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Eco Friendly Energy Models for Total Waste and Reuse Management in Selected Villages of Punjab State: Observational Study Report

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Abstract

Introduction: Eco Friendly Energy Models (EFUEM) solving everyday problems and ineffective waste management have an impact on life, work, health and overall wellbeing of humans, all beings in the planet and also Earth itself.The investigator trying to identify the best practices of total waste and re use management system on needs/issues of the current practices. Based on assessment and evaluating the process of TWaRUM in Pilot study report, the large scale study will be conducted in Fategarh sahib district, Punjab, India Overall Aims of the study are; Primary Aims; 1. Develop an appropriate system of total waste and re use management focused on reducing waste volumes, re using materials for cost effective beneficial of whole and specific indisposal of reusable wastes products and the byproducts to create value in worth. 2. Implement specific new equipment's for high effective and moderate cost for total waste and re use management for selected villages. Secondary Aims; Based on Pilot study report the best practices and issues will be identified to implement in Larger scale study on Fategarh Sahib District. EFEM will be introduced in larger population such as Cities, Municipalities, and Corporation.

Objectives: I Assessment ***i.*** Assess the existing practices of waste management system in selected villages. ***ii.*** Explore the current reusable energy sources, recycling products and byproducts. ***iii.*** Identify the waste disposal reached points and check the environmental health hazards. ***iv.*** Survey and screen the health hazards illness of people and prepare the report. ***v.*** Provide and refer the health care services based on needs and problems. ***vi.*** Write report regarding the needs and issues in selected villages of Punjab state.

Methods & Materials: Qualitative approach of Observational field notes was used to assess the current practices of villages of Khumna and Khanian. The investigator interviewed Sarpanch (Panchayat President) with translator of Punjabi of each village, with Panchayat President Approval.

Results: The researcher visited the villages and interacted with people and the details is narrated with photographs of Khumna. The village have open drainage system and few places obstructed the drainage, mosquitoes breeding may be for long times happened. People are managing with mosquitoes repellents with cow dung smoke at evening in their house premises to control and prevent health issues. The waste disposable is in road side dumping or the spaces anywhere throwing are the real practices existing; there are no facilities to follow waste management of using different dust bins for disposable and regular collecting waste and in different streets. No sanitary workers and other

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Government schemes of benefits not reached to this village. This village has Primary school and Primary Health Centre for their use. In this village cattle's are living around 300. The cow dung used for manure and dry cow dung named Guhara for fuel use. This village is practicing open drainage system and maintaining somewhat cleanliness. Sanitary worker arranged by their own to disposable of waste in weekly 2 or 3 times. The villagers are paying money for sanitary worker who is residing from the same village.When the observation of waste disposable, the road side dumping is commonly seen and plastics wastes are found everywhere in village. It is affecting the cultivating land, pollution of air and water sources.

Discussion: The investigator observed the village practices of Waste Management with check list of current waste management system and Drainage facility of the 2 villages. There is no appropriate waste and re use management system and open drainage system is existing and road side dumping is regular practice of this two villages. Based on observation a basic equipments of Wet Composter Machines, Plastic Scrab Grinder Machine and Municipality Solid Waste Plant is required for a village to keep clean. For all equipments to keep and function on a unit of minimum 2400 square feet is required for shelter of each village.

Conclusion: Eco friendly models for basic equipment of wet composting, plastic scrap grinder machine, municipality solid waste trommel plant and plan of construction unit to install equipment, manpower requirements and the cost of implementation of each equipment described in brief. If once the unit establishes it may collaborate with available Government existing sanitary workers to continue the unit as permanent salary basis. The use of TWaRUM and EFEM the sanitary workers, families, children they will follow right practice of segregating waste disposable for long time, it will continue throughout their life time. The Government will implement such a system in all the villages, cities in India to maintain good waste management system.

Keywords: (TWaRUM) Total Waste and Re Use Management; (EFEM) Eco Friendly Energy Model; (MSWM) Municipality Solid Waste Management; (WCM) Wet Composter Machine; (PSGM) Plastic Scrapper Grinder Machine; (MSWP) Municipality Solid Waste Plant; (WMU) Waste Management Unit.

Introduction

Amid falling growth rates, global population projected to peak around 10.4 billion in the 2080s.

