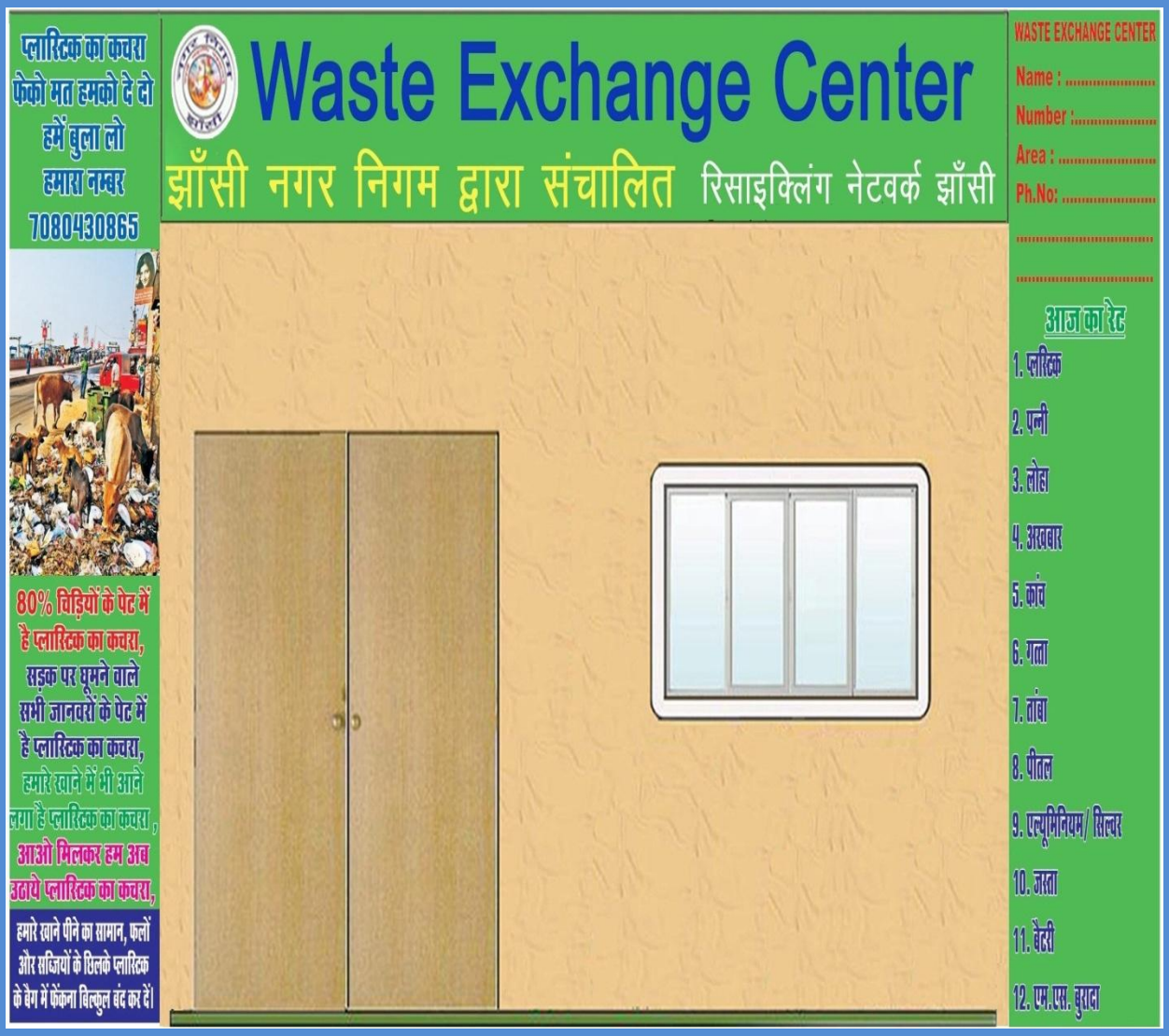
DETAILED PROJECT REPORT
ON
PLASTIC WASTE MANAGEMENT
JHANSI, UTTAR PRADESH



SUBMITTED BY:

R.R. COLLECTIVE - A PROJECT MANAGEMENT AGENCY

FOR

JHANSI NAGAR NIGAM

2015-2016

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EXECUTIVE

SUMMARY

EXECUTIVE SUMMARY

Detailed Project Report on Plastics Waste Management system for Jhansi, Uttar Pradesh.

Regulatory Need: This DPR is based on "Plastics Waste (Management and Handling) Rules 2011, of Ministry of Environment and Forest, Government of India. This innovative and pioneering Plastic Waste Management system takes in to account the extended producer responsibility (EPR) of plastic industry, as well as the responsibility of the urban local bodies (ULB), in organizing Plastics waste collection of littered- left out plastic waste. This is through the recyclable waste collection centers, recycling facility and litter free campaign. It also harnesses most of the informal sector workers in a formal set up, as is mandated in various regulatory guidelines.

Socio-Environmental Responsibility: Plastics are good, Plastics litter is the problem. It is not commercially viable for the waste pickers. Litter picking needs a separate viability gap funding, and so is its recycling, which is not so profitable either. Though most of the waste management laws are plastic centric, this small pieces of metalized plastics and carry bags are the main contentious issue in most of the other waste streams, and more so in MSW. A solution is developed here by harnessing, informal sector, recycling network in a workable formal setup. This can also meet the partial cost of litter management. ULBs give space as in the law, waste traders gets an identity, and the faceless waste pickers gets extra income with a little extra responsibility of litter free area management. The system has been test marketed and experimented. To innumerate:

1. The Rag Pickers / Scavengers, which are presently highly unorganized, need to be converted into an organized self –sustainable work force.
2. With proper system development Rag Pickers / Scavengers will get the right price for their work/effort.
3. With collection centers this work force can get better price for their work/effort and with better remunerations/income. Their social acceptability will also increase.
4. Presently Rag pickers/ Scavengers sort the plastic form dump heaps and foul smelling places. To work in these highly inhospitable environments, they tend to become drug addicts/alcoholics.

Figure 1 depicts the rapid growth of Municipal Solid Waste from 1990 to 2010 in India. The graph shows that the projected solid waste collection rising up to 235 Million ton/year in financial year 2041, which is shown in figure no. 1. These rising line also shows that, how the Indian cities are being engulfed into waste dump sites all around them. With a local baseline study in camera, the plastics waste left out at dumpsites is found to be 11%, which corroborates with a few national studies, could be a clean raw material for the recycling plant if collected from homes and is as envisaged in this report.

(Referenced from Chapter 1 of this document).

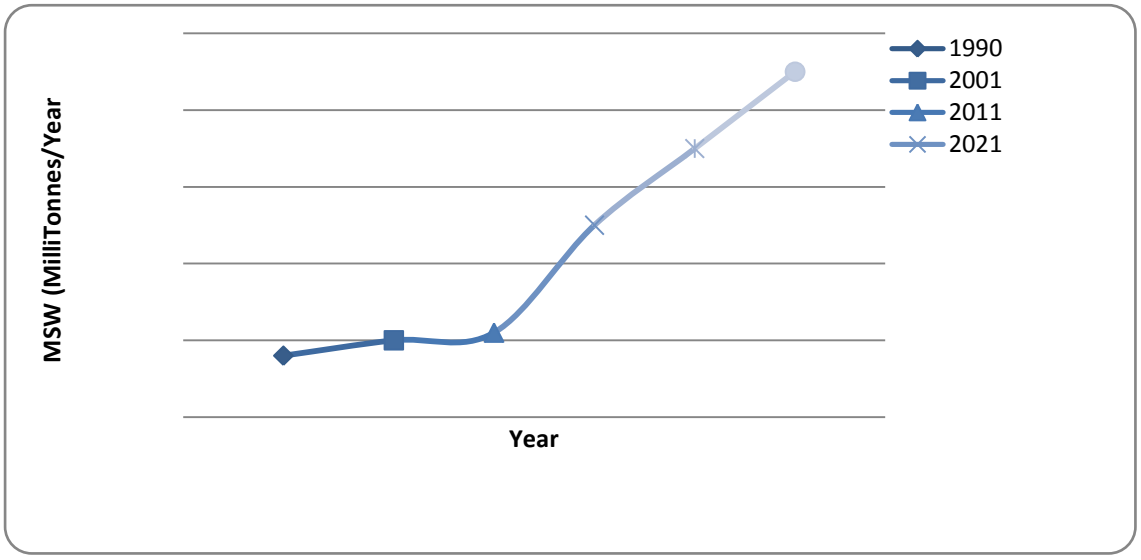

Figure no. 1: The projected solid waste collection rising up to 235 Million ton/year in financial year 2041

This project has TWO Major Components:

1. **Collection and Transportation (C&T)**

Plastics are 100% recyclable, even at the end of its useful lifecycle. In absence of bins, awareness and lack of sense of our environmental responsibility, the throw away habits of our citizens, gives this littered plastics everywhere, creating problems to our earth systems and waste water drains. To meet this challenge of making Jhansi, litter free this project is developed with right commitment, compassion, entrepreneurship and innovation.

Waste Exchange Centers (WEC) will be opened in approximately every 5 to 10 sq. kms. area within Jhansi municipal limits. These waste Exchange centers (WECs) will work as a nodal point for collection of recyclable waste in their respective area. These Waste Exchange Centers (WECs) will be housed in a Portacabin and there will be Standard Operating Protocols (SOPs) for the Waste Exchange Center Operators (WECOPs), their house to house waste purchasers (WECGUIDEs), and waste pickers (WECANGELs). These persons will be locally placed informal sector workers and will work under a profit sharing mechanisms serving a definite population and earmarked area.

WECs will arrange to distribute free bags for plastics waste collection to every household, which are provided by the Nagar Nigam, collect it periodically and purchase recyclable waste. Waste collected at various WEC's will be sold to authorized recycling industry with well supervised and synchronized modalities and the remnant plastic waste having negligible or no commercial value, will be sent to the recycling plant. This recycling facility will make fuel oil and/or lumber of left over plastics waste, after segregation and sale of other recyclables.

Waste Exchange Centers (WEC):

Waste Exchange centers (WECs) in uniform design Portacabins, of approximately 5x5x5 meters sizes. They will be

- ***Well ventilated, segregated waste collection in hanging bags, and racks***
- ***With Security arrangement, Biometric identification and attendance system***
- ***Used only for waste collection and storage purpose (not for residence)***
- ***With Weighing scale, and small bailer, shredder , packers at a few places***
- ***Display for rate for recyclables, Place for advertisement,***
- ***Distribute free bags for Plastics waste collection.***
- ***Fire Extinguisher, Table-1 & chairs- 2, With a calculator, registers etc***
- ***Bill machine for collection with mobile data transmission***

2. Recycling Facility -Processing and Disposal (P&D)

Jhansi Nagar Nigam has earmarked a land for the recycling plant having area of approximately 5 acre. This facility will segregate, make fuel oil, lumber and sell it along with other recyclables with a support mechanism.

The Municipal solid waste generated in Jhansi has approximately 11% plastic waste as per the study conducted by the R.R. Collective in 2015. This means that approximately 300 tons of municipal waste will have approximately 33 tons of waste containing various kinds of plastics and recyclables. We will be able to harness approximately half of this waste in our system and after segregation and sales, process the non-recyclable plastic waste into fuel oil and lumber. This should be for ten to fifteen tons per day. We have other options of giving the processed waste/shredded waste to cement and power plants in Jhansi, or use in road constructions along with other recycling options.

This model has been worked out in a way that under the supervision of the Project Management Agency, the recycling plant will become self-sustainable within three (3) years of its commencement including add-ons. The plant will be monitored and supervised by the PMA - by a manager under the employment of PMA, while the rest of the manpower will be employed by JNN. The estimated investment for the setup of complete plant and machinery (barring the civil work required) is Rs. 15 Cr. The Jhansi Nagar Nigam will be investing 20% of the total amount in the project (Rs. 3 Crore), and the remaining approximately 3 crores are planned to be sought under VGF, EPR and CSR.

Once the basic demonstration model of waste collection is in place, the informal sector is brought under the operational umbrella of this system, and primary sorting system is installed, the DPR will be given a final shape to approach other agencies. It will be more convincing then and more realistic.

The PMA will work for JNN to receive grants, subsidies and other support from government, industries and international agencies under the provision of CSR (Corporate Social

Responsibility), EPR (Extended Producer's Responsibility) and VGF (Viability Gap Funding) – which will be accomplished within 2 years of establishment of the plant.

Whole of this project does not have any profit motive, but is an essential part of municipal service. The sole objective of collecting littered plastics-waste along with all the non commercial plastics waste from households through rag pickers, serves two purposes - rag pickers rehabilitation and segregated waste collection, most cost effectively. And that's why the project will always call for capital funding from outside and meet the operations cost - working capital from ULBs funds after setting up a demonstrable model and capabilities.

The complete business model for the Project is provided under Chapter 9 of Volume 1 of this DPR.

(This is systems innovation based on a proposed National Recycling Program, and meets the norms of upcoming waste management laws.)

This draft of the project report was submitted to Regional Center for Urban and Environmental Studies (RCUES) Lucknow for vetting. The communication summary with the RCUES has also been attached herewith to be part of this executive summary. Apart from the narration and explanations regarding the suggestions by R.C.U.E.S mentioned in the summary, all other changes have been made in the document in the related chapters, the details of which are mentioned in the narration.

NARRATION 1

During the discussion with R.C.U.E.S., some issues came up, which are important to understand the concept behind this DPR and they form the part of Executive Summary.

They are questions of relationships and flow of the data in the DPR in following way:

Factors for relevancy and relationships:

1. Population and population projections,

2. Plastics waste and plastics waste projections with respect to population.

3. Processing plant and its capacities, based on waste quantities

4. Investment and returns based on plant and its capacity utilization.

Relationships foundations:

1. Unlike in solid waste management, plastics waste has a distinctive and very well established supply chain network and very well established recycling industry. Therefore while all the municipal solid waste needs to be collected and treated, here getting all the littered plastics collected is the primary objective. Plastics is 100 % recyclable, if not mixed with the solid waste, and it gets recycled

2. Therefore relevance and relationship of the above data in isolation of understanding this supply chain network will not meet the objectives of plastics waste management.

3. That's why there has been a need of making separate rules of plastics waste management in spite of the all the other waste management rules being plastics centrist, which are established, practiced and experimented (BMW, MSW, & WEEE).

