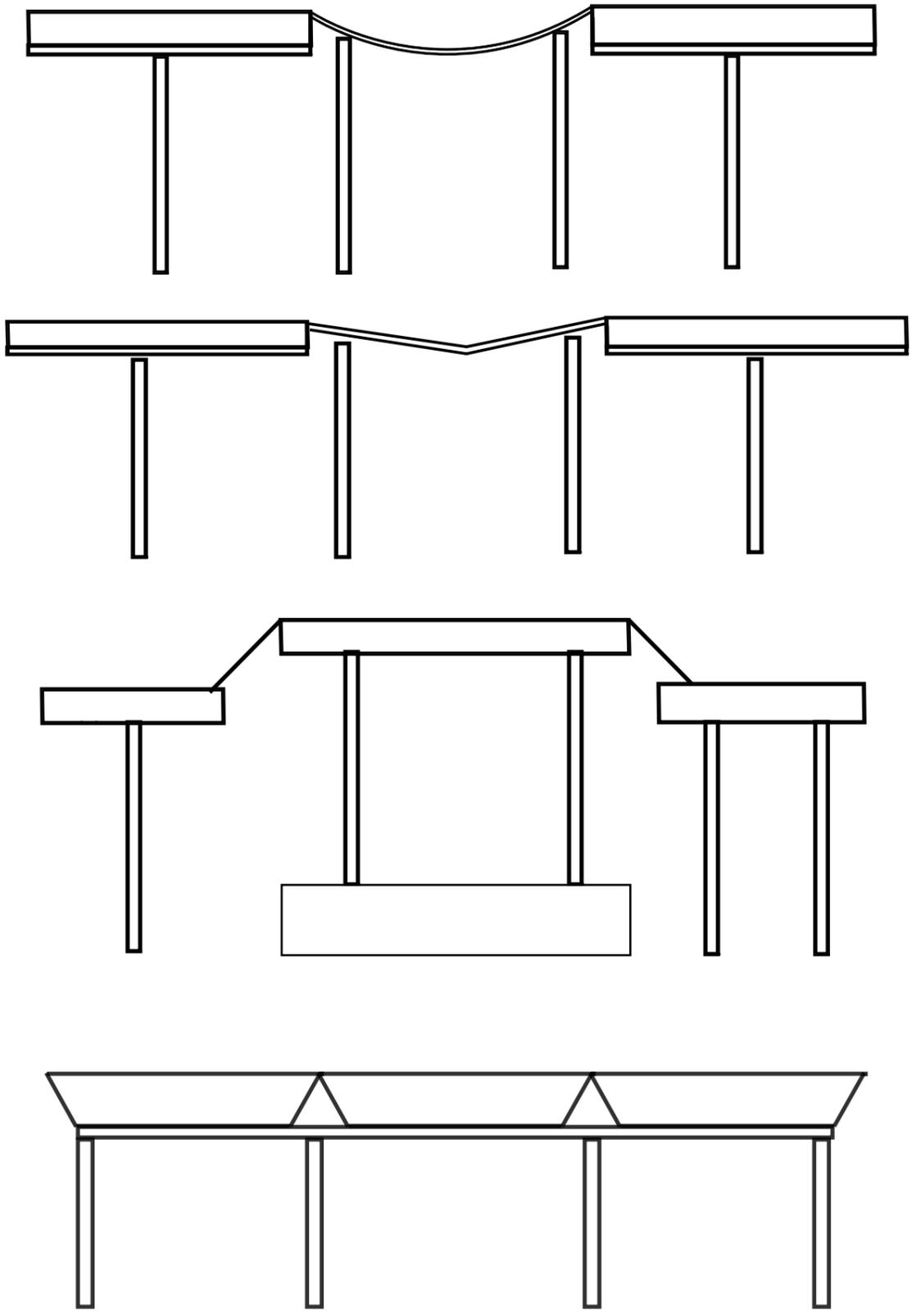


Four Sorter Table