The global population is reached 8009502082 (Eight Billion Nine Million Five Hundred Two Thousand Eight Two) on 15 November 2022, and India is ranking number 1 country in 2023, according to World Population Prospects 20221. Per day waste of each human very minimum is 1kg approximately it comes around 8 billion and 10 million. If not disposed the second day double the wastes it may around 16 billion and 20 million. Likewise it adds on going unbelievable figure. Solid waste refers to any type of garbage, trash, refuse or discarded material. It can becategorizedaccording to where the waste is generated, for example as municipal solid waste, health carewaste and e-waste. Over 2 billion tons of municipal solid waste is produced annually.[2] 3 About 54 million tons of e-waste, such as TVs, computers and phones, are created annually (2019 data) with an expected increase to 75 million tons by 2030. In 2019 only 17% of e-waste was documented as being properly collected and recycled.[4] Exposure to improperly managed e-waste and its components can cause multiple adverse health and developmental impacts especially in young children.[5]

Poor collection and inadequate transport contribute to the accumulation of solid waste in every corner of Indian cities (Alam et al., 2021; Pervez

Current Practices of Waste Management System

et al., 2022).[6] In most cities and towns in India, approximately 90% of MSW is directly disposed of in an unscientific manner. Unscientific disposal of solid waste is shown to directly affect human health and the environment (Wang and Nie 2001).[7]

Specifically, it creates environmental hazards in terms of health risks from flies and rats, pollution of water bodies through runoff and rainfall, pollution of ground water from leachate, air pollution from burning of wastes, and aesthetics aspects as well (Mazhar et al.,2021).[8] Furthermore, the growing waste is responsible for theincreasing methane (CH4)emissions (44%) (Mohammed et al.,2021).[9] MSWM has become a political, legal, socio-cultural, and environmental challenge that requires economic considerations as wellas resource availability (Alam et al., 2020).[10] Generally, MSW budget is divided into three cost service categories, a) MSW collection, b) disposal, and c) recycling. The total cost of each MSWM alternative is the planning cost, construction cost, and operation and maintenance costs (Idris et al., 2004; Guo et al., 2001).[11], MSWM in India, and especially in urban cities like Delhi, is going through a critical phase where the disposal and treatment services available are fewer than the generated amount of MSW. The study revealed that only about 80% of the garbage generated in Delhi is collected. In terms of treatment and disposal, the MCD (Municipal Corporation of Delhi) has proposed additional facilities such as disposal through sanitary landfills with linings, as well as a system for leachate collection and disposal. Furthermore, construction and demolition waste are used in the construction of various pavement components, such as base coarse, surface coarse, and soon. The total social value added by garbage trade operations in Delhi is expected to be INR 358.7 crores (approximately 46.60 million USD) between 2017 and 2020. Recycling saves the municipal budget about INR 17.6 crores (approximately 2.3 million USD per year).[12]

The Transport Strategy of the Russian Federation up to 2030 suggests implementing a set ofmeasures intended to manufacture vehicles, corresponding to high emission standards, with power units using environmentally friendly fuel. Such vehicles include e-vehicles driven by electric engines powered by batteries. In the late 20th century, development of powerful, high energy capacity batteries defined a new round for expanding e-vehicle production and the market of their consumers. For many decades, e-vehicles were used in factory workshops to reduce gas accumulation. In 130 years after the automobile's invention, a stable ever improving culture of automobilism, reflected in the VDE (Vehicle Driver Environment) system functioning, developed. It should be noted that implementing new technologies within this conservative system, including introduction of environmentally friendly vehicles, is viewed ambiguously by the automobile society. According to various information sources, petrol and diesel vehicles have a negative impact on the environment, cause global warming and lead to exceeding the allowable air pollution levels in megacities. Studies involving assessment of the environmental effect related to introduction of vehicles with electricpower units are already performed in the USA, EU countries (Pistoia, 2010; Bohnes et al., 2017; Han et al., 2017; Gogoi, 2017)[13], and Russia (Azarov and Sajkin, 2013; Gusarov, 2009; Chebotaev et al., 2017).[14] Vehicles currently manufactured in Russia use petrol and diesel fuel which meet at least Euro-5 standard regulating CO, CH, NOx and PM (Particulate Matter) emissions. But in the nearest future, Russian manufacturers will have to implement Euro-6 emission standard already effective in EU countries. This standard establishes the limit of CO_2 emissions from vehicles of 95 g/km. currently, CO_2 emissions from Russian vehicles amount to 170–190 g/km, i.e. this valueshall be reduced twice (Gusarov, 2009).[15] This solution will require radical changes in the design of power units.