4. We are dealing with plastics waste, left out littered and at landfill, after all the collection and consumption of this plastics waste in its supply chain network and the recycling industry.

5. Population increase or decrease alone cannot be considered a determining factor as much as the matrix of this supply chain network and its relationship or reasons for the left out plastics waste.

6. Influencing and integrating this supply chain net work will influence the quantum of plastics waste recovery by us more than the population variations.

7. The consumption and throw away waste in plastics bags and multilayer plastics used in food packaging is primary plastics waste not going to recycling network exactly for which the rules are laid down.

8. Addressing this by collecting it from door step by the same recycling network will determine reduction in landfill waste and increase the quantity and quality of the plastics waste to the re recycling industry first and to our recycling plant at the end.

9. This has to be a little modified but highly advantageous municipal service, and if control by ULB will give a better relationship of ULB and citizens, by increased interaction. Estimated municipal sanitary service cost reductions may be to the tune of 30% or more, if implemented correctly.

10. There are avenues available for funding of this modified methodology, which also have to be explored, tested and **brought in the system**, like EPR as in PWM rules, VGF as in MSW rules and CSR for poverty alleviation and skill development program.

11. And the other most crucial factor being that, though the ultimate objective of the waste management is **recycling** in a way, that it is no more harmful to the nature, the rules for different waste streams make it get lost midway. A NATIONAL RECYCLING PROGRAM CAN ADDRESS IT.

Relationships facts:

1. 5 tons per day plant is planned, established by Nagar Nigam for approximately 30 tons per day plastics waste going to land fill every day. (as the waste collection quantum increases, and if the VGF, EPR, and CSR funds are available will be grown to be 15TPD)

Population of Jhansi in 2011=	556107 (SWM DPR R.C.U.E.S report)
Population of Jhansi in 2021 =	657091
Total population increase in 10 years=	100962
Population increase per year =	10096.2
Population increased in 4 years =	40385
Population of Jhansi in 2015 =	556107+40385 = 596492 ≈ 6 lacs

MSW in Jhansi @ .45 kg per capita per day (As per CSP for Jhansi, 2012)

= (600000x0.45) = 270000 kg = 270 tons per day

Total plastics waste in Jhansi = 27000x 11/100 (11% plastics left in land fill)

= 29700 kg per day or say 30 tons per day.

Against which the plant capacity is **only 5 tons per day to begin with**. To grow with better capacity utilization, we will operate in 2 shifts or in three shifts. And with 80% plant efficiency in two shifts and with 100% installed capacity, we only get approximately 100 % (30tpd)) waste treatment capacities. These figures will become more realistic once we start, with no risk at all and advantages, a great many.

2. With the collection mechanism initiated for door to door non commercial recyclable waste collection, assuming all the 30 tons per day plastics waste is collected, its recyclability, marketability will also increase multi fold and out of 11% going to land fill only a miniscule of 1 or 2 percent will go to land fill.

3. But out of 30 tons collected only about half will remain left out not to be used by this recycling plant. That is approximately 15 tons. (The decentralized composting will then reduce the land filling and transportation cost.) (NO studies possible unless operational. Initial response is great.)

4. Two important factors are: plastics waste with other dry recyclable waste collection from home periodically will give waste without moisture content and its market value will increase for it being clean and not mixed with wet organic biodegradable waste. This will greatly reduce quantum of waste at our plant, but it will eliminate plastics waste going to landfills. (Cost of segregating this MSW, has been horrific, resulting in failure of all the plants and DPRs.)

(We will promote decentralized composting and source segregation as in old laws and more so now in Swachch Bharat and new laws.)

5. A plant is necessary for non commercial recyclable waste, taking a cue from Plastics waste rules. Even if plastics waste of no commercial value dose not reach the plant to meet its capacities: it will be operated to process the recyclable waste of all the waste traders, who are unable to do proper sorting, and do not do any bailing, and leave the rest in our drains and land. We have envisaged even this service to be Rs. 5 a Kg to meet the plant operations cost and a little profits.(segregation at kabadi wala's godown, is under hellish conditions for rag pickers, children are most exploited, their skill will be of good use and education is our responsibility)

6. If we don't buy the raw material and do not sell the finished products, the plant is still serving the municipal need. It is a necessary investment to channelize non commercial recyclable waste and energize source segregation by increasing the value of plastics waste direct from home.

7. Once this system is operational- source collection of non commercial recyclable waste and processing - relevance of population projections, or waste projections linked to SWM projects loses its significance. The data which will emerge will be- per capita consumption and collection of recyclable waste, and life styles of the populace. It becomes a separate stream of waste away from SWM.

8. Plastics waste not mixed with organics waste has great recyclable value and organic waste without plastics and house hold hazardous waste has great value for us and the nature. That is why we have asked three-fold segregation process – at house hold level- house hold hazardous waste, dry recyclable waste and organic biodegradable waste in the new rules coming this week.

9. **We have talked about EPR in PWM rules.** We have not one project, where we have really taken any EPR benefits. Plastics industry is willing to give,(they are supporting us), but to the right people and for right work. To use this benefit, we can use not much profitable technologies like making fuel and lumber- they are or may be not much profitable but are self sustainable, if we have capex support . so the Lumber making and fuel making technologies are included in the projects partially from the EPR fund. This will set trend and a system for correct availability and utilization of EPR funds.

10. **We have talked about viability gap funding in all our SWM projects**, (Once all of them failed) in REPORT OF TASK FORCE ON WASTE TO ENERGY Released by planning commission on may 14, 2014. (We are talking to Dr. Indrani chandrasekharan, principal coordinator , regularly and keep her apprised of the project) . But we have not been able to release much of this VGF to any of the failed plants, for the questionable reasons. We wish to apply under this VGF availability to set trends to fund ULBs directly and not PPP partners under the prescribed norms of the central /state support. This will/ can fund our recycling plant to do more by having two more sorting systems at same land or different lands. Justifications will depend on successful operations and more waste availability.

11. **We have talked about inclusivity in UN charter, rag picker rehabilitation, and poverty alleviations**. Our rag-pickers, when empowered with ULB support, ask as a matter of right for non commercial recyclable waste from houses in their entrusted area, it's a win –win. People don't litter and have found an out let for non commercial recyclable waste. Rag pickers become empowered recyclable waste collector as a primary member of the recyclable waste – supply chain network. So – both littering and rag picking – become an endangered species on the way of extinction. Still we need to these drivers of change to give a push—so we need VGF- for picking up the litter, handling non commercial hazardous and plastics waste from households, their education and skill development, UNDER CSR. On availability, we should have right place to use it.

That's why for putting up a system in place for EPR, VGF, and CSR, we have made this project of 15 CR. Investment, and if we get capex support, opex support will happily be coming from the ULB and could be self sustaining.

In view of the above narratives, we wish to say:

1. There is no most important relationship between **plastics waste and municipal solid waste.** They become separate waste streams- like electronics waste, or biomedical waste, once collected separately. And they are two separate rules even in the rules to be released next week. And no relationship in population projections- this is only baseline, for which we have used this data.

2. **Plastics waste and plastics waste projections** WILL EMERGE after the practice is started and tabulated, of house hold recyclable waste collection and the whole supply chain network system is under a formal setup. As of now if can stop littering, harness the waste at sources, induce source segregation, include rag pickers to do this service to make a respectable living, and little more money, enter into supply chain network of recyclables, develop recycling trend in ULBS- our immediate task is over.

3. **Processing plant and its capacities**—to start and put up a plastics waste recycling plant as prescribed in the rules and take majority participation from EPR of plastics Industry and recycling network. Not one is available till date in the country. And unless we show demonstration capabilities, no one will come forward, no justifiable use can be made, and no system will emerge. So the VGF and EPR will remain in books and CSR will go to corporate. The cause of inclusivity, polluter pay principal, and viability issues will never be tested on ground.

4. **Investment and returns based on plant and its capacity utilization:** The investment is necessary part of service like buying waste transport vehicles sweeping tools etc. or managing the landfills. In fact transportation network for recyclable waste is self sustaining and gets us more valuable waste. Partial investment in collection facilities is again self sustaining from day one if managed well. 20% Capex investment is necessary to show demonstration capabilities, which are of no risk at all, but empower the ULB for VGF, EPR and CSR. Our opex are designed and could be regulated by holding the creditors (15 days), recovery from debtors (7 days--- in fact it will be advances for the processed waste quantum from factories, as is the practice). The cost of processing –or operations being equal to value additions in the product (here @ Rs. 5 average.) this for the reasons of the nature of the project and service necessities.

To conclude;

This is first DPR of its kind, its **different from SWM**, because it has different waste streams right after source segregation, up to final disposal, in complete partnership of recyclable waste supply chain network, governed by a different law- PWM rules and based on different base parameters. This DPR is prepared with continuous on ground experiments.

The advantages are far more than SWM management with plastics wastes (RDF separation technology costs, court cases for emission and environmental hazards.), of clean organic –biodegradable waste, which simply needs composting – decentralized is best, and is as proposed.

The advantages for Electronics waste – this encroachment in recyclable waste supply chain network will ensure and give a platform to households to dispose WEEE, if not for a price, but at least for a good cause. This will be called crowd funding when we go on line.

The advantages for Bio-medical waste are great, that even after 18 years of the BMW rule existing and practiced. The law says –don't burn the infectious plastics waste, sterilize it and give to **controlled recycling.** We have 200 + BMW plants **and how many controlled recycling plants are there for plastics waste????**

P.S. We hope that this narration is good for conceptual clarity. It is included in different chapters of the DPR. We are different from SWM and setting up a system for PWM.

We may still be wrong in an odd parameter of DPR valuation, but on ground, we have done great, system is functioning, and functioning well – rag-pickers are vibrant, and so are the households supporting them. They have found a place to dispose of their tooth brush and razor. They don't keep fruit and vegetable peelings in a bag and throw in municipal bin - and see a cow or a crow fiddling with it, and eating it.

OBSERVATIONS IN DPR ON PLASTICS WASTE MANAGEMENT PLANT, JHANSI- MEETING 1.

1. **Under (6G) of the ACT, There is need to formulate the bylaws under 6(G) of the ACT.**

The subject matter is in process. It has approval of the municipal council and District magistrate and divisional commissioner, as various discussions have been held, contributions received and presentations made to whole of Jhansi mandal. The draft document is submitted with examples and references.

Added in the document in Chapter 5.

2. **Population projection has to be done considering base year 2011 as per census population of Jhansi (population projection CDP Jhansi, solid waste management report, DPR etc)**

The Detailed Project Report for Solid Waste Management for the city of Jhansi, made by R.C.U.E.S, Lucknow has been referred for population projections.

Added in the document in Chapter 2.

3. **Proper survey to conduct at initial level to determine per house waste generation and Quantum of plastic waste**.

The surveys countrywide in DPR's, CPCB documents, Planning Commission documents, and documents of the Urban development ministry mentions the quantum of the plastics and recyclable waste in municipal solid waste streams. But no survey mentions the actual plastics waste (as defined in the rules- multilayer and thin film) reaches to a land fill.

In Jhansi this Plastics waste is the raw material to feed the recycling plant and all strategies for its collection are based on its safe and clean collection from every house hold.

The actual study was done on camera and shared with numerous networks in the country. It has been tabulated here for all the verifications after the incorporations of the suggestions.

Based on the population projections, the estimates for the waste generation too has been calculated and projected in this document.

Added in the document in Chapter 8.

4. **The framework of this plastic waste management to be worked in a stepped procedural manner, which is**

a) **Initial survey b)quantity of plastic waste generated – method of collection, segregation and transportation c) area covered and no of centers d) Transportation of waste to site network work force involved e) Efficiency of plant / per day waste recycling quantity f)**

processing and cost recovery mechanism g) model of operation under PPP mode (B.O.T, B.O.OT)

The system is a systems innovation and it also meets the norms of most of the plastics waste centric waste laws and other regulatory norms. The issue is addressed in details in chapter 5.

Mentioned & Added in the document in Chapter 5.

For reference, we wish to add the ministers' recent comments- :

(Revised rules on waste management by July 15: Environment Minister Prakash Javadekar)

PTI *May 1, 2015, 02.09PM IST*

NEW DELHI: The government will come out with revised rules on waste management by July 15, Environment Minister Prakash Javadekar today said.
The minister also recognized rag pickers' contribution in managing waste on the Labor day.

The reason behind the revised rules is to make waste management more effective and scientific to change the face of the country in the next three-four years and thereby achieve Swachch Bharat (Clean India), he said.

The revised rules pitch for segregation of waste at the source. Though it is an "ambitious" target, but "much difficult to achieve", he added.

"The draft rules on waste management have been prepared. After seeking public comments, the revised rules will be notified by July 15," Javadekar told PTI on the sidelines of a stakeholders' consultation meeting on the draft Waste Management Rules 2015 organized by industry body CII.

The rules on waste management are being revised as the norms (on solid waste, e-waste, biomedical waste and plastic waste) have not been changed for last many years, he said, adding that rules are being changed taking public views.

"For years, these rules were not revised. We are revising with public consultation. With new technologies, we will make waste management more effective to change the face of the country within five years. That's how we will achieve Swachh Bharat," the Minister said.

Emphasizing the importance of segregation of waste, he said that only 15 per cent of the waste gets separated as organic and inorganic waste like in Mumbai at present.

Much of the domestic waste either gets into water or remains on earth in the form of a landfill dump on the outskirts of a city, he said.

"It is an uphill task to achieve 100 per cent segregation in the next 3-4 years. But we can, we will do it," he said, adding that there is a need to create awareness on this issue.

Waste management should be incorporated as part of a school curriculum as it is easy to teach children during their growing age as compared to elders, he said and added that he would speak to the HRD Minister in this regard.

Applauding the contribution of rag pickers in managing solid waste, the Minister said: "On Labor day*, I recognize rag pickers contribution. They have done wonderful service to the country for years together.*
"In an environment when there is no scientific management of waste, they toiled their labour and they lead what we should have done much earlier," he added.)

5. **Proper calculation required for overall plastic waste and investment required in procurement to assure cost recovery.**

The average procurement cost estimated for noncommercial recyclable plastic waste to reach at our recycling plant is Rs. 5 a Kg. And after sorting and processing, we expect that it will sell at an average of Rs. 10. The processing cost is also calculated to be almost same value. After all other costs put together and micro calculations, the operations cost will be neutralized at 35% of capacity utilizations. (This is as shown in the business model-Break Even Point (BEP) as 35%)

As explained, the project is not for profit making and is part of municipal service. The profit from litter, even if collected from households cannot be expected, and if any will go to meet the cost of the waste pickers service. We are happy, that a little support from the ULB, the waste pickers are mobilized for this collection, and any incentive offered by households, should go to them.