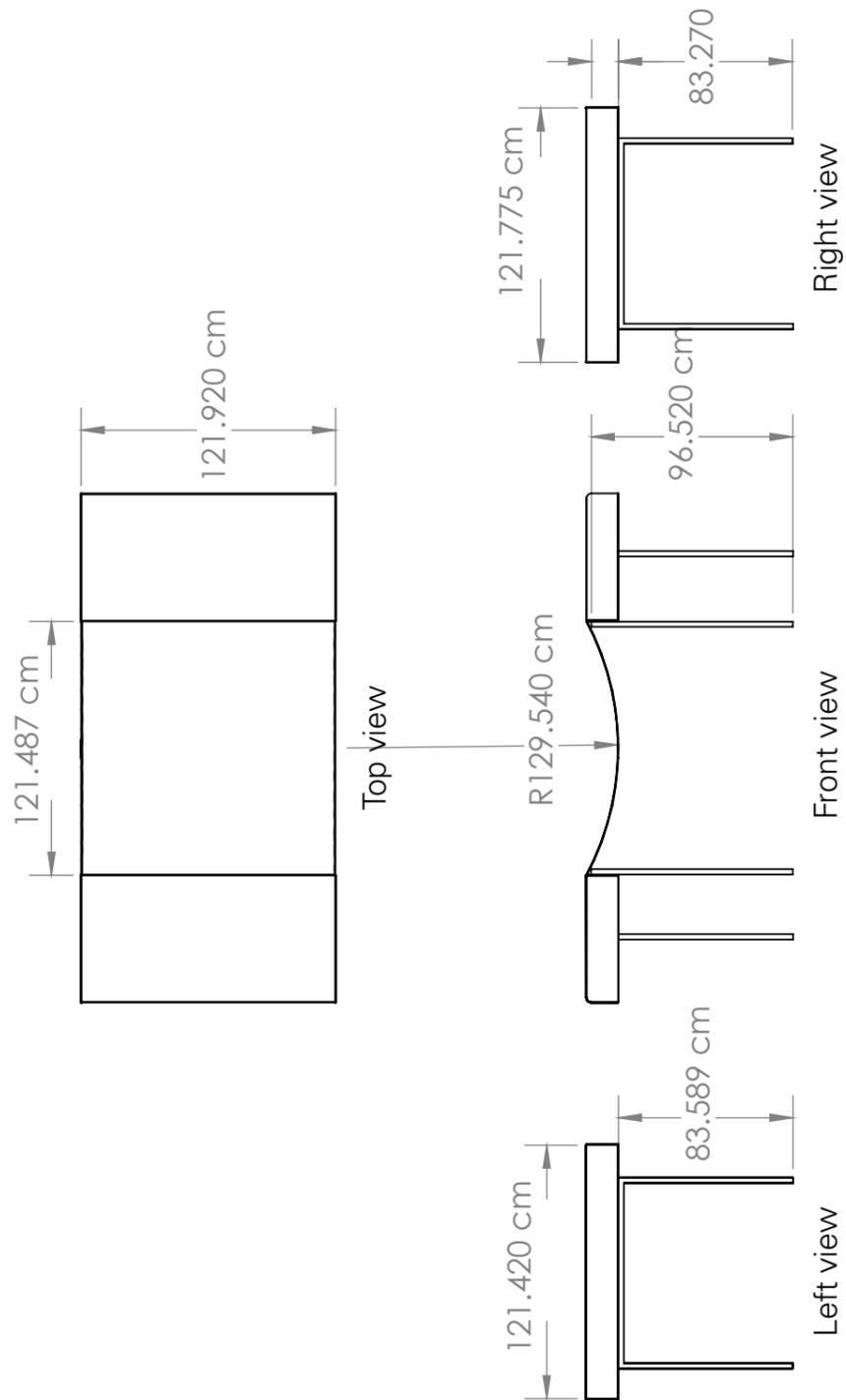
Form Exploration(for 3 table sorting)