A safe management system for solid waste

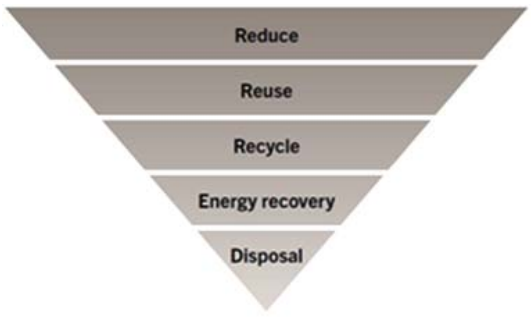
A solid waste management system includes different components: waste generation, collection, transport, treatment and disposal. Regulating and formalizing informal structures play a crucial role in providing safe waste management systems including for hazardous waste.

Reduced waste generation

Reduction of the amount of solid waste generated following the three-tiered

Approach (the 3 R's) to managing solid waste:

1. Reduce
2. Reuse



3. Recycle.

The 3 R's are part of the waste management hierarchy, which ranks waste management options or interventions starting from the most favored (reduce) to the least favored (disposal).[2]

Recycling of Waste (Plastics, paper, glass, metal etc.)

Recyclable materials like paper, cardboards, plastics, polythene bags, pieces of metals and glass are recycled to recover useful resource.

Possible Waste Management Options

At least 50% to 55% of municipal solid waste is also availuable resource which can be recovered profitably using different technologies through following options.

1. Wealth from Waste

The organic fraction of municipal solid waste contains bio-degradable matter ranging from 30% to 55% depending upon the size of the city, income levels of citizens, eating habits of the population and on going economic activity. This organic matter can be profitably converted into useful products like compost (organic manure), methane gas (used for cooking, heating, lighting, production of energy) etc. through the following processes:

(a) Waste to Compost

Composting

Composting is a method of combined disposal of refuse and night soil or sludge. It is a process of nature where by organic matter breaks down under bacterial action resulting in the formation of relatively stable humus like material, called the compost which has considerable manurial value for the soil, The principal by products are carbon dioxide, water and heat. The heat produced during composting, about 60 deg C or higher, over a period of several days, destroys eggs and larvae of flies, weed seeds and pathogenic agents. The end product compost contains few or no disease producing organisms, and is a good soil builder containing small amounts of the major plant nutrients such as nitrates and phosphates.[16]

Types of Composting

(i) Aerobic / Anerobic Composting

Composting is a process of conversion of biodegradable waste into stable mass by aerobic /an erobicde composition producing Carbon dioxide, Nitrogen, Phosphorous, Potassium etc. useful for soil fertility.

(ii) Vermi Composting

Organic waste is stabilized through consumption by earthworms into worm castings which is known as vermi-compost and which is used as organic manure in agriculture.

Waste to Energy

(i) Refuse Derived Fuel (RDF) / Pelletization

Pelletization involves segregation of incoming waste into high and low calorific value materials, Shredding them separately to uniform size, reducing its moisture content, mixing them together and making into pellets/briquettes which are used for producing thermal energy.

(ii) Bio-methanation

Segregated garbage under goes an aerobic digestion producing methane gas and effluent sludge. Bio-gas production ranges from 50 M^3 – 100 M^3 / MT of wastes. The gas is utilized for heating applications /dual fuel engines / steam turbines for generation of power. Sludge after stabilization can be used as soil conditioner.

(iii) Incineration

Process of direct burning of wastes in the presence of excess air at temperature of about 8000C to 8700C, liberating heat energy, inert gases and ash. The process is power intensive and used for bio -medical waste management.

(iv) Pyrolysis / Plasma Gasification

The process of thermal decomposition of organic waste for energy recovery using Plasma Arc torch producing temperatures between 50000C and 140000C for heating of waste and converting into gaseous form. The process is cost-intensive and can be used for hazardous waste / bio-medical waste only.

2. Sanitary Landfilling

Municipal waste contains 40% to 55% of the inert matter depending upon the type of city and ongoing in frastructure development activity. This inert material cannot be converted into any useful product and needs to be managed in the scientific and hygienic manner in order to prevent pollution of under ground water reservoirs or surface sources in the vicinity of the town. Therefore, the residuals/ unutilized/inert from the waste processing facilities like compost / waste to energy plants are put into the scientifically engineered land fills to prevent environmental pollution.