The concept of cost recovery has connotation of profit in it and the countrywide experiences of profit oriented models of solid waste management have miserably failed.

The cost of managing municipal waste mixed with plastics waste is horrific—

While getting it picked from house hold is negligible. Rag pickers – becomes noncommercial recyclable waste collector, and littering is discouraged—move on the way of extinction.

The estimation of Plastic Waste generation as per the projected population has been calculated and added in the DPR.

Added in the document in Chapter 9 - Narration & in Easy-to-read Financial Aspects (Annexure A)

6. **Estimation and costing of civil works should be done in detailed manner, which has to specify specification of materials, units, quantity, and cost per unit to total cost. Rates should be worked out by referring prevailing schedule of rates by CPWD of works.**

In the project costs, the civil work is considered to be provided by the Nagar Nigam. This includes office, servant quarters, routine industrial sheds and platforms etc, under their normal civil work development activity. Only the cost of foundation of the machines is considered in the project costs, and that is defined and included in the cost of machines.

Added in the document in Chapter 6.

7. IRR mentioned is not feasible in terms of achieving invested cost in plant.

As mentioned earlier and explained, the total estimated plan outlay is of Rs. 15 Cr. The promoter fund is 20%, i.e. Rs. 3 Cr. Rest is planned to be funded by EPR, VGF and CSR. This is as per the theme and guidelines given in the report of task force on waste to energy of planning commission, released on May 14, 2014.

This is a necessary municipal service related to waste management and cleaning.

It is a service model to meet the service level bench mark of the ULB. There will not a recovery of the invested cost of the plant except meeting the Invested cost of the plant.

Cost benefit in terms of collected mixed MSW and handling verses collecting segregated plastics waste with other recyclable waste is huge and very apparent. But since it needs an approach, where there is plenty of hard work in system establishment than direct indirect monitory benefits, it is neglected and not taken up.

Explained in the document in Narration 1.

8. Should work out financial viability of this plant / project in terms of payback period, cost benefit analysis, ignored cost done by MOUD.

As mentioned in the financial feasibility report the breakeven point is approximately 35% of plant capacity.

This financial feasibility study was than studied by Shri Santosh Verma, of RCUES finance adviser and the CA, Shri Prem Prakash Agrawal, who helped develop the financials of this project and reached a synergy in understanding and formats.

Again the history of DPR's of waste to wealth and a DPR of essential innovative service level benchmark achievement have to have different approach, than financial viability. If the system is financial viable, than any promoter would have jumped in and we had no plastics litter in this country.

Cumulative benefits in terms of environmental management of the city are very clear.

Explained in the document in Narration 1.

SUGGESTIVE MODIFICATIONS AND CHANGES MENTIONED IN DETAILED PROJECT REPORT FOR PLASTIC WASTE RECYCLING PLANT AT JHANSI – MEETING 2.

(1) Shredder work on 40% efficiency at one plant (5 Tones)
3 units to 1 Unit of shredder recommended
1.5 – 98 Lakhs = Air separator
Waste segregate Plants – No of Plant wt Clear

(2) Waste Segregate Plant after discussion 3 waste segregate Plant of each 5 tone X 3(1.5 Cr.)

Shredder work on 40% efficiency at one plant and additional segregation Plant

A. In Phase- 1 of the operation it is expected that in 3 months, 5 Tons of total waste will start coming from Collection Centers out of which we expect nearly 50% to go for shredding.

B. Along with this around 1 Ton waste from Packaging Units (Sticker Plastics) will also start coming in. As this plastic waste has cannot be monetized it will be directly fed into the shredder.

C. Once the Collection Centers starts operating smoothly we will encourage operators to pick waste cloths. These are also major eye sores and after plastic another miscreant in sewage and drainage blockage.

We expect to run the shredder at 100% capacity in 3 months time in Phase –I and we anticipate that we may need additional shredder if the waste collection increases besides targeted 5 Tons at one site.

If the waste at one particular site increases beyond 5 Tons/ day then the output of the operation can be increased by increasing manpower and increasing No of side conveyors to 5 Nos from 3 Nos. This will increasing the sorting capacity and the plant can work on 120-125% capacity.

(3) No Specifications units with regard to vibrator & feed conveyor.

- **Vibrator**
- **Feed conveyer belt**

The Feed conveyor specifications are on Page 65 of DPR.

Vibrator is primarily a vibrating screen with spun mesh of size 2.5mm and with the vibration the loose dust in the plastic waste is separated. This improves the quality of the shredded waste and the plastic which will be going for recycling.

The technical details of the vibrator is

1. Down Inclination
2. Mesh size 2.5mm
3. Size of mesh 1500mm x 2500mm
4. Power- 2 HP
5. Handling capacity – 5-6 Tons/Hr

Added in the document in Chapter 6.

(4) In the DPR only (Pie) chart of Composition of waste is provided but there is no detail with regard to

- **Sample Size**
- **How the Sample of waste is collected. Composition of waste in terms of weight is not provided in DPR.**

(5) It is because all the technical specification and financial viability of Project completely depends upon the composition of waste generated. If the survey went wrong then all the proposal & feasibility of project will be effected.

True, but our surveys are correct, rational, and meet the common sense. There is 7 to 11 % plastics waste is left out in landfills, equals to approximately 33 tons per day, and harnessing one – sixth of this waste will make our plant running at 100% capacity as far as the promoters fund is concerned, (5TPD). Treatment plan or the rest of plastics waste or half of total the plastics waste will need project support from other sources. Only the working capital requirement will be met from the municipal funds at every stage.

The nationwide surveys mentioning recyclable waste content to be 15 to 25% in MSW. And the systems for segregation and processing including all waste to energy plants needs almost 40 to 60% of recyclable waste content. They are finding it difficult to survive, while this innovative system serves the cause in best way possible.

Estimated waste generation as per population projections have been calculated and added in this document.

Added in the document in Chapter 8 (Narration) & in Chapter 9 (Annexure A).

(6) While working out the financial viability of the report they have mentioned that quantum of recyclable plastic waste will be 4500 tonnes / @10,000 Rs / Tonnes, But There is no justification that plants will produce above mentioned quantity.

It is plastics waste processing capacity taken as 15 tons per day for 300 working days.

i.e. 15 X 300 = **4500.**

The processing cost, which is almost equal to the value addition in the average marketable plastics waste is taken again @ Rs. 5 per KG. . Our purchase price of raw material is also Rs 5 a Kg and after processing, we get cost of the finished product to be Rs. 10.

As well as the recovery after sales and other expenses is also @ Rs. 10 a KG. which is equal to Rs.10000 per ton.

Rs. 10 per kg is equal to Rs. 10000/- per ton.

Explained in the document in Narration 1.

(7) In addition to this it is also mentioned that plant will also produce

- **48000 Lit/MLD**
- **600 Tonnes Lumber Plant generating**

With regards to above products these is no technical specification that how much and what type of plastic will produce diesel and lumber.

SDP type of Plastic

- **High density Plastic**
- **LDP – Low Density Plastic**

FUEL: These projects will be developed with help of approved manufacturers promoted by the governments and supported agencies and the actual costing will come from them. The NEERI is promoting it and the plant at Motibaug in Delhi is considered pilot project.

For making fuel from plastic, the type of plastic being converted to fuel is important. If pure hydrocarbons are burned, such as polyethylene (PE) and polypropylene (PP), it will produce a fuel that burns fairly clean. But burn PVC, and large amounts of chlorine will corrode the reactor and pollute the environment. HDPE (jugs) and LDPE (bags and films) are basically polyethylene hence usable as fuel as well, just slightly more polluting as a thicker heavier fuel is created.

HDPE can also be processed, but additional equipment and processes needs to be established.

LUMBER MAKING:

This is made by a plastic waste recycling equipment manufacturer – Dolplast in Ahmadabad, and aggressively promoted by Plast-India Foundation. However the manufacturer does not want to reveal the processing technology and will work under a non discloser agreement, probably under an EPR fund.

Lumber making from Plastics waste can be done on nearly all family of plastics. With PVC it is preferred to granulate and then mix with wood chips/wood straw etc to make boards. Heating PVC beyond a particular temperature chlorine gas is generated which is very unhealthy.

8) With regard to project sharing through Porta cabins how this income will come to Nagar Nigam.

In the DPR Cost of the optional equipment has to been provided but while in the income side in DPR income from Diesel and lumber has been added.

- **Bio-clave**

- **Five shedder**
- **Palletizing line**
- **Lumber machine**
- **Fuel oil machine (Making)**

The Portable Cabin deposits will be taken from the operator, whom so ever is finalized by JNN. The same has been mentioned in Chapter 9 of the DPR. The letting out of shops and Nagar Nigam properties is a regular activity of the Nagar Nigam and comes under assets management and estates. The issues relating to circle rate etc. apply. Only its operating protocols need to be defined.

1. Besides these deposits the target of the Plastic Waste Management system is
    a. To make the designated area around a particular Portable Cabin, litter free. The cost of the same has to be borne directly/indirectly by the Waste Pickers and the Operator of the Portable Cabin
    b. It will be the duty of the Portable Cabin operators to ensure that the litter free Jhansi is ensured.
    c. If the above target is achieved the indirect saving of the JNN will be too high/ difficult to be assessed monetarily.
2. The plastics waste, which has monetary value and easily saleable will be taken and processed by the operator and the balance will be taken by JNN and sent to the processing plant without any cost. Only the transportation cost may be borne by JNN.
3. JNN will be paying for the plastic waste, which will be gathered by giving license/ rights to Rag Pickers in the wards, where there is no Door to Door Collection Agency. Some ground work has already been initiated in Jhansi in this regard, which is self sustaining.

It is again stressed that JNN primary target is to make

A. Jhansi a litter free city
B. Have very Low/ Nil choking of drainage/sewage and reduce the cost spent on cleaning etc.
C. To Avoid/Reduce flooding during rains
D. Have a clean, healthy Jhansi

the revenue generation proposed is an additional benefit to sustain the project efficiently and effectively.

The cost of the Optional Equipment has been calculated and taken into account Chapter 9 of the DPR.

Added in the document in Chapter 9.

9) In the DPR while calculating the revenue from the plant (only). Only plant will function in single shift.

If plant can run round the clock 24*7 then there is no need for provision of (3) waste segregation machines. So cost of plant can be reduced by provision of single unit of plant only.

- **Working capital requirement**

1st Yr 2nd Yr 3rd Yr 4th Yr 5th Yr 6th Yr 7th Yr

100% 110% 120% 130% - constant ----------

1. The facility design has been conceived in a way that all the plastic waste carrying vehicles directly dump the waste on to the hoppers of the equipment and there is no plastic littering in the facility.
2. We feel that we should limit one facility to do 5-7 TPD per day and in case of further increase, we should establish another facility at the other corner of Jhansi. The cost of transportation will by itself will be one of the incentive to establish another facility as the pickups, which are planned will be carrying nearly 200-300 Kg of waste in one load only (this can be lower also). And funded separately.
3. The concept of the plant is immediate processing of plastic waste and with three shifts we will need to have an additional storage facility for the waste, which will be processed in the IInd and IIIrd shift. This additional storage facility will increase the internal movement of the waste and increase operational cost.
4. As the concept, we have developed is clean and simple but labor intensive as sorting is completely manual. Running these plants far from the city limits will require other logistical issues like transportation / canteen etc.
5. If need arises the IInd plant can be ordered with a capacity of 10-15 Tons per day in one shift and this may be placed at this site only or a new site at a different corner of the city.

However these points are well considered, our focus is to provide citizens means to handle plastics waste and collection mechanism. Absence of this is primary cause of mismanagement of waste in India.

Explained in Narration 1.

10) In the DPR first four years cost of Raw material @ 10% income / annum after that no appreciation has been added in not clear in DPR. Raw material & finished goods – cost justification / annum 1st yr 20 lakhs – 2nd yr 26 lakhs, 20 lakhs will include -: Raw material, Bills, labor cost, plant expenses Provision & payables – under which head is justifiable and clear.

These are part of regular business models formats developed for industry and in synergy with the advice of Mr. Santosh Verma of RCUES and our CA, Shri Prem Prakash Ji. It was discussed and agreed to be ok.

Explained in Narration 1 and Narration in Chapter 9.

NOTE: These are the suggestive comments on DPR as discussed with your representative some other detailed changes have been discussed and advised to do the necessary.

We have incorporated almost all the points, and have taken clarifications from manufacturers, Industry, other opinion makers, Nagar nigam officials, regulators and the CA.

We have included financial status of Jhansi Nagar Nigam, New Waste management laws and discussions in various forums in last three months and our work reports relating to servicing of enthusiastic households with dedicated self sustaining empowered rag pickers.

Other Changes made in the document:

1. The missing information about the population of three wards has been added in ***Chapter 2 on Page No.33*** of this document.
2. Easy-to-read financial aspects as Annexure 'A' have been added to the ***Chapter 9, Page No.135*** of this document.
3. Narration regarding the financial aspects has also been added in ***Chapter 9, Page No.120*** of this document.
4. The process flow chart for effective Plastic Waste Management has also been added in ***Chapter 5, Page No.67*** of this document.
5. The agreement with JNN and PMA M/s R.R. Collective is enclosed, with justifications of costs and expenses as ***Annexure III***.
6. The population figures which were contradicting have been rectified in ***Chapter 2; Page No.30*** of this document.
7. The Income & Expenditure Summary of Jhansi Nagar Nigam too has been added in ***Chapter 9, Page No.137*** of this document.

CHAPTER 1

INTRODUCTION

1. INTRODUCTION

1.1 Objective

The law - Plastics Waste (Management and Handling) rules have been enacted in 2011, by Ministry of Environment, Forest and Climate Change, Government of India, and has yet not been implemented in any city or a municipal body in its correct form. For this there is a need for system designing, which encompasses the responsibility of municipal body, getting the plastics industry involved under extended producer responsibility and getting the informal sector in a formal regulated framework.