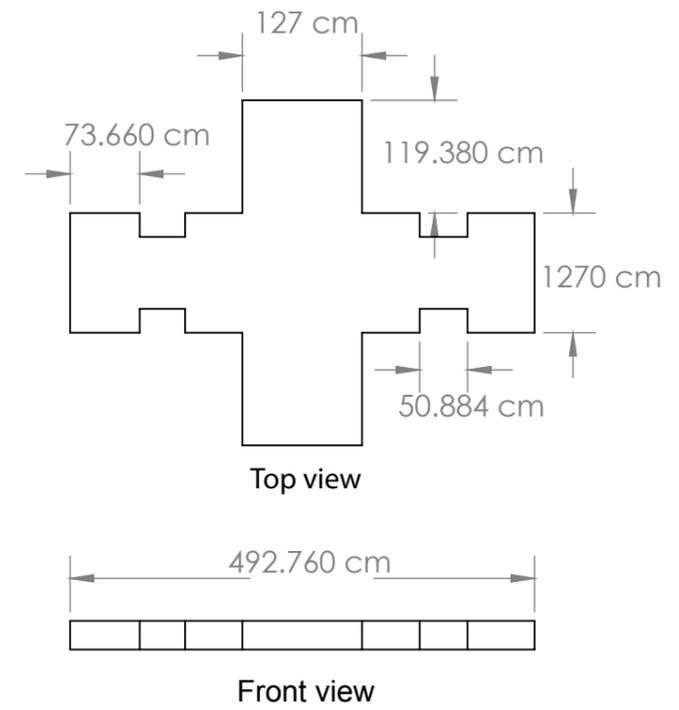


2D Drawing

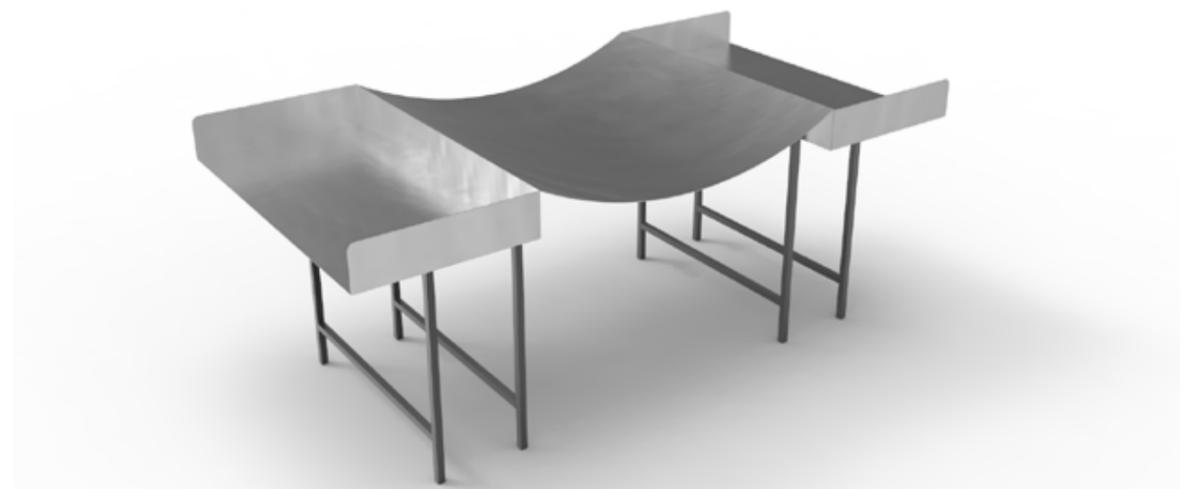
1) Sorting Table



2) Platform



3D Drawing

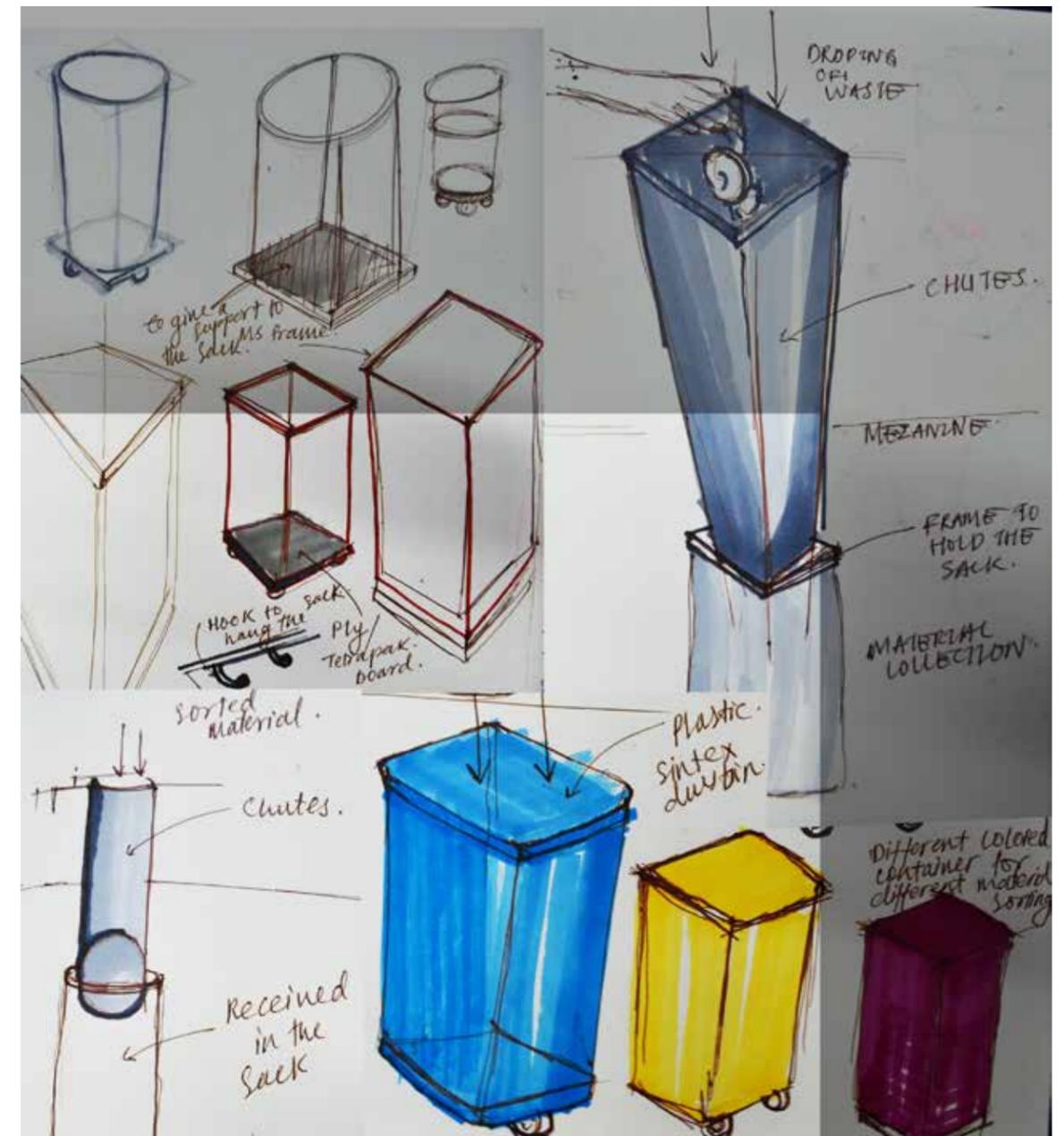




Sack holder

It is for holding the woven HDPE sacks which once filled after sorting is tied with rope and stored in the storage space and then sold to the recyclers.

Concept Sketches



Development



Sack holder are of two size. The quantity of different material sorted varies day to day.. The amount of white virgin paper, colour paper, Polyethylene are collected more in quantity, hence a bigger sack holder for those material..



Measurement

Sack Holder 1	
L x B x H	1ft x 1ft x 4 ft
Sack Holder 2	
L x B x H	2ft x 2ft x 4 ft

Material

Frame
Round MS rod

Base
Plywood/ Tetra Pak chip Board



Material of the Sack

Woven HDPE Sack



Final design



- | | | | | | | | |
|---|--------------|---|---------------------|---|------------------------------|----|--------------------|
| 1 | Cans | 4 | News paper | 7 | Road Waste(Polythylene bags) | 10 | Puga/Hard Plastics |
| 2 | Colour Paper | 5 | Magazine/News Paper | 8 | Kadak(HDPE) | 11 | Laminates |
| 3 | Tetra Pak | 6 | Virgin Paper | 9 | Smooth Plastic(HDPE) | 12 | Kadak(HDPE) |

Ergonomics

Optimal work surface height varies with the work performed:

(While sitting)

Precision Work : 31 to 37 inch

Light assembly work : 21 to 28 inch

(While standing)

Precision Work : 37 to 43 inch

Light assembly work : 34 to 37inch



Optimal Reach/ Work Envelope :
(For Seated Work)

Primary reach must be with in : 13 to 17 inch

Secondary reach must be with in : 21" to 25"