Manure pits

In rural areas in India, there is no system for collection and disposal of refuse. Refuse is thrown

around the houses in discriminately resulting in gross pollution of the soil. The problem of refuse disposal in rural areas can be solved by digging 'manure pits' by the individual house holders. The garbage, cattle dung, straw, and leaves should be dumped into the manure pits and covered with earth after each day's dumping. Two such pits will be needed, when one is closed, the other will be in use. In 5 to 6 months' time, the refuse is converted into manure which can be returned to the field. This method of refuse disposal is effective and relatively simple in rural communities.

Burial

This method is suitable for small camps. A trench 1.5 m wide and 2 m deep is excavated, and at the end of each day the refuse is covered with 20 to 30 cm of earth. When the level in the trench is 40 cm from ground level, the trench is filled with earth and compacted, and a new trench is dug out. The contents may be taken out after 4 to 6 months and used on the fields. If the trench is 1 m in length for every 200 persons, it will be filled in about one week.[17]

3. Recycling of Waste (Plastics, paper, glass, metal etc.)

The municipal solid waste contains 5 to 15% recyclable matter like plastics, glass, paper, metals etc. which can be easily recycled and reused by the community. There cyclables are collected by abides at house hold level and by informal sector from compost plants and dumpyards and sent to recycling industries for conversion into useful products.[18]

Observational visit on villages of Khulna & Kantian Fatehgarh Sahib district, Punjab State field notes report

Village Khulna is a small village located in Aloha Tehsil of Fatehgarh Sahib district, Punjab with total 327 families residing. The village population is 1558 of which 839 are males while 719 are females as per population census 2011. The village population of children with age 0-6 is 165, literacy rate of was 71.79%.

Waste Management System

The village have open drainage system and few places obstructed the drainage, mosquitoes breeding may be for long times happened. People are managing with mosquitoes repellents with cow dung smoke at evening in their house premises to control and prevent health issues. The waste disposable is in road side dumping or the spaces any where throwing are the real practice sexisting; there are no facilities to follow waste management of using different dust bins for disposable and

Waste Management in Village of Punjab Khumna

Open Drainage

regular collecting waste and in different streets. No sanitary workers and other Government benefits not reached to this village. This village has Primary school and Primary Health Centre for their use. In this village cattles are living around 300. The cow dung used for manure and dry cow dung Guhara for fuel use.

Village Khanian is a medium village located in Amloh Tehsil of Fatehgarh Sahib district, Punjab with total 446 families residing. The village population is 2046 of which 1056 are males while 990 are females as per population census 2011. The children with age 0-6 is 215 which makes up 10.51% of total population of village.

Waste Management System

The village is practicing open drainage system and maintaining some what cleanliness. Sanitary worker arranged by their own to disposable of waste in weekly 2 or, 3 times. The villagers are paying money for sanitary worker who is from their same village. When the observation of the road side

Waste Management in Village of Punjab, Khanian, Road Side Dumping

Open Drainage

dumping is commonly seen and plastics found everywhere in village. It is affecting the cultivating land , pollution of air and water.

As per constitution of India and Panchyat Raaj Act, Khumna and Khanian villages are administrated by Sarpanch (head of village) who is elected as representative of village.

Ineffective Waste Management of Health Sector

When the investigator visited the villages of Punjab, almost the residences are neat and streets are some what better in cleanliness and maintenance by each individual family. The surroundings are unhy gienic practices of road side dumping and wherever the free space of land available dumping all type of wastes without guilty conscious. It never be cleaned at any time, the wastes are dumped in same places for years, a small mountains or big hill like figure is the result of wastes accumulation for over a period of years.

Discussion

The observation based report of Khumna and Khanian villages of Waste Management System is very poor and inappropriate.

The investigator is recommending a appropriate equipments and a unit plan is require to implement a right practices in villages of Punjab and it may be applicable to all the villages of India. The investigator is chosen a required basic eco-friendly equipments of Wet Composter Machine Plastic Scrap Grinder Municipality Solid Waste Plant for total wastage system.

A unit is required to set up equipments and function of waste process in all 3 machines installing. Further the investigator designed a unit for each village with 2400 square feet space to divide in installing equipments in provision of spaces and e-vehicle parking with manure pits for wet composting preservation of storage for 10-15 days to get organic manure. Both of the villages they are accepted to provide 10,000 square feet which is their own land to give for this unit.

Recommended Eco-Friendly Energy Models for villages of India.

The selected machineries for each village.

i. Wet composter machine 1 in each village.

ii. Municipality Solid Waste (MSW) Trommel Plant.

It is big in size, more space is required, and wastes will be collected in e-vehicle van in daily basis in single point time.