This forms the basis of this project for the first time in the country under a contract of an ULB. This replicable system is based on in-depth grass root experience in a varieties of waste streams across India and leaves a very few questionable modalities. The costs associated with the municipal waste sorting systems, which were designed for the waste having recyclable content of more than 60% have resulted in mass failures all over the country. And the diversion to waste to energy – with all its emphasis now, leaves the questions of feasibility – exactly for the same reason. If recyclable content having combustible values, remains less than 50% in our waste — the feasibility will always be questionable. The major hurdle is realization by the same regulatory agencies, and resistance of ULB operatives, for reasons best known to them. The proactive initiatives by city managers can make it successful with right understanding, commitment and enthusiasms.

We believe this customized system will be set a trend to address the plastics litter problem, and plug in the loopholes in the most of the waste streams, where the laws are plastic centric. As of now, not one ULB in the Country transports the recyclable waste, an activity, which we see everywhere in urban landscape run by informal sector. The focus here is all based on contribution made by informal recycling network and their better participation in this innovative system, making rag picking a phenomenon on the verge of extinction.

This reverse supply chain network has all its dimensions of retail management – a contemporary foray of corporate world. The systems management, the operative protocols, the technology intervention, the engineering conceptualizations, all goes with advance understanding of inclusive growth. The compulsive contribution of populace has sentimental base in the guilt of awareness to cause of death to our birds, livestock, harm to earth and waters, rivers and oceans.

The over-all objective of this work is three-fold.

i. To investigate the actual supply chain network of plastic waste from households to commercial units along with the other recyclables.

ii. To identify and propose a sustainable plastic waste management by installing Waste Exchange centers and bins for collection of recyclables with all the plastic waste and a Waste Processing Unit for primarily non-recyclable plastics waste.
iii. Preparation of a Project Report, system design, sourcing of equipment, and necessary modalities for implementation and monitoring.

1.2 Scope of the work.

I. Conduct a survey and mark suitable places for opening waste exchange centers, earmark the populace, which can be served with each of them, and identify and register the informal recyclable waste traders and collectors to be connected with them.

II. Design and execute a customizable system, for plants and machinery, and norms of regulatory clearances.

III. Source the equipment, install and commission, and stake holders meet, and awareness campaign.

IV. Source a part of the funding for the project under EPR, CSR & VGF.

V. Monitor the operations for 10 year.

1.3 Overview

The increased use of plastics in product manufacturing and in packaging application in the recent times has increased the quantity of plastics in all the waste streams to a great extent. The quantum of waste is ever increasing due to increase in population, development activities, changes in life style, and socio-economic conditions. It is estimated that approximately 15722 ton per day (TPD) of plastic waste is generated in India on the basis of **per capita consumption** based on population of India (Ref. 2.)

Plastics and its waste in life time analysis perspective throws another point, the recyclability. The most frequently asked question about a product is 'How long will it last?' Lifetime expectancy is often many years, the service conditions may be complex, and there is a scarcity of definitive data on durability. The situation is complicated by the fact that there are a vast number of degradation agents, service conditions, properties of importance and different plastics.

There are many inherent difficulties in designing durability tests. In many cases, the time scale involved is such that accelerated test conditions are essential. Whilst large amounts of durability data are generated by accelerated methods, much of it is only useful for quality control purposes and relatively little has been validated as being realistically capable of representing service.

Most assessments of the lifetime of plastics are made by considering some measure of performance, such as impact strength, and specifying some lower limit for the property, which is taken as the end point. Lifetime is not necessarily measured in time. For example, for some products it will be thought of as the number of cycles of use.

1.4 The History of Plastics

From a historical viewpoint, the development of plastics can be regarded as one of the most important technical achievements of the twentieth century. In just 50 years plastics have permeated virtually every aspect of daily life, paving the way for new inventions and replacing materials in many existing products. The success of these products has been based on their properties of resilience, resistance to moisture, chemicals and photo-biodegradation, their stability and the fact, that they can be molded into any desired form.

The original breakthrough for the first semi-synthetic plastics material - cellulose nitrate, occurred in the late 1850's and involved the modification of cellulose fibers with nitric acid. Cellulose nitrate had many false starts following its invention by a Briton, Alexander Parkes, who exhibited it as the world's first plastics in 1862. The world's first plastic was reproduced at the turn of the twentieth century, and was based mainly on natural raw materials. Only in 1930 were thermoplastics, made from the basic materials styrene, vinyl chlorine and ethylene, introduced onto the market. However, the main growth of the plastics industry did not take place before the 1960's, reaching production of over 40 million ton per year in 1973. Following a temporary drop in production during the oil crises and the economic recession in the beginning of the 1980's, the world production of plastics continued to increase to approximately 77 million ton in 1986, and 86 million ton in 1990 (ref. 8,9).

1.5. What is Plastic?

Plastic is the general term for a wide range of synthetic or semi synthetic polymerization products. They are composed of organic condensation or addition polymers and may contain other substances to improve performance or economics. There are few natural polymers generally considered to be "plastics". These polymers are broken in presence of suitable catalyst, into monomers such as ethylene, propylene, vinyl, styrene and benzene. These monomers are then chemically polymerized into different categories of plastics (ref. 2).This subject is dealt in a separate chapter in this document.

1.6 Categories of plastics

A. Recyclable Plastics (Thermoplastics): PET, HDPE, LDPE, PP, PVC, PS, etc.

B. Non-Recyclable Plastics (Thermoset & others): Multilayer & Laminated Plastics, PUF, Bakelite, Polycarbonate, Melamine, Nylon etc.

As per BIS Classification, there are seven categories of plastics like; PET, HDPE, PVC, LDPE, PP, PS and other. The typical thermoplastic and thermosetting resins are shown in table no 1.

Table no. 1: The typical thermoplastic and thermosetting resins

S. No.	Thermo plastic	S. No.	Thermoset Plastic
1	Polyethylene Tetraphthalate (PET)	1	Bakelite
2	Polypropylene (PP)	2	Epoxy
3	Poly Vinyl Acetate (PVA)	3	Melamine
4	Poly Vinyl Chloride (PVC)	4	Polyester
5	Polystyrene	5	Polyurethane
6	Low Density Polyethylene (LDPE)	6	Urea-Formaldehyde
7	High Density Polyethylene (HDPE)		

1.7 Description of Plastic Waste

Plastic products have become an integral part of our daily life as a basic need. It is produced on a massive scale worldwide and its production crosses the 150 million ton per year globally. In India approximately 8 Million ton plastic products are consumed every year (2008). Its broad range of application lies in films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household and industrial products, and building materials. It is a fact that plastics will never degrade and remains on landscape for several years. Mostly, plastics are recyclable but recycled products can again be recycled but the litter left over in earth system and water systems are more hazardous to the environment. The recycling of a virgin plastic material can be done many times, but after every recycling, the plastic material is deteriorated due to thermal pressure. Considering, 70% of plastic consumption is converted as waste over time, approximately 5.6 million ton per annum (TPA) plastic waste is generated in country, which equals to 15342 ton per day (TPD) (ref.2).

Plastic waste has a significant portion in total municipal solid waste. Though, there is a formal system of waste collection in urban areas, however, informal sectors i.e. rag pickers, collect only value based plastics waste such as pet bottles etc. Plastic carry bags, metalized plastics and low quality plastic less than 20 micron do not figure in their priorities, because collecting them is not profitable. This is primarily because the rewards are not much as compared to the efforts required for collection, and this leads to plastic bags and other packaging materials continuing to pose a major threat to the environment (ref.3).

Moreover, the major concern for this waste stream is that these are non-biodegradable and remains in the environment for many years. Clogging of drains by plastic waste is a common problem. The packaging and poly vinyl chloride (PVC) pipe industry are growing at 16-18% per year. The demand of plastics goods is increasing from house hold use to

industrial applications. It is growing at an annual rate of 22% annually. The polymers production has reached to 8.5 million ton in 2007.

1.8 Growth of Waste in India

While working on plastics littered waste, it is pertinent to understand the other waste streams in India including the Municipal solid waste (MSW), Biomedical waste(BMW), Industrial hazardous waste(IHZ) or Electronics waste (WEEE).

Figure 1 depicts the rapid growth of Municipal Solid Waste from 1990 to 2010 in India. The graph shows that the projected solid waste collection rising up to 235 Million ton/year in financial year 2041, which is shown in figure no. 1. These rising line also shows that, how the Indian cities are being engulfed into waste dump sites all around them.

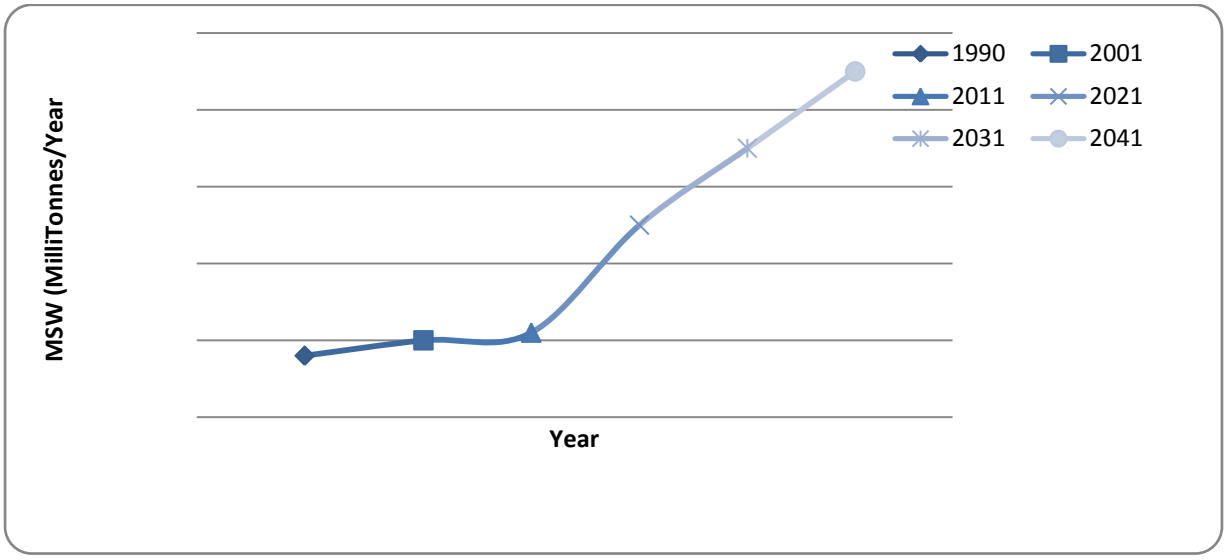

Figure no. 1: The projected solid waste collection rising up to 235 Million ton/year in financial year 2041

Cities in India with growing population, changing life styles, migration of people from rural areas to urban areas and rapid industrialization end up generating an enormous quantity of urban waste (Municipal Solid Waste - MSW) every day. By and large, the Municipal Bodies/Urban Local Bodies ("ULB") in various cities/towns collect MSW, transport it to the dump yards and dispose it off in open ground dumping or non-sanitary landfill. These landfill sites are an environmental hazard – emanating methane causing greenhouse effect, smell & dirt causing health problems, and contaminating the ground water, etc.

When the MSW Handling & Management Rules 2000 were framed, all the ULB's were directed by Ministry of Environment & Forests, Government of India (MoEF, GoI) to set up municipal waste processing facilities. Over a 100 ULBs have implemented the directive, with JNNURM, UIDSSMT and local grants as well as industry investments. The RDF, out of these

facilities is a perennial problem, just as the sterilized medical waste of BMW facilities and emission management in other waste streams. A vast quantizes of this plastics waste lands up in waste dumps if collected, or left out on grounds, farms or goes in water bodies.

At times the old and existing dumping grounds are being used for parks, or construction of commercial and residential complexes. Due to the chemical reactions below the ground, obnoxious gases emit throughout the year. However it is intensified during summer and affects the human health, damage sensitive equipment's like computers, electronic devices etc. Still absence of understanding of a scientific method of remediation of waste dump yards, it remains a most poorly managed civic activity.

Open dumping of solid waste including plastics affects the aesthetic value of the surrounding area of the disposal site. At the time of decomposition it releases various gases within the surrounding area due to which air gets polluted and this pollution contributes to global warming (ref. 5). The main challenge in applying waste sorting at the source programs, which has to do with the correspondingly high level of citizens involvement in dispensing the different wastes components that comprise waste. The recycling potential is as shown in Figure 2, can be achieved if house hold sorting mechanisms is adopted.

In most of the cities, the waste quantity is not measured and is usually assessed based on number of trips made by transportation vehicles. There is a need to integrate the role of different stakeholders involved in waste management specially the formal sector. A reliable approach is to be critical and creative; to start from the existing strengths of the city and to build upon them; to involve all the stakeholders to design new local models; and to 'pick and mix', adopt and adapt the solutions that will work in a particular situation. (Ref. 5)

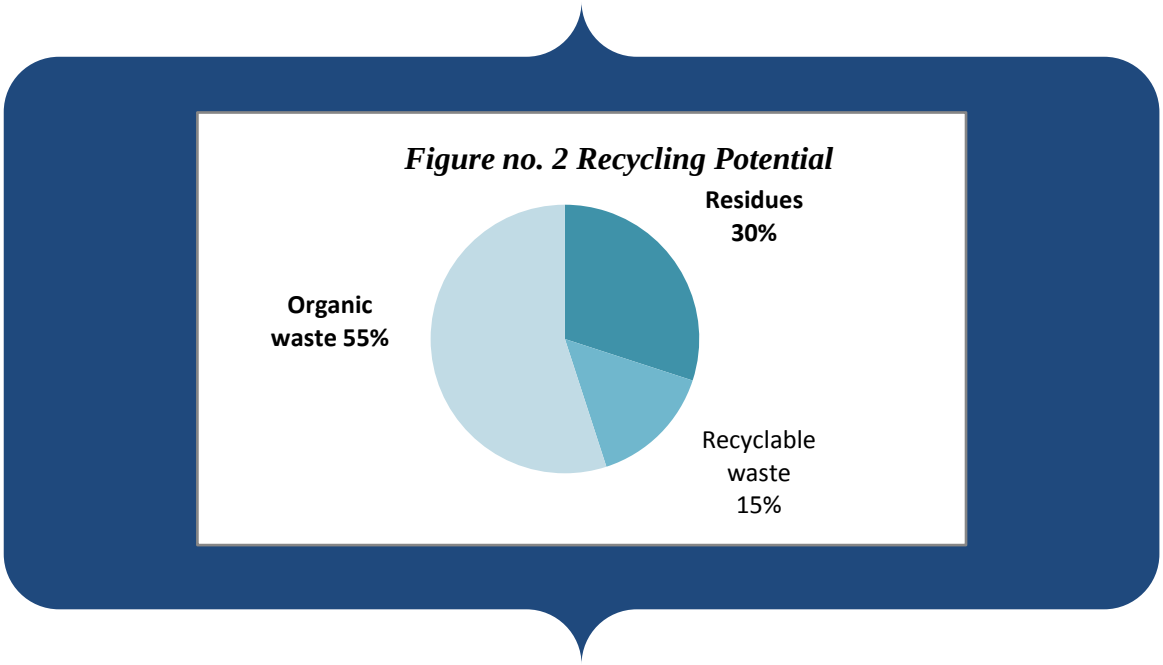

Figure no. 2 Recycling Potential

1.9 Waste Generation and Composition in India

The rate of waste generation in India is growing very quickly owing to urbanization and higher incomes. The current composition of waste carries a high potential for recycling that is barely exploited. Generally, about 15 percent of waste materials—which consist mainly of paper, plastic, metal, and glass—can be retrieved from the waste stream for further recycling (as shown in figure no. 2). Another 35 to 55 percent of waste material is organic waste, which can be converted into useful compost, leaving only 30 to 50 percent that needs to go as inert or as soil supplement.