Proposed Equipments for the Dry Waste Collection Centre

Manual Mini Baler

- Ceco MiniPak is a small hand operated baler for baling numerous different products.
- With a footprint of only 575 x 700mm this machine produces bales of up to 20 Kgs. of cardboard and up to 35 kgs. of silage wrap.
- The machine is ideal for use with shop plastic, pallet wrap, silage wrap, plastic bags, shredded paper and light cardboard.
- Needs no power source the machine can be used anywhere and is ideal where space is limited or ceiling height is low.



Vacuum Lifting for Sacks or Bags

- The vacuum lifting equipment for sacks enables the operator to lift a variety of sacks or bags.
- The sacks can then be split and opened, and contents emptied, without losing suction from the vacuum lifting head.
- This sack lifting solution is suitable for production and mixing areas involving raw ingredients and bulk materials.
- The bag or sack can be split and contents poured into a hopper without loss of suction from the vacuum lifter.



Shredded Paper

Smooth Plastic Wrap

Silage Wraps

Plastic Bags

FROM POST-CONSUMER FLEXIBLE PACKAGING TO A DURABLE CONSUMER PRODUCT



Billions and billions of pouches ending up in a landfill or an incinerator, where in both cases valuable material is wasted. It is one of the realities the flexible packaging industry faces, simply said, there is no facility in the world for the recycling of post-consumer multi-layer flexible packaging.

If put in incinerator, it leads to heavy smoke generation resulting in atmospheric pollution.

So, What can be done with this waste ?