I. **Wet composter machine: Fully Auto Composting machine** which will be used for all kinds food/wet wastes and also attached with shredder (breaking non vegetarian food bones) in different

capacities according to the population of village.

- Duration of the time; 8-10 hours' work in day. The end product to be stored 10-15 days to take bio culture for manure. Electricity power required through out the process of composting.
- Approximate space required maximum for 9 feet length and 4 feet width in one equipment to fixing.

- Total Working area required each side 5 feet total 20 feet required.
- The lowest rate equipment available in each cost is per 100 kg Rs. 6,18,240. Manure will be ready within 2 weeks to use as fertilizer. Nearest of Machine need space for storing manure for 2 weeks.

II. **Plastic recycling machine / Plastic Scrap Grinder machine: The size available is 24 inches. If the population is small, 12 inch size of equipment will get if ordered.**

- 150-200 kg capacity 1 hour time duration required.
- Length 3 feet and width 2 feet
- Working area required 10x10- 20 feet required.
- Total area required 25 feet
- The lowest cost of this machine in each Rs. 1,18,000.
- Recycling products of plastics possible to create for value of money.

III. **Municipality Solid Waste Plant (MSWP) Trommel Plant machinery**

- The equipment is widely acclaimed for its unique design, which eliminate undue vibration or wobble.
- It is suitable for wet and dry applications.
- Available machine per time 3 tons the cost is Rs. 10,36,000.
- Plantation and working area is required for more space. It is fixed in open space.

IV. **Waste Collecting Equipments**

Dust Bins

- 5 color codes given for 5 category of waste for easy segregation in each house it self. Which is easy to collect the trained staff.
- Outside of house available space is selected

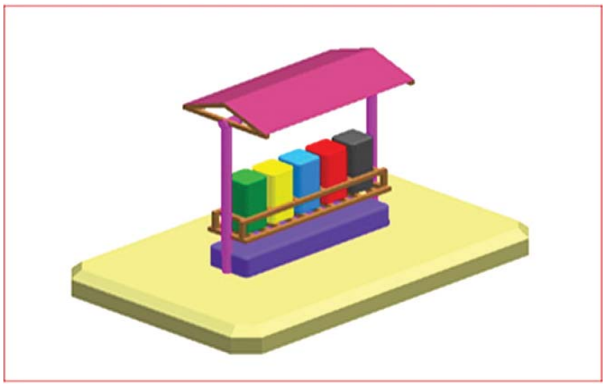
and construction with steel and cement for safe in rain, wind and animals approach.

Color Coding

Blue: Paper and card board (Dry waste). ***Green:*** wet and bioderadable wastes. For eg: kitchen wastes including vegetables and fruits skins. ***Red:*** Plastic bottles, packaging and general household waste that cannot go in the recycling or organics bins. ***Yellow:*** human waste, tissues, organs, or bodily fluids. ***Black:*** Bin is for waste which cannot be recycled.

Fibre Plast Containers FBC (Big size capacity)

- It is required for to keep inside shed to store the recyclable products like metals,