Data pertaining to the physical and chemical composition of the waste has been compiled for 75 cities by CPCB and for 60 cities for plastics waste.. An attempt has been made to establish a relation between the Calorific Value and the biodegradable and paper fractions of the waste generated in various cities. The cities have been classified on the basis of population, i.e. cities having a population of over 20,00,000 are classified as Tier 1 cities, between 5,00,000 to 20,00,000 as Tier 2 cities, between 1,00,000 to 5,00,000 as Tier 3 cities and less than 1,00,000 as Tier 4 cities, in which Jhansi comes in Tier 3 city. Also, the state wise potential of waste to Energy has been calculated using values of various WTE technologies taken from literature reviews of several research papers. Using the projected population figures (Census) for the years 2011, 2015 & 2020 along with the scenarios stating which types of technologies could be used for waste generation to energy conversion as proposed by the authors, the projected waste potential for India for the given years has been calculated. Which all compels us to think differently for us in India –more innovatively.

1.10 Plastics Consumption in India

National plastic waste management task force in 1997 projected the polymers demand in the country. Polymers Demands in India (Million Ton) documents the demand of different polymers in India during years 1995-96, 2001-02 and 2006-07. The comparison of demand and consumption from more than one fourth of the consumption in India is that of PVC which is being phased out in many countries. Poly bags and other plastic items except PET in particular have been a focus, because it has contributed to host of problems in India such as choked sewers, animal deaths and clogged soils.

1.11 Literature Sources

Literature information for this work was gathered from diverse sources. A lot of information was obtained or collected through the internet from different sources such as journals, technical reports on international research work on plastic waste recycling, press releases on recycling and findings of research centers and pilot projects.

Also, important information and recycling techniques were obtained from countries such as Turkey, Egypt, Ghana and South Africa and therefore it is worthwhile learning from their

experiences. Majority of the terminologies and techniques on recycling and the practical demonstrations were drawn from the research work of Waste Consultants on Plastic Waste.

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CHAPTER 2

THE CITY

OF

JHANSI

2. THE CITY OF JHANSI

2.1 Introduction

Jhansi is a historic city of northern India, in the region of Bundelkhand on the banks of the Pahuj or Pushpavati River, in the extreme south of the state of Uttar Pradesh. Jhansi is the administrative headquarters of Jhansi District and Jhansi Division. This district is on the banks of the Betwa River. The original walled city grew up around its stone fort, which crowns a neighboring rock. The ancient name of this historical city was Balwantnagar. From 1817 to 1854 Jhansi was the capital of the princely state of Jhansi which was ruled by Maratha rajas. The city is situated between North longitudes 24°11' and 25°57'and East latitudes 78°10'and 79°25'. It has an average elevation of 284 metres (935 feet). It is about 415 kilometres (258 mi) from New Delhi and 292 kilometres (181 mi) from Lucknow, and is called the Gateway to Bundelkhand.

2.2 Population Density, Sex Ratio and Literacy

As per the reports of Census India, population of Jhansi in 2011 was 507,293; of which male and female are 268,101 and 239,192 respectively. Although Jhansi city has population of 507,293; its urban / metropolitan population is 549,391 of which 292,497 are males and 256,894 are females *(1)*. Jhansi District city constituted 0.25 percent of total Uttar Pradesh population (199,812,341 – as per census 2011).

2.3 Jhansi City Overview

2.3.1 Jhansi Literacy Rate 2011

In education section, total literates in Jhansi city are 381,771 of which 214,375 are males while 167,396 are females. Average literacy rate of Jhansi city is 83.81 percent of which male and female literacy was 89.18 and 77.81 percent.

2.3.2 Jhansi Sex Ratio 2011

The sex ratio of Jhansi city is 892 per 1000 males. Child sex ratio of girls is 868 per 1000 boys.

2.3.3 Jhansi Child Population 2011

Total children (0-6) in Jhansi city are 51,762 as per figure from Census India report on 2011. There were 27,715 boys while 24,047 are girls. The child forms 10.20 % of total population of Jhansi City. (2)

2.4 The Municipality of Jhansi

Jhansi Nagar Nigam was establishment under the provisions of the Uttar Pradesh Municipal Corporations Adhiniyam of 1959, making necessary amendments from time to time. It has been categorized as Urban Local Body under the provisions of the 74th Amendment of the constitution, where the rights duties, functions and administration have been streamlined as per the act.

The initial provisional data released by census India 2011, shows that density of Jhansi district for 2011 is 398 people per sq. km. In 2001, Jhansi district density was at 347 people per sq. km. Jhansi district administers 5,024 square kilometers of areas.

Since its inception, the Jhansi Nagar Nigam (JNN) has been the provider and facilitator of all core municipal services, including water supply and sewerage, in its jurisdictional area. (3)

2.5 Slums in Jhansi

Slums form an important composition of present urban landscape. The efforts are on, to make Jhansi a slum free city with a development plan. Since the people, who will play an important role in this Litter free campaign, it is pertinent to be aware of the support, which will be available to them in the future. We reproduce below few excerpts of the JNN plan proposal for slums:

SUDA (State Urban Development Agency) Jhansi has selected the following 7 slums for Re-Development under RAJIV AVAS YOJNA.

1. BaharkaPura
2. AmankaBagicha
3. Satyam Colony
4. Badagao gate Bahra
5. Mahkaleshwar colony
6. Dhimariyana
7. Adivashi Colony

Some slum dwellers are living on encroached Govt. Land.

The living condition of the slum is very unhygienic due to lack of Infrastructure facilities like roads, drainage and proper water supply.

Location of slum in a fast growing locality would encourage mainstreaming the slum-dwellers into citywide network.

S. No.	Name of Slum	Kaccha House (Proposed)	Pakka House	Total Household in slums
1	BaharkaPura	69	186	255
2	AmankaBagicha	22	160	182
3	Satyam Colony	111	317	428
4	Badagaon gate bahar	151	321	472
5	Mahakeshwara colony	24	94	118
6	Dhimariyana	86	229	315
7	Adivashi Colony	54	0	54
	Total	**517**	**1307**	**1824**

Table no. 2 Ward wise population: JNN*(3)*

Serial No.	Ward Name	Ward No.	Male	Female	Total
1	Hansari Gird First	1	4266	3998	8264
2	Hansari Gird Second	2	5101	4516	9617
3	BaharSaiyar Gate	3	4206	3805	8011
4	Bhattagaon	4	3508	3051	6559
5	Masihaganj	5	5678	5007	10685
6	NainaGarh	6	4194	5785	9979
7	School Pura	7	4914	4627	9541
8	Talpurta First	8	5529	5986	11515
9	Khushipura First	9	2735	2455	5190
10	Simardha	10	5569	6716	12285
11	NaiBasti First	11	5752	4994	10746
12	Taalpura Second	12	1623	2381	4004
13	GariyaGaon	13	3333	2938	6271
14	Khushipura	14	3711	3218	6929
15	Bijauli	15	4609	6791	11400
16	Isaitola Second	16	4743	6533	11276
17	Kachiyana Puliya No. 9	17	4000	3602	7602
18	Gudri	18	3542	3242	7848
19	NaiBasti Second	19	3653	3561	7714
20	Bangla Ghat	20	3995	5215	9210
21	NainaGarh South	21	4409	4399	8807
22	Isaitola First	22	4373	5022	9395
23	Simraha	23	4102	4139	8241
24	Lahargird First	24	3958	3600	7558
25	Hirapura	25	3989	3765	7754
26	Kochabhawar	26	3410	3045	6455
27	Bagicha Puliya No.9	27	3477	3119	6596
28	Nainagarh South Second	28	3551	3263	6814
29	Pichhor	29	5590	7471	13061
30	Sagar Gate	30	4216	3473	7689
31	Lahargird Second	31	6225	6388	12613
32	Nandanpura Second	32	5861	5868	11729

33	Bahar Orchha Gate Second	33	4947	4499	9446
34	Nandanpura First	34	3762	2839	6601
35	Bahar Orchha Gate First	35	2525	2344	4869
36	Aligole Second	36	3986	3749	7735
37	Aligole First	37	3706	4211	7917
38	Chaniyapura	38	4878	3951	8829
39	Nandanpura Third	39	4091	5664	9755
40	Talaiya	40	3853	2324	6277
41	Dadiyapura First	41	6610	7012	13622
42	Civil Lines Souh First	42	3347	3280	6627
43	CIvil Lines Souh Second	43	2350	5706	8056
44	Outside Datiya Gate First	44	4984	8753	13737
45	Dadiyapura Second	45	8717	7105	15822
46	Mewatipura	46	5297	4839	10136
47	BaharKhanderao Gate	47	3745	3773	7518
48	Premganj First	48	2683	2566	5249
49	Premganj Second	49	3975	3699	7674
50	Outside Datiya Gate Second	50	2693	2451	5144
51	Civil Lines West	51	3459	2867	6326
52	Civil Lines North	52	3200	3737	6937
53	Azad Ganj	53	3109	2705	5814
54	C P Mission Compound	54	4268	3735	8003
55	Nanakganj	55	2243	3145	5383
56	ToriyaNarsinghrao	56	3579	3877	7456
57	Mukaryana	57	4727	4322	9049
58	Darubhonela	58	4832	4228	9060
59	Gusainpura	58	4966	4009	8975
60	Lakshmanganj	60	4357	4163	8520

2.6 POUPULATION PROJECTION AS PER SWM DPR 2006 *(4)*

Population Projections for Jhansi City		
Past Population Estimates (Based on Census Data)		
S. No.	**Year**	**Population**
1	1951	1,27,365
2	1961	1,69,712
3	1971	1,98,135
4	1981	2,84,141
5	1991	3,68,154
6	2001	4,63,281
Population Projections (Based on International Increase Method)		
1	2006	5,11,302
2	2011	5,56,107
3	2021	6,57,069
4	2031	7,73,167

2.7 Municipal Services – Solid Waste Management in Jhansi

JNN is responsible for the collection, transportation and disposal of all solid waste generated in the city, except the untreated bio-medical waste and hazardous industrial waste, which is taken care of by the respective generators. JNN organizes the collection and transportation of the waste through the private agencies.

The Jhansi city is divided into 2 administrative zones namely East Zone and West Zone. Amongst the 60 wards of Jhansi city, 36 wards fall under East zone and 24 wards fall under the West zone.

Apart from the two zones, part of the Jhansi city area also falls under Jhansi Cantonment Board and Railway administration.

Currently only 8 wards are being served for Solid Waste Management by S.R. Gwalior (this is being though door to door waste collection system). The same system will soon be applied to 12 other wards in city – to be managed by another company. The sanitation department of the Jhansi Nagar Nigam is taking care of the solid waste management in rest of the 40 wards in the city. (3)

2.8 Scavenging and Recycling Activities

There is significant scavenging and recycling activity. Scavengers normally salvage large size plastic films, sheets; carry bags, corrugated boxes and metals. About 20% recyclables are scavenged from various spots. The details forms part of our actual survey for the waste exchange centers. (3)

2.9 List of Mohalla's as per the wards(7)

The complete list of the mohalla's/colonies in every ward has been attached in the ***Appendix 2***.

2.10 References:

1. http://www.census2011.co.in/census/city/134-jhansi.html
2. http://www.census2011.co.in/census/city/134-jhansi.html
3. Reports provided by Municipal Corporation Jhansi, relating to slums, and MSW services.
4. DPR on Solid Waste Management by R.C.U.E.S published in the year 2002.
5. Jhansi Nagar Nigam Website (www.jnnjhansi.com)
6. http://www.jhansipropertytax.com/

CHAPTER 3

PLASTICS AND SOURCES OF PLASTICS WASTE

3. PLASTICS AND SOURCES OF PLASTICS WASTE

3.1 The History of Plastics

From a historical viewpoint, the development of plastics can be regarded as one of the most important technical achievements of the twentieth century. In just 50 years plastics have permeated virtually every aspect of daily life, paving the way for new inventions and replacing materials in many existing products. The success of these products has been based on their properties of resilience, resistance to moisture, chemicals and photo-biodegradation, their stability and the fact, that they can be molded into any desired form.

The original breakthrough for the first semi-synthetic plastics material - cellulose nitrate, occurred in the late 1850's and involved the modification of cellulose fibers with nitric acid. Cellulose nitrate had many false starts following its invention by a Briton, Alexander Parkes, who exhibited it as the world's first plastics in 1862. The world's first plastic was reproduced at the turn of the twentieth century, and was based mainly on natural raw materials. Only in 1930 were thermoplastics, made from the basic materials styrene, vinyl chlorine and ethylene, introduced onto the market. However, the main growth of the plastics industry did not take place before the 1960's, reaching production of over 40 million ton per year in 1973. Following a temporary drop in production during the oil crises and the economic recession in the beginning of the 1980's, the world production of plastics continued to increase to approximately 77 million ton in 1986, and 86 million ton in 1990 (ref. 8,9).