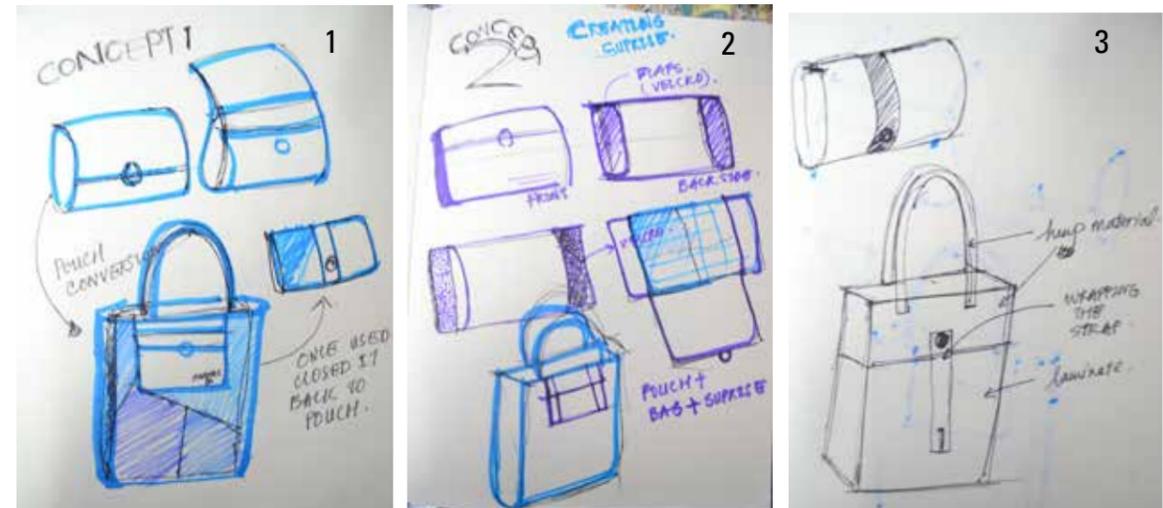


After brainstorming about the usability, applications and possible limitation to the material it was concluded that it very much possible an easy to upcycle laminates into grocery bags.

Attributes

Durable : **Compact** : **Handy**

Concepts



1. Converting the pouch into a grocery bag by flipping out to in.
2. Similar to the first concept it has a flap on both edge which is removed to bring the bag out.
3. The bag is wrapped with a string .
4. Base of the bag converts into two sides of the pouch which could be closed by zip mechanism.





5 Prototyping

Manufacturing process
Costing



Dry waste collection bag



Manufacturing Process

- The bag is stitched manually by a local tailor.
- It is having a double layer stitch keeping the printed surface inside.
- Once stitched it is has to be washed and dried.
- In the end screen printing is done using single ink colour black

Costing

Post Consumed flex banner would be directly handover to the organization by the BBMP. For temporary the post consumed flex is bought from the market.

Material	Rs. 30
Stitching	Rs. 30
Screen Printing	Rs. 10

	Rs. 70

Dry Waste Collection Point



Manufacturing Process

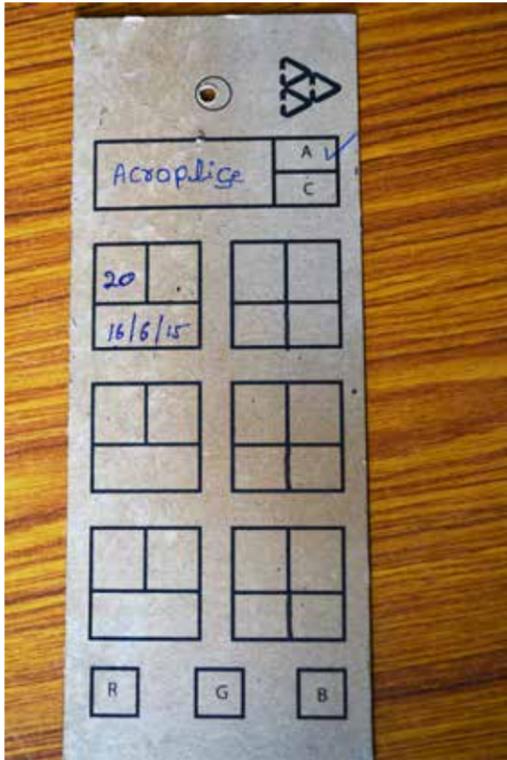
- **Frame-** Mild Steel angles welded and powder coated.
- **Collection Bag-** Single Layer Post Consumed flex banner stitched manually and double layer stitched only at the edge with four hole for it to hang in the frame.
- **Information Panel-** Information Panel is Sticker Print done on the back side of used sunboard.

Costing

Frame	Rs. 2000
Collection Bag	
Stitching	Rs. 150
Plastic curtain ring holes	Rs. 40

	Rs. 2190
4 Sticker Print panel	Rs. 1000

Tracking and Efficiency System for Storting



Manufacturing Process

- Hard board / corrugated board are collected in the dry waste unit.
- It is cut and punctured according to the dimension mentioned earlier.
- Tag is given for single color screen printing.

Costing

Screen Printing	Rs. 300
for 200 tags	Rs. 1.5 /piece

Sorting Table



Sorting Table

Manufacturing Process

- Table top is fabricated with Stainless Steel. Each table top is made separately and then placed together .
- Table Leg is made with MS frame .
- The Table top and the Leg is welded together.

Costing

- S.S. Sorting Table with 1¼" MS Leg Pipes. Rs. 29,000

Laminate Bag

Prototype 1



Converting a fabric pouch into a grocery bag by flipping the pouch outside in. Top edge of the Pouch is stitched to the Laminate Bag.