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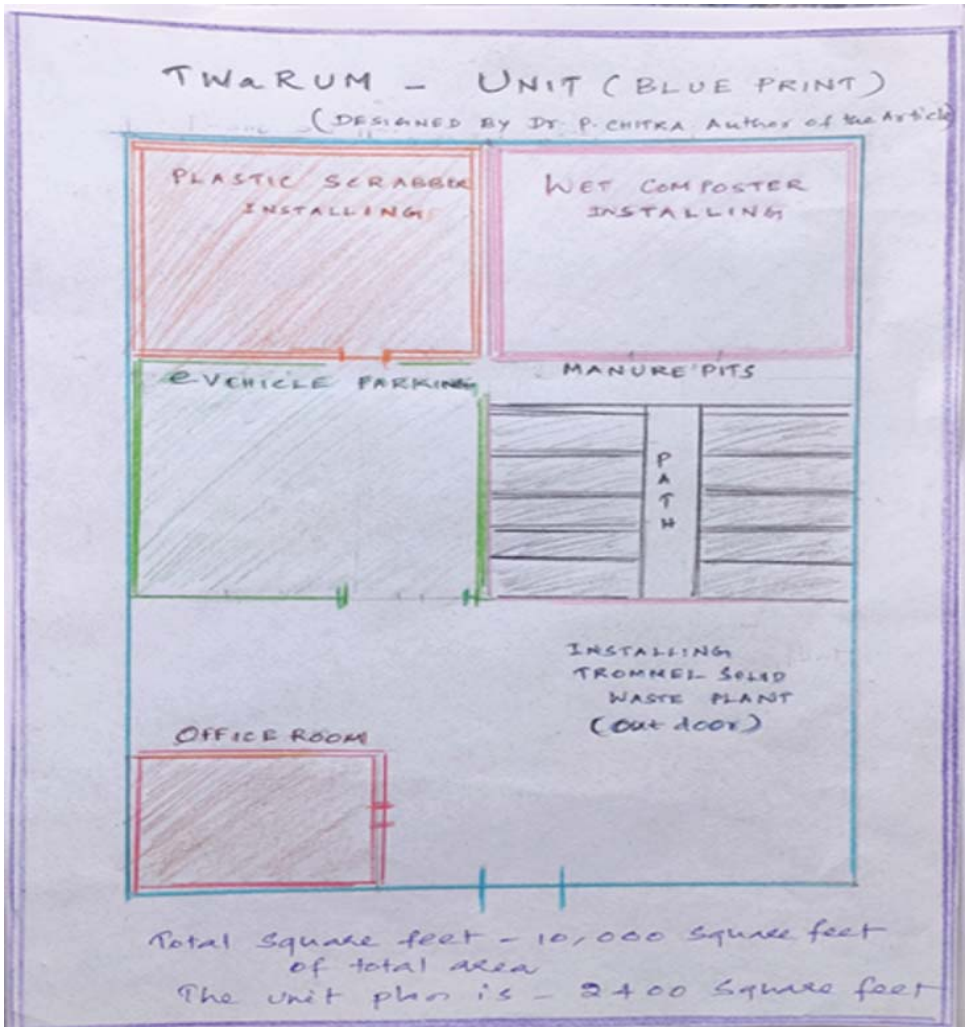
aluminium, glass, copper, iron, e-wastes. After adequate collection of materials send for recycling products. It save fuel, manpower and same time will get good profit of value of money.

e-vehicle

- 6th e-Vehicle van is required for each village waste to collect in different streets, Fixing 5 FPC is designed inside van to directly disposable of waste bins according to the segregation. The sanitary staff can collect the waste from 5 bins and same to be disposed in 5 cabins in van .
- Driving an electric vehicle can help to reduce carbon footprint because there will be zero tailpipe emissions. It can reduce the



environmental impact of charging vehicle further by choosing renewable energy options for home electricity.

a. Waste Management Unit WMU

Constructing a compound wall and shed inside the unit.

Each village approximately 5000 - 10000 square feet is required for EFEM & TWARUM process for one unit. According to the population size the equipment size and numbers may require one or two or capacity of machine may be big size.

- Planfor 10,000 square feet for compound wall with the metal sheet in 6 feet if in less cost metal net with cement stumps can use for compound wall. Adequate space is required for maintain good work space for all types work. Solid waste trammel plant is big in size and installation require more space.
- Inside the compound wall 2,400 square feet shed with metal sheet with cement floor to fix equipment of wet composting, plastic scrapper, e vehicle parking, store room for collecting re usable products, office room.
- Manure processing for 15 days without rain and sunlight inside to keep.
- The discharge of compost wet wastes from machine not possible to use immediately as manure, it takes 2- 3 weeks time to get manure for agriculture use.

V. Man power Requirement for TWaRUM unit

Manager 1, Administration charge 1, Accountant 1, Supervisors 2, Workers 20 and 1 driver, 1 Security.

Conclusion

Each individual we have to create a self-realization of responsibility to throw anything as waste, think twice to before considering as waste. Buying TV, computers, electronics equipment, plastic items to be rationalized by Government to each family. Buying new goods need a policy to implement and the replacement of old goods properly done disposal as part of legal procedure. There is a budget of cleaning alone Delhi Capital the cost estimated 358.7 cores. Likewise the whole India cities, village sif cleaning is unpredictable expense is required and the cost it may be more billions. Already the poor waste management system exists of Municipality solid waste system in towns, cities, municipalities. The sanitary workers collect the refuse in vehicle and dumping some government land for years for most of the places. It accumulate waste mountains no segregation and recycling and reusable done for wastes. Villages practices there are very poor practice existing road side, anywhere dumping around is their practice and there is no sanitary workers and waste management system. Plastics are float and find everywhere in land, open sewages, surface water sources polluting environment. So it is required well planned Waste Management System to improve the present condition.

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