3.2. What is Plastic?

Plastic is the general term for a wide range of synthetic or semi synthetic polymerization products. They are composed of organic condensation or addition polymers and may contain other substances to improve performance or economics. There are few natural polymers generally considered to be "plastics". These polymers are broken in presence of suitable catalyst, into monomers such as ethylene, propylene, vinyl, styrene and benzene. These monomers are then chemically polymerized into different categories of plastics (ref. 2).This subject is dealt in a separate chapter in this document.

3.3 Categories of plastics

A. Recyclable Plastics (Thermoplastics): PET, HDPE, LDPE, PP, PVC, PS, etc.

B. Non-Recyclable Plastics (Thermoset & others): Multilayer & Laminated Plastics, PUF, Bakelite, Polycarbonate, Melamine, Nylon etc.

As per BIS Classification, there are seven categories of plastics like; PET, HDPE, PVC, LDPE, PP, PS and other. The typical thermoplastic and thermosetting resins are shown in table no 6.

Table no. 6 The typical thermoplastic and thermosetting resins

S. No.	Thermo plastic	S. No.	Thermoset Plastic
1	Polyethylene Tetraphthalate (PET)	1	Bakelite
2	Polypropylene (PP)	2	Epoxy
3	Poly Vinyl Acetate (PVA)	3	Melamine
4	Poly Vinyl Chloride (PVC)	4	Polyester
5	Polystyrene	5	Polyurethane
6	Low Density Polyethylene (LDPE)	6	Urea-Formaldehyde
7	High Density Polyethylene (HDPE)		

3.4 Description of Plastic Waste

Plastic products have become an integral part of our daily life as a basic need. It is produced on a massive scale worldwide and its production crosses the 150 million ton per year globally. In India approximately 8 Million ton plastic products are consumed every year (2008). Its broad range of application lies in films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household and industrial products, and building materials. It is a fact that plastics will never degrade and remains on landscape for several years. Mostly, plastics are recyclable but recycled products can again be recycled but the litter left over in earth system and water systems are more hazardous to the environment. The recycling of a virgin plastic material can be done many times, but after every recycling, the plastic material is deteriorated due to thermal pressure. Considering, 70% of plastic consumption is converted as waste over time, approximately 5.6 million ton per annum (TPA) plastic waste is generated in country, which equals to 15342 ton per day (TPD) (ref.2).

Plastic waste has a significant portion in total municipal solid waste. Though, there is a formal system of waste collection in urban areas, however, informal sectors i.e. rag pickers, collect only value based plastics waste such as pet bottles etc. Plastic carry bags, metalized plastics and low quality plastic less than 20 micron do not figure in their priorities, because collecting them is not profitable. This is primarily because the rewards are not much as compared to the efforts required for collection, and this leads to plastic bags and other packaging materials continuing to pose a major threat to the environment (ref.3).

Moreover, the major concern for this waste stream is that these are non-biodegradable and remains in the environment for many years. Clogging of drains by plastic waste is a common problem. The packaging and poly vinyl chloride (PVC) pipe industry are growing at 16-18% per year. The demand of plastics goods is increasing from house hold use to industrial applications. It is growing at an annual rate of 22% annually. The polymers production has reached to 8.5 million ton in 2007.

3.5. Plastic Materials

Plastics are man-made organic materials that are produced from oil and natural gas as raw materials. Plastics consist of large molecules (macromolecules), the building blocks of all materials. The molecular weights of plastics may vary from about 20,000 to 100,000 mg/L. Plastics can be regarded as long chains of beads in which the so-called monomers. Development of plastics production worldwide ethylene, propylene, styrene and vinyl chloride are linked together to form a chain called a polymer. Polymers such as polyethylene (PE), polystyrene (PS) and polyvinyl chloride (PVC) are the end products of the process of polymerization, in which the monomers are joined together. In many cases only one type of monomer is used to make the material, sometimes two or more. A wide range of products can be made by melting the basic plastic material in the form of pellets or powder (1). Plastics can be either thermoplastics or thermosets, having melting which is given in table no. 7.

Table no.7 Melting point of common thermoplastic (4)

Polyolefin	Melting point (^{0}C)
LDPE	115
LLDPE	123
HDPE	130
Polyethylene (PE)	135
Polypropylene (PP)	170
Polystyrene (PS)	240
Polyethylene terephthalate (PET)	245
Polyamide 6 (PA6)	233

Materials that repeatedly soften on heating and harden on cooling are known as thermoplastics. They can be melted down and made into new plastic end products. Thermo plastics are similar to paraffin wax. They are dense and hard at room temperature, become soft and moldable when heated, dense and hard again and retain new shapes when cooled (see Figure 3 for a schematic overview of the structure of thermoplastic and Thermoset).

This process can be repeated numerous times and the chemical characteristics of the material do not change. In Europe, over 80% of the plastics produced are thermoplastics (1). Thermosets, on the other hand are not suitable for repeated heat treatments because of their complex molecular structures (see Figure 3b).The structure of thermosetting materials resembles a kind of thinly meshed network that

is formed during the initial production phase. Such materials cannot be reprocessed into new products unlike thermoplastics. Thermosets are widely used in electronics and automotive products. The properties of plastics can be modified by a number of substances known as additives.

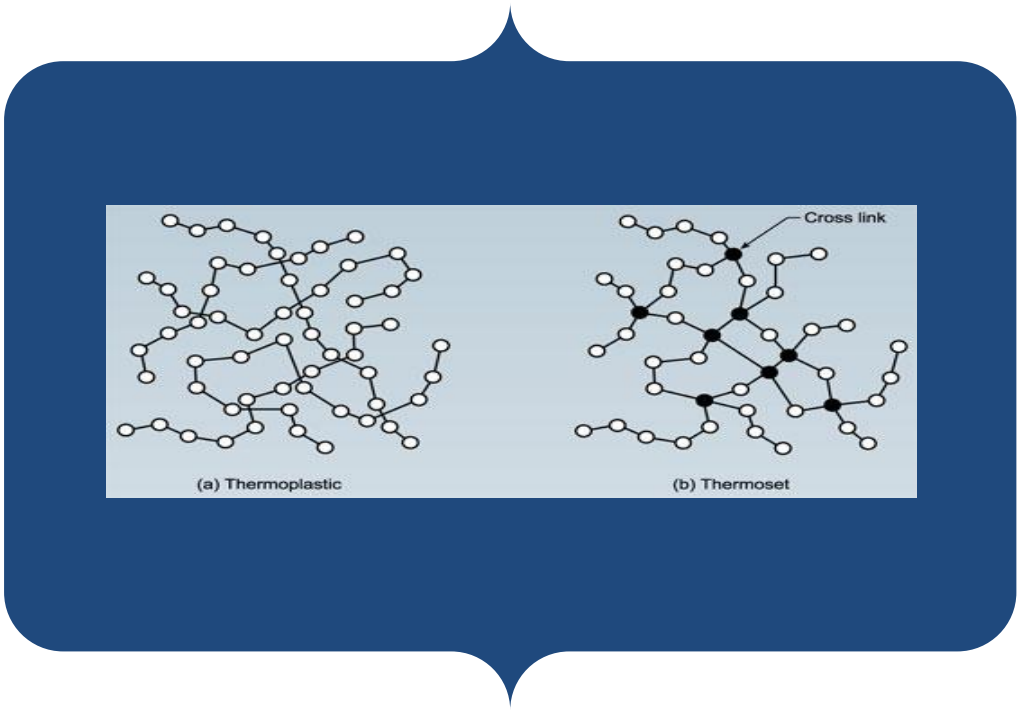


Figure 3. The structure of (a) thermoplastic and (b) thermosets

3.6 Types of Plastics

In industrialized countries, literally hundreds of plastic materials are available commercially. In economically less developed countries however, fewer types of plastics tend to be used. In both economically less developed and industrialized countries, the four types of plastics that are most commonly reprocessed or recycled are polyethylene (PE), polypropylene (PP), polystyrene (PS) and polyvinyl chloride (PVC). Each of these can be subdivided according to their density, the type of process involved in their manufacture, and the additives they contain. These four types are briefly described below.

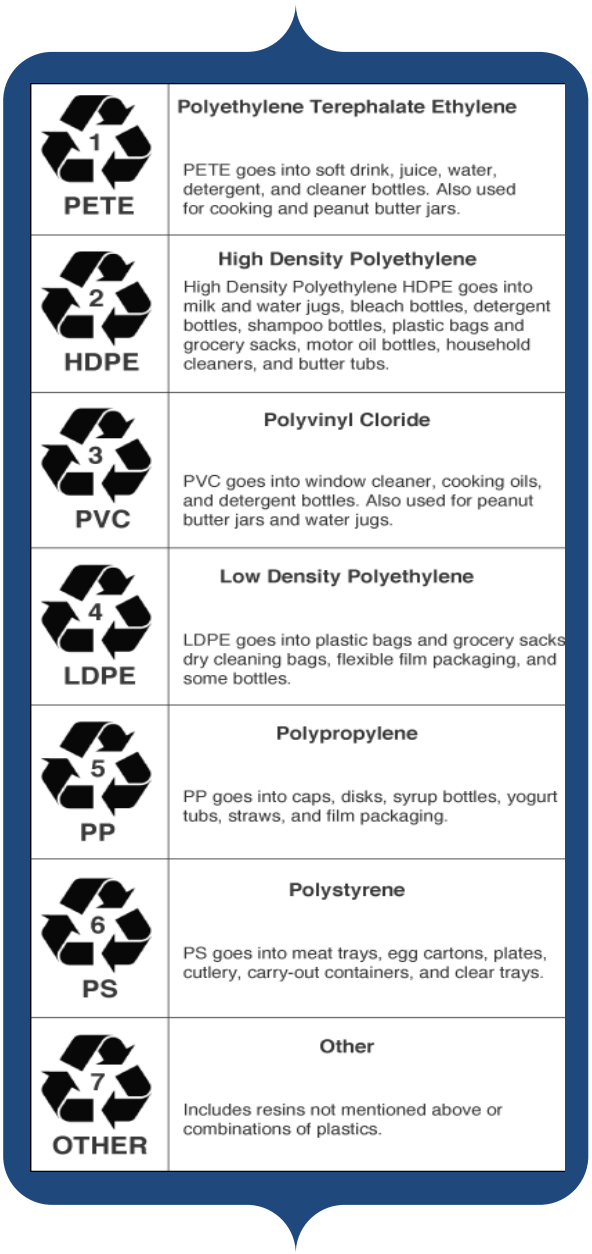
3.6.1 Polyethylene (PE)

The two main types of polyethylene are low density polyethylene (LDPE) and high density polyethylene (HDPE). LDPE is soft, flexible and easy to cut, with the feel of candle wax. When very thin it is transparent, when thick it is milky white, unless a pigment is added. LDPE is used in the manufacture of film bags, sacks and sheeting, blow-molded bottles, food boxes, flexible piping and hosepipes, household articles

such as buckets and bowls, toys, telephone cable sheaths, etc. HDPE is tougher and stiffer than LDPE, and is always milky white in color, even when very thin. It used for bags and industrial wrappings, soft drinks bottles, detergents and cosmetics containers, toys, jerry cans, crates, dustbins, and other household articles.

3.6.2 Polypropylene (PP)

Polypropylene is more rigid than PE, and can be bent sharply without breaking. It is used for stools and chairs, high-quality home ware, strong moldings such as car battery housings, domestic appliances, suitcases, wine barrels, crates, pipes, fittings, rope, woven sacking, carpet backing netting surgical instruments, nursing bottles, food containers, etc.



3.6.3 Polystyrene (PS)

In its unprocessed form, polystyrene is brittle and usually transparent. It is often blended (copolymerized) with other materials to obtain the desired properties. High-impact polystyrene (HIPS) is made by add in grubber. Polystyrene foam is often produced by incorporating a blowing agent during the polymerization process. PS is used for cheap, transparent kitchen ware, light fittings, bottles, toys, food containers, etc.

3.6.4 Polyvinyl chloride (PVC)

Polyvinyl chloride is a hard, rigid material, unless plasticizers are added. Common applications for PVC include bottles, thin sheeting, transparent packaging materials, water and irrigation pipes, gutters, window frames, building panels, etc. If plasticizers are added, the product is known as plasticized polyvinylchloride (PPVC), which is soft, flexible and rather weak, and is used to make inflatable articles such as footballs, as well as hosepipes and cable coverings, shoes, flooring, raincoats, shower curtains, furniture coverings, automobile linings, bottles, etc. Other types of plastics include

polycarbonate (PC), polyethylene terephthalate (PET), he polyurethane (PU) and nylon or polyamide (PA). Table no.8 depicts the types of plastics and their variations in bending strength.

Table no.8 Types of Plastics and variation in bending strength

Type of Plastic	Percentage of Plastic	Bending strength in Kg	Compression strength (Ton)
PE	10	325	250
	20	340	270
	25	350	290
Poly propylene	10	350	280
	20	370	290
	25	385	310
PS	10	200	155
	20	210	165
	25	215	170
PE foam	10	310	250
	20	325	265
	25	335	290
PP foam	10	340	270
	20	360	290
	25	365	270
Laminated plastic	10	360	290
	20	385	310
	25	400	335
BOPP	10	380	300
	20	400	310
	25	410	330

3.7 Sources of Plastic waste

Plastics can be used for many purposes, and thus, waste plastics are generated from a wide variety of sources. The main sources of plastic waste in Jhansi can be classified as follows: industrial, commercial and municipal waste.

3.7.1 Industrial waste

Industrial waste and rejected material (so-called primary waste) can be obtained from large plastics processing, manufacturing and packaging industries. Most of this waste material has relatively good physical characteristics; i.e., it is sufficiently clean,

since it is not mixed with other materials. It has been exposed to high temperatures during the manufacturing process which may have decreased its characteristics, but it has not been used in any product applications. Many industries discard polyethylene film wrapping that has been used to protect goods delivered to the factory. This is an excellent material for reprocessing, because it is usually relatively thick, free from impurities and in ample supply. Many industries may provide useful supplies of primary waste plastics:

- The automotive industries: spare-parts for cars, such as fan blades, seat coverings, battery containers and front grills.
- Construction and demolition companies: e.g. PVC pipes and fittings, tiles and sheets.
- Electrical and electronics industries: e.g. switch boxes, cable sheaths, cassette boxes, TV screens, etc.

Unregistered plastics processing industries in Jhansi sometimes recycle the waste they generate but this is relatively very low. Physical properties of waste plastics are given below in table no.9 (5).