Drawback:

It was difficult to put back the laminate bag into the pouch back again.

Prototype 2



Similar to the above prototype only change it has is, it has flap on each side which is stuck with Velcro.

Drawback:

The Flap keep hanging while using the bag which creates discomfort. Also using velcro frequently will spoil it fast.

Prototype 3



The Bag is wrapped with one string and buttoned in one end.

Once unbuttoned the string hangs in the front side.

Prototype 4



The base of the bag converts to two sides of the Pouch. A Zip is used to join and close the two sides.

Base will get dirty faster if it is kept on ground.

Prototype 5



Similar to the fourth prototype, it also converts base into pouch and the only difference is that, the laminates are not used as it is. Instead its been cut and weaved together to form a attractive collage

Since it has 3 layer of Laminate there is no mark created for the folds, so every time a new crease forms on the laminate.

Process Followed to make the Bag

1

Laminate is separated from the mixed dry waste

2

It is categorized into different Colours



3

Edges of the laminate are cut from both the sides

4

Washed with natural cleaning agent

5

Dried

6

Packed and given to the tailor.



6 Testing+ Evaluation

Feedback



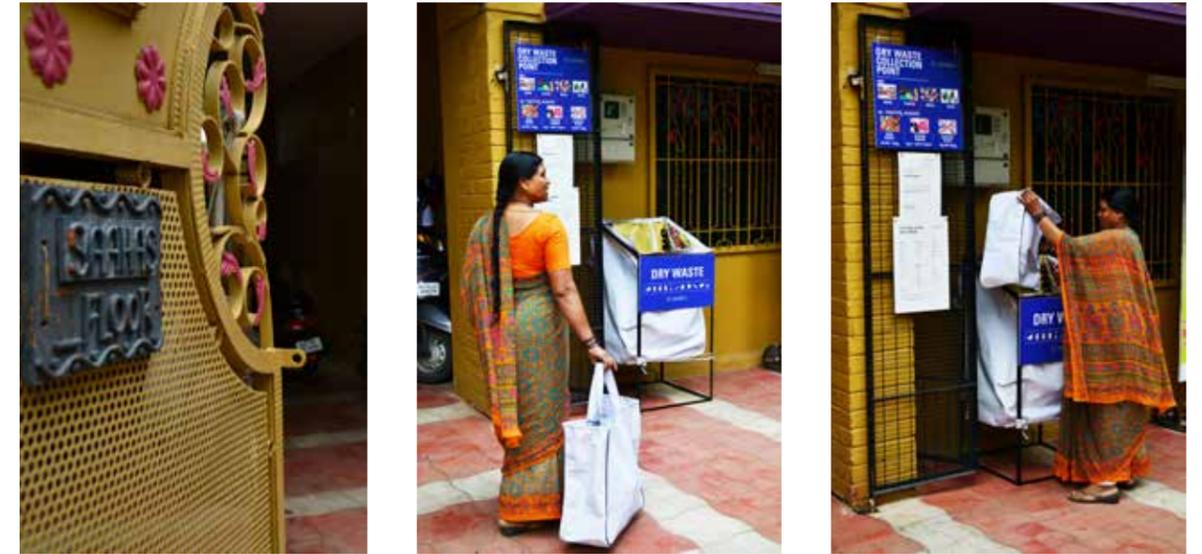
Feedback

Dry Waste Collection Bag



- The bag is sturdy and can hold up to good amount of weight.
- As it's made from used flex, there is always a requirement of material for the bags, which is not very easy to procure, thus causes delay most of times.
- As back side of the flex is used, it's difficult for the ink to settle properly on the grainy surface, thus affecting the print.

Dry Waste Collection Point



- There has been increase in foot fall of people dropping there dry waste after establishing a more visible collection center, which also had information in local language in it

Drawbacks



- The holding capacity of the sack is not sufficient in comparison to the frequency of waste being dropped in a day.
- Filled sack builds pressure on the rings further leading to gradual tearing at the corners.

Tracking and efficiency System



- Insufficient rope to tie the tag on to the bag.
- At a time there are five to six sack coming from the same source so tagging each bag takes more time.

Sorting Station



Existing sorting



Three Table sorting

A Mock setup was created for three table sorting to test the efficiency of the staff, sorting waste per hour. The Staff was made to follow the new sorting method for a week and end of the week , a test had been conducted.

Comparison between the existing sorting and Three table sorting

	Weight of the sack(kgs)	Time taken to Sort(mins)	No. of person
Existing sorting table(Inconsistent staff)			
1	35.2	30	3
2	43.4	50	2
3	38	50	1
4		28	1
	116.6	158	
Time taken to sort 155 kgs of waste is approximately 2 hrs 40 mins			
In an hour they sort 41 kgs			
Three table sorting (4 Field staffs)			
1	18	15	4
2	15	14.5	
3	11	7	
4	20	28	
	64	64.5	
In an hour they sort 64 kgs.			