Table no. 9 Physical properties of waste plastics

Commercial Plastic material	Nature of Plastic	Thickness (μ)	Softening point (^{o}C)
Cup	PE	150	100-120
Carry bag	PE	10	100-120
Water bottle	PET	210	170-180
Cool drinks bottle	PET	210	170-180
Chocolate covers	Polyester + PE + metalized polyester	20	155
Parcel cover	PE	50	100-120
Supari cover	Polyester + PE	60	120-135
Milk pouch	LDPE	60	100-120
Biscuit covers	Polyester + PE	40	170
Decoration papers	BOPP	100	110
Film	PE	50	120-130
Foam	PE	NA	100-110
Foam	PS	NA	110

Considerable amounts of waste plastics generated by many industries remain uncollected or end up at the municipal dump. Industries are often willing to cooperate with private collecting or reprocessing units.

3.7.2 Commercial waste

Workshops, craftsmen, shops, supermarkets and wholesalers may be able to provide reasonable quantities of waste plastics for recovery. A great deal of such waste is likely to be in the form of packaging material made of PE, either clean or contaminated. Hotels and restaurants are often sources of contaminated PE material.

3.7.3 Municipal waste

Waste plastics can be collected from residential areas (domestic or household waste), streets, parks, collection depots and waste dumps. In Jhansi, considerable amounts of plastic waste can be found within the Municipal Solid Waste stream due to the littering habit of the population. The most common type of plastic waste within the municipal waste stream is the “sachet” water film bags that are discarded in discriminately soon after consuming its contents. In Asian countries in particular, the collection of this type of waste is widespread. However, unless they are bought directly from households, before they have been mixed with other waste materials, such waste plastics are likely to be dirty and contaminated. Sometimes the plastics can be separated and cleaned quite easily, but contamination with hazardous waste is not always visible and may be more difficult to remove. Litter that has been waiting for collection for some time may have been degraded by sunlight. This is mainly a superficial effect, however, and does not always mean that the plastics cannot be reprocessed. The data on waste generated based on income with characterized of some Asian countries as given below in table no. 10 (6).

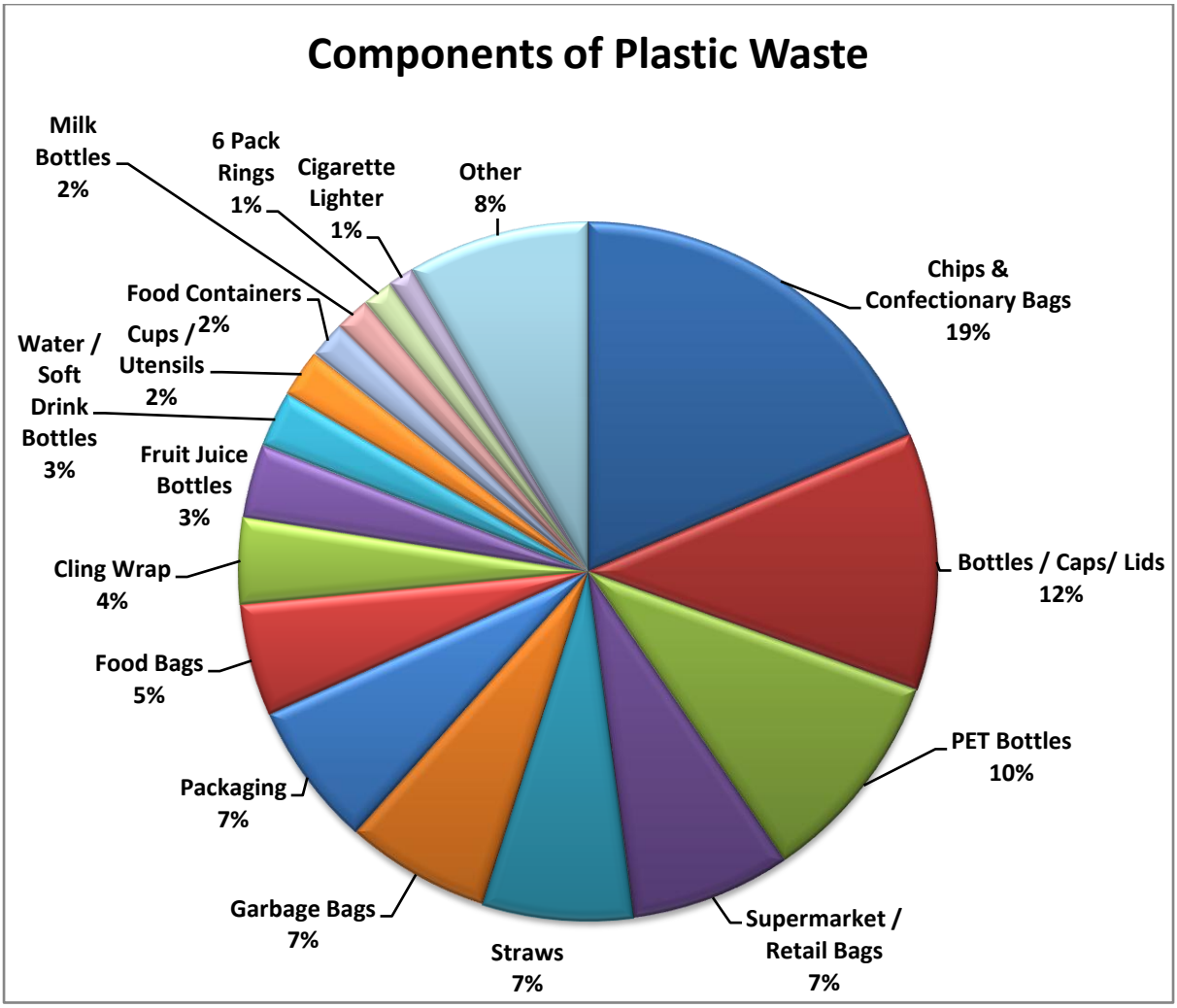


Table no. 10 Data on waste generated based on income with characterized of some Asian countries

Country	GDP, PPP capita estimated for 2077 (USD)	Waste generation (Kg/capita/ day)	Composition (% wet weight basis)						
			Bio - degradable	Paper	Plastic	Glass	Metal	Textile/ leather	Inert and others
Hong Kong	35,385	2.25	38	28	19	3	2	3	9
Japan	33,010	1.1	26	46	9	7	8	-	12
Singapore	31,165	1.1	44.4	28.3	11.8	4.1	4.8	-	6.6
Taiwan	31,040	0.667	31	26	22	7	4	9	-
South Korea	23,331	1.0	25	26	7	4	9	29	-
Malaysi	12,702	0.1-0.8	40	15	15	4	3	3	20

a									
Thailand	9426	1.1	48.6	14.6	13.9	5.1	3.6	-	14.2
China	8854	0.8	35.8	3.7	3.8	2	0.3	-	47.5
Philippines	5409	0.3-0.7	41.6	19.5	13.8	1.3	4.8	-	17.9
Indonesia	5096	0.8-1	74	10	8	2	2	2	2
Sri Lanka	5047	0.2-0.9	76.4	10.6	5.7	1.3	1.3	-	4.7
India	3794	0.3-0.6	42	6	4	2	2	4	40
Vietnam	3502	0.55	58	4	5.6	1.6	1.5	1.8	27.5
Lao PDR	2260	0.7	54.3	3.3	7.8	1.5	3.8	-	22.5
Nepal	1760	0.2-0.5	80	7	2.5	3	0.5	-	7

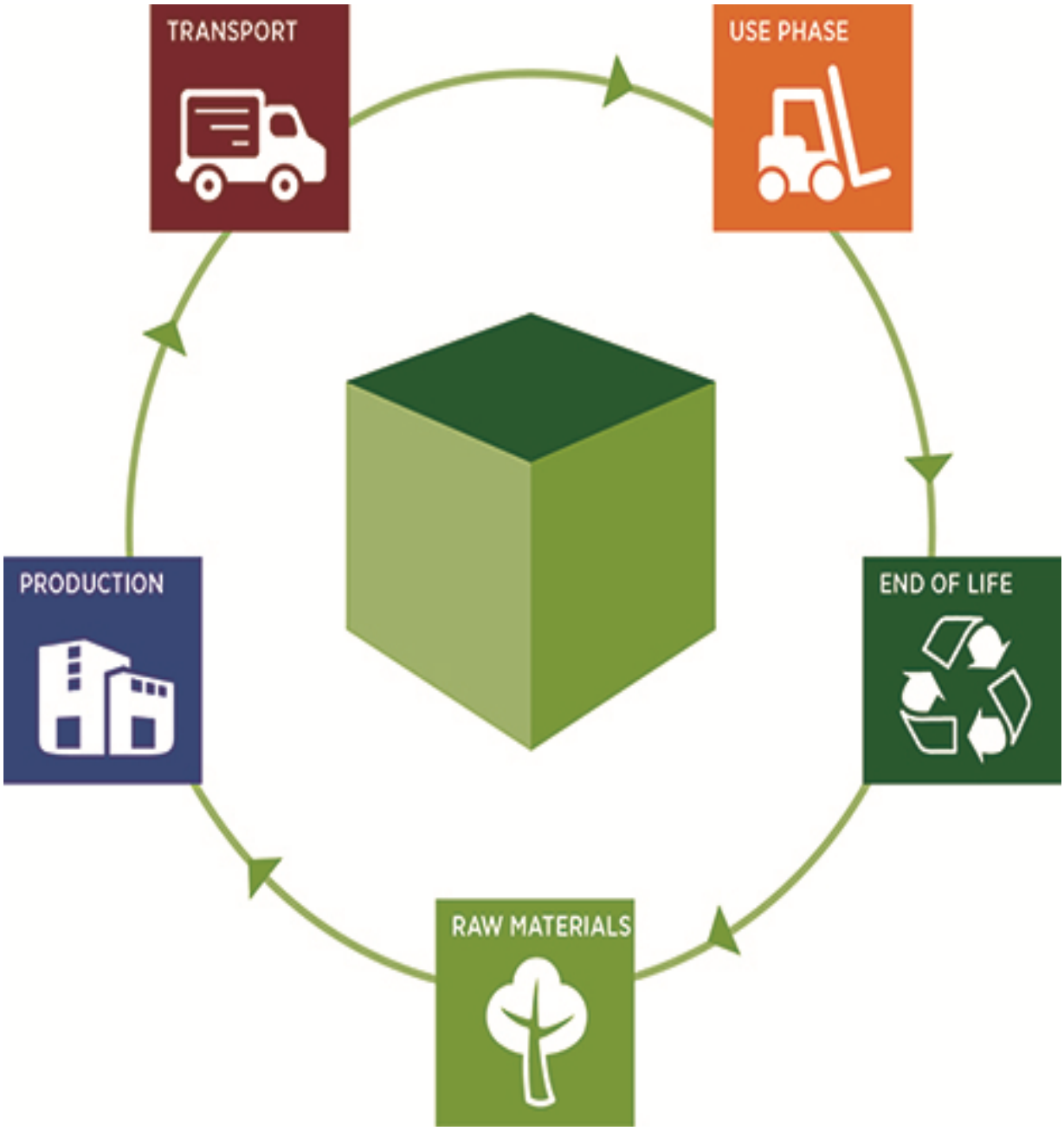
3.8. Hazardous effects of Plastics

Polluting Substances

In terms of environmental and health effects it is important to differentiate between the various types of plastics. Most plastics are considered nontoxic (PVC is an important exception). Polyethylene (PE) and polypropylene (PP), for example, are inert materials (2), but it should be realized that plastics are not completely stable. Under the influence of light, heat or mechanical pressure they can decompose and release hazardous substances. For example, the monomers from which polymers are made may be released and may affect human health. Both styrene (which is used to make polystyrene, PS) and vinyl chloride (used to make PVC) are known to be toxic, and ethylene and propylene may also cause problems (3). The environmental effects of plastics also differ according to the type and quantity of additives that have been used. Some flame retardants may pollute the environment (e.g. bromine emissions). Pigments or colorants may contain heavy metals that are highly toxic to humans, such as chromium(Cr), copper (Cu), cobalt (Co), selenium (Se), lead (Pb) and cadmium (Cd) are often used to produce brightly colored plastics.

Cadmium is used in red, yellow and orange pigments. In most industrialized countries these pigments have been banned by law. The additives used as heat stabilizers (i.e.

chemical compounds that raise the temperature at which decomposition occurs), frequently contain heavy metals such as barium (Ba), tin (Sn), lead and cadmium, sometimes in combination (Nagelh out, 1989).



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CHAPTER 4

PLASTIC WASTE MANAGEMENT

(GENERAL)

4. PLASTIC WASTE MANAGEMENT- GENERAL

4.1 PWM

Plastic Waste Management will involve activities associated with segregation, collection, storage, transportation, processing and disposal. Plastic waste disposal in an environmentally sustainable manner should be achieved by adopting principles of economy, aesthetics, and energy conservation and pollution control. It encompasses planning, organization, administration, financial, legal and engineering aspects involving interdisciplinary relationships.

India as a developing country needs simpler, low cost technology keeping in view of maximum resource recovery in environmental friendly manner. An advanced technological solution for plastic waste disposal available in developed countries but cannot be directly adopted in developing countries due to difference in waste characteristics, financial constraints and socio-cultural aspects. With the aim of restrain littering and have proper disposal process for plastic waste, following activities are required to enforce in plastic waste management.

4.1.1 Two-Bin/bag collection System

In order to follow appropriate plastic disposal technologies, segregation at source is essential. The recyclable waste material should be separated from food waste and other biodegradable waste, in a separate bin at the source of waste generation, by having a two bin/bag system for waste storage. It is proposed to have recycling waste collector is a waste trader of the network, and gives a plastics bag free to every household.

The bags are clearly labeled/marked on them “Recyclable Waste” which could also be a bag for easy handling, since it will contain mostly dry waste and not wet “Bio-degradable Waste”. This will be replaced when full with another bag. This way the plastic waste is separated out easily from other recyclable materials. The bio-degradable waste goes to the Municipal waste processing site for conversion into fertilizer and recyclable waste can be handed over to newly net worked this recycling system. The reuse of recyclable waste material will reduce processing cost drastically as well address the segregation needs and environment pollution.