- After comparing the existing and the new sorting system, it was noted that the amount of waste sorted per hour was more in the new system.
- Ladies have been given the choice of sorting either by sitting or standing.
- Reduction of transferring points have been minimized during sorting.
- Space around the sorting table gives better mobility for the ladies.
- Sorting while sitting, Sack holder becomes a hindrance in the free movement of the hands.

Laminate Bag



Type 1

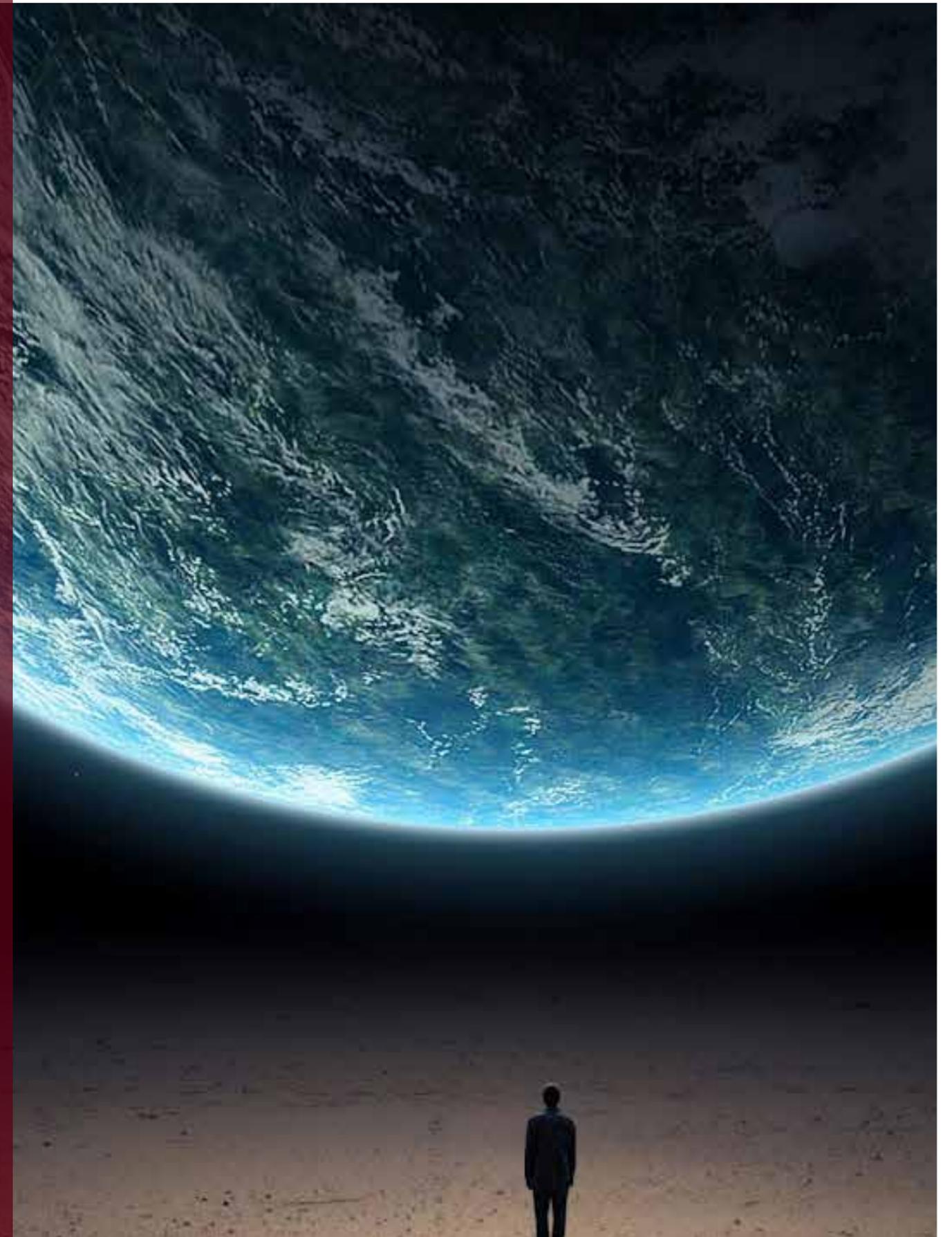


Type 2

- Weight carrying capacity of the bag is good. It holds maximum up to 15 kgs of weight.
- The stitching cost of the bag is comparatively higher than other similar kinds of bag available in market
- More creative patterns can be worked on with the same material.

7 Conclusion

System at Glance

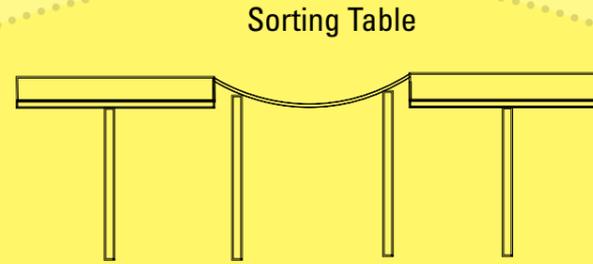


System at Glance

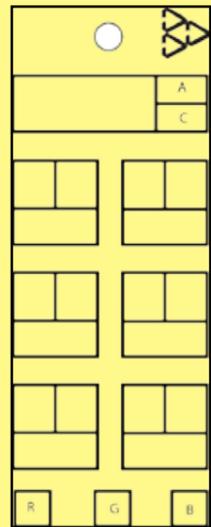
5 ALTERNATIVE SOLUTIONS FOR NON RECYCLABLE MATERIAL



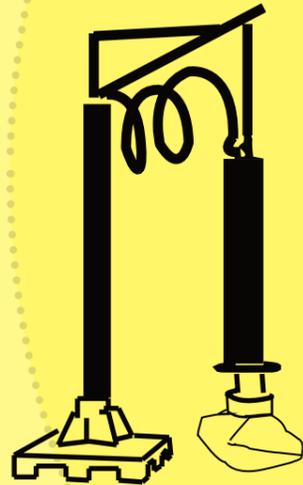
Grocery Bag



Sorting Table

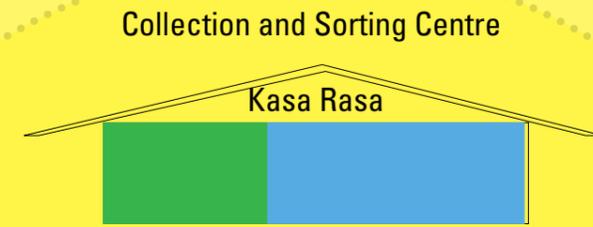


Tags



Vacuum Sack Lifter

4 TRACKING AND ASSESSMENT OF WASTE IN FLOW AND OUT FLOW



Collection and Sorting Centre

Kasa Rasa



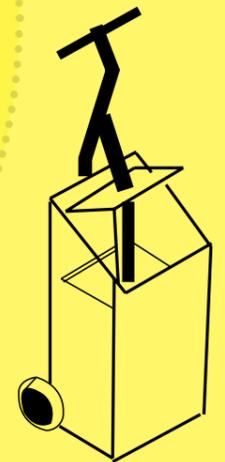
Sack Holder



2 PROPER WASTE HANDLING



Waste collection Point



Manual Bailer

3 EFFICIENT WORKING CONDITION FOR THE FIELD STAFF

Conclusion

Looking at the humongous quantities of waste been generated, one might think about the impending crisis which stands ahead of us in terms of the impacts these quantities will be causing on every living organism. The project revolves around the basic idea of seeing "Waste as resource", thus all the interventions done are from the locally available resources and mostly from the left over material after consumption.

The emphasis was also given at first understanding the outlook of people towards waste, and bringing possible alternatives around available, which gradually reflects the value in idea of waste as resource. During the same time, it was also observed, that if people are provided with better alternatives in there vicinity, they can be motivated for playing their role as responsible citizens by using the options efficiently. After working on the observation, a dry waste collection center was established within the community, catering close to 100 houses.

While working inside the waste management system, the role which filed staff plays needs a specific mention, as they are the one who spearhead this whole system and does incredible work, most of the times which goes un-noticed. The need to provide them with conducive environment was one of the priorities.

During this project efforts were drawn to make the space more interactive to break the monotony of the tiring work they do.

Idea of designing sorting table keeping in mind points like, working at ease, providing better positioning to reduce the physical stress and bringing group of people to work together as a whole rather than individuals, were major focus. As all the factors mentioned above gives extra space, to do things in a bigger and better way, thus affecting the efficiency of the whole system.

Certain suggestions regarding the technological interventions were also made, after the research done of the technologies available in market, which can be customized to specific needs and can be very helpful and time saving.

Lastly, looking at the pace with which we are moving in "Use and throw" culture of products, it's difficult to fathom the behavioral transitions happening. Increase in number of "to be used one time" products specific to FMCG, the need to realize continuous depletion of natural resource is still to be felt by many. Some efforts were put down by using non-recyclable waste and converting it into a better usability product like the Grocery bags from Post consumed Flexible Packaging (Laminates), which eventually increases the life span of the waste, which might have ended in to a land-fill just after its consumption.

Thus the world we imagine always need efforts to be converted into reality. The responsibility lies more with us as individuals, and every single, big or small step counts.

The Earth does not belong to man; man belongs to Earth. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself."

-Chief Seattle, Dwamish Tribe

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