4.1.2 Waste Exchange Center (WEC) as Porta cabin

Figure no. 4: Porta-cabin for collection of all Plastic Waste

A WEC is a waste collection point, placed in earmarked communities. It is most suitable for almost of the recyclable waste collection. The methodology as devised here is based on the operability of a system, which has three major factors:

1. Responsibility of a Urban local Body with respect to Plastics waste management as is in the PWM rules:
2. Harnessing the informal sector working for recyclable waste into a formal system.
3. Rehabilitation of waste pickers,
4. Picking the Litter lying around harming the earth and ecosystem.

There are usually a separate containers/ bag hangers for the collection of plastics, which are subsequently sorted into valuable and refuse fractions. For some polymers where cleanliness of the material is important, may be collected separately. Large sized containers and disposal apertures permit the collection of bulkier goods such as furniture, pipes, windows etc. They also enable some degree of control to be exerted over the types of waste deposited. Porta cabins can be used for temporal or fixed deposits as shown in figure no 1.

The collection schemes established for industrial and commercial sectors usually have better results than for the household waste and municipal waste (from retail, small business). There are two main reasons for this. Firstly, the waste is concentrated in a reduced number of places; this is in contrast to household waste arising, which are geographically more dispersed, making collection more difficult. Secondly, wastes from industry are cleaner and better identified than wastes from households, which give a better value to this waste. Nevertheless, some professional sectors, like the agricultural or construction sectors, do generate quantities of films contaminated by such as earth, humidity etc.

4.1.3 Quality control

As already mentioned, the quality of the sorted plastics has a direct influence on its sale price. In order to maintain the desirable quality, routine quality control must be established. Samples of sorted materials should be analyzed in detail and the results compared with the requested quality.

This enables streams that have sorting deficiencies to be identified. A more detailed analysis will identify the cause of a bad sorting: misunderstanding of the sorting instruction, equipment failing etc. In order to maintain the desirable quality, routine quality control must be established. Samples of sorted materials should be analyzed in detail and the results compared with the requested quality. This enables streams that have sorting deficiencies to be identified. Reduction of volume and storing sorted waste plastics which can be bulky to transport and store. To make these activities more economical, some type of volume reduction process is necessary.

4.1.4 Bailing

This device reduces the volume of plastic waste by compacting, so that storage and transportation becomes relatively easier Baling is a suitable option for both films and bottles, providing a reduction in volume that aids storage, transportation and management of the waste plastics. The baler must be compatible with the baled materials and with the flow. Over-compaction may weld the waste together making it difficult to separate, whilst under compacted bales will be unstable and difficult to stack. Most balers can be used for several materials, but adjustments may be necessary. The choice of baler strapping is also important; it must be strong enough to contain long-term baled material and particularly if the material is to be stored outdoors, be rust-resistant. Polyester strapping or stainless steel is commonly used. For plastic bottles, previous perforation of the bottles improves the density of the bales.

4.1.5 Pre-shredding

For the big pieces of waste plastics, such as pipes or window frames, pre-shredding can be an interesting option in order to reduce the stocking area and the transportation costs. However, it is the responsibility of the sorting plant to evaluate the benefits of such equipment in relation with its price. This type of equipment can also be helpful in reducing the volume of other waste. As for the baler, the two important points to check are the material compatibility and the outflow of materials to shred. It is important to note that shredded material, particularly mixed shredded plastics are not accepted by some markets because quality standards beyond common sorting processes are required and therefore assured applications for the shredded material should be investigated (4).

4.1.6 Storing sorted waste plastics

Rain does not affect the quality of plastics; however, UV light does degrade the physical and chemical structure of most plastics. The effect of UV degradation varies according to the virgin polymer, therefore if plastics are to be stored outside, they should be protected by tarpaulins or other UV-protective material. To avoid contamination by dust and dirt, plastics should be stored on clean concrete floors; storage of the material on pallets can also reduce contamination. Where plastics are to be stored indoors, fire-safety and prevention systems should be installed. Plastic is flammable and while it is difficult to ignite baled plastics; it is much easier for non-baled material. As such, these considerations must be integrated into the planning stages of storage areas.

4.1.7 Collection and transportation

The collection and transportation of plastic waste on a daily basis is an imperative step.
Since the waste cannot be removed as fast as it is littered, it is stored and transported as soon as possible at specific pre-defined frequencies by private traders.. The system of storage and types of vehicles are often compatible.

4.2 Micro Planning -life cycle assessment

An efficient and cost beneficiary system of waste management requires micro planning for collection, storage, transportation processing and disposal of plastic waste. This should also ensure an effective participation of the Government, citizens and NGO's in planning and waste management system.. Integrated sustainable waste manage model as shown in figure no. 5 (1).

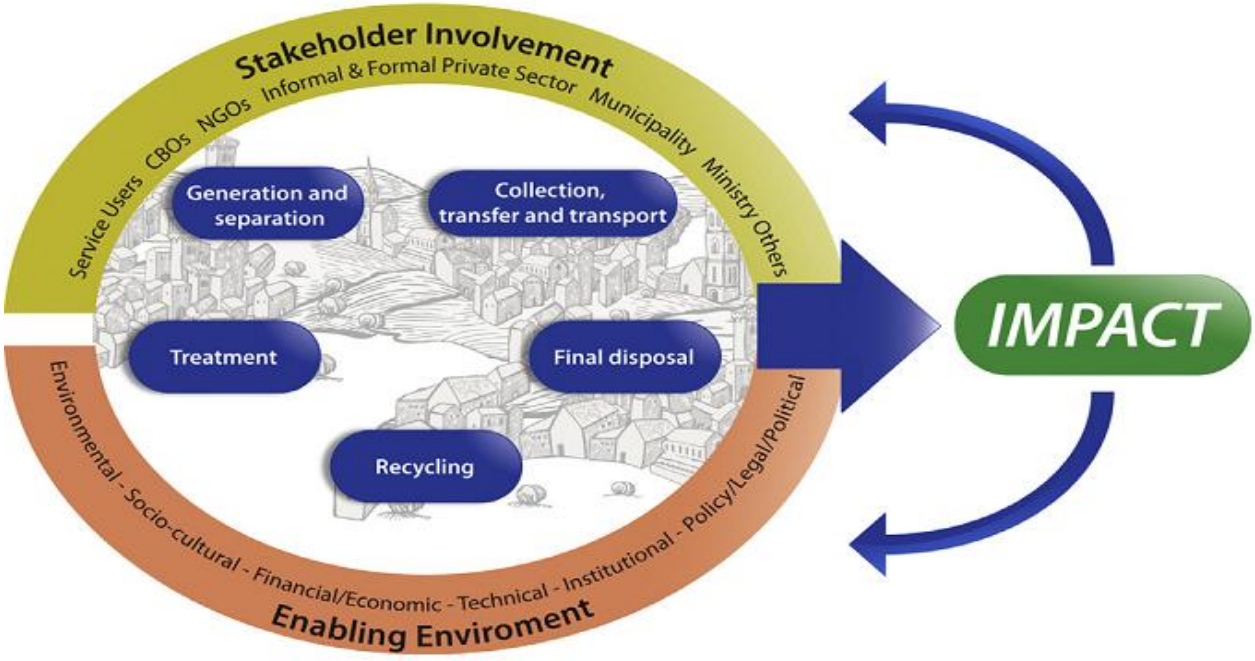

Figure no. 5: The integrated sustainable waste management model

Life-cycle analysis is a technique used to quantify the environmental impact of products during their entire life cycle. The different parts of the life cycle are examined from raw material extraction, manufacture, transport and use through to waste processing. For each stage, an inventory is made of the energy and material consumption and of any emissions to the environment. This makes it possible to identify components where improvement can be made to benefit the environment.

This type of investigation of products may bring economic advantages, as often material and energy consumption are reduced. Environmentally friendly products also have a marketing advantage, as consumers are becoming increasingly aware of 'green' issues. In addition, legislation is being introduced across the world to enforce environmentally friendly practices. The concept of product responsibility is commonplace and manufacturers and end-users must now consider the cradle to grave pathway of each product.

There are many different types of environmental impact. For example, plastics are generally produced from fossil fuels, which are gradually becoming depleted. The production process itself involves energy consumption and further resource depletion. During production, emissions may occur to water, air or soil. Emissions of concern include heavy metals, chlorofluorocarbons, polycyclic aromatic hydrocarbons, volatile organic compounds, sulfur oxides and dust. These emissions have effects such as ozone depletion, carcinogenicity, smog, acid rain, etc. Thus, production of a plastic product can have adverse effects on ecosystems, human health and the physical environment.

The Association of Plastics Manufacturers in Europe (APME) has been at the forefront in developing eco-profiles for the plastics industry and users of plastic products. ISO has been active in generating new standards on environmental management, notably the ISO 14000 family of standards. The Indian center For Plastics in Environment (ICPE) has conducted this study and is available on their website.

As one of the principal uses of life cycle assessment is to improve environmental performance from the first stages of product development. There are many factors to consider for each environmental impact assessment, so a system has to be used to highlight the most significant factors for comparisons to be made. One major advantage of plastic materials is their lightweight and strength - a thin polymer film may perform the same job as a thick layer of natural material, thus resulting in reduced material use and reduced energy costs in transport.

Life cycle analysis is a crucial technique for the plastics industry in the 21st Century. Manufacturers and suppliers need to demonstrate that they are acting responsibly towards the environment in all aspects of production, from the design phase through consumer use and abuse, to disposal of end of life components. This overview of the subject explains the

factors to be considered, the terminology, the organizations involved in developing these techniques and the legislation, which is driving the whole process forward. The ISO standards relating to environmental management are also discussed briefly in the document.

4.3 Recycling of Plastic Waste

The practice of recycling post-manufacturing plastic waste has been in vogue, since the last many years. The recycling of plastic is done through different methods. The compacted bales of plastic waste should reach the recycling units by a dedicated supply chain network on a daily basis. Recycling of plastics waste is carried with a view to make an alternative product for better profit. Following issues should be taken into account, while recycling the plastics.

- Minimize the pollution level during the process
- Enhance the efficiency of the process, and
- Conserve the energy

The collected plastic from WECs of Jhansi has to be channeled properly to recycle unit, and the multilayered metalized plastic, which is littered in the area has to be recycled primarily at the plant. The selection of technological options to recycle/reuse of plastic wastes is depends upon the quality and quantity of plastics waste , the plant will receive. While determining the methodologies of recovery system, it is required to make a distinction between different recovery options namely:

Primary Recycling (Conversion of waste plastic into products having performance level comparable to that of original products made from virgin plastics);

Secondary Recycling (Conversion of waste plastics into products having less demanding performance requirements than the original material);

Tertiary Recycling (The process of producing chemicals/ fuels/ similar products from waste plastics); and

Quaternary Recycling (The process of recovering energy from waste plastics by incineration). However, International Standards like ISO refers Plastics Recycling as a Recovery Process. The recovery has been divided into two categories namely material recovery and energy recovery.

The process flow chart for recovery process is depicted in Figure no. 6.

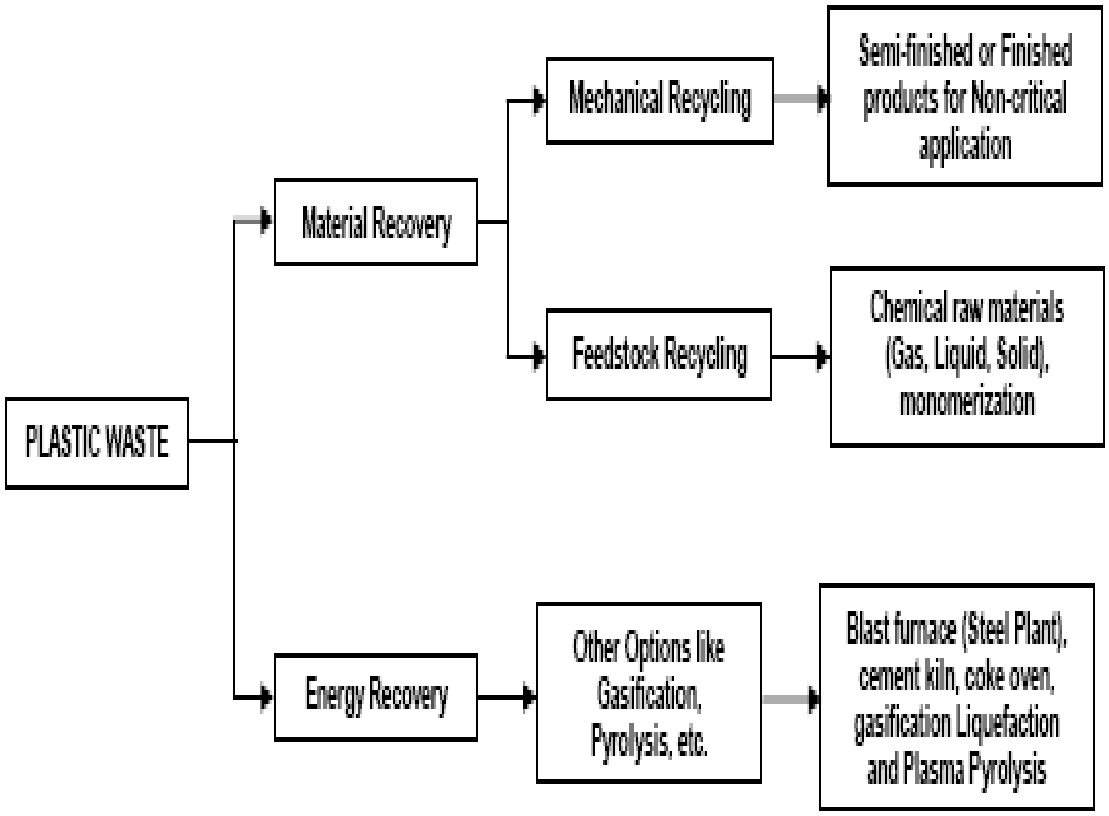

Figure no. 6 Schematic diagram of Plastic Recovery Options

4.3.1 Mechanical Recycling

Mechanical recycling involves processing of waste in to a product with characteristics similar to those of original product. This is the most preferred and widely used recycling process due to its cost effectiveness and ease of conversion to useful products of daily use.
The limitation of this process is that the process requires homogenous and clean input. The process of mechanical recycling of waste plastics into products of varying usefulness mostly involves the essential steps namely:

- **Collection/ Segregation** (Plastic wastes are separated/segregated by Flotation Process in which varying density property of plastic waste is made use for segregating plastics);
- **Cleaning & Drying** (Post consumer plastic wastes require cleaning and drying than industrial waste. The wastes generated during these processes require proper treatment and disposal methods);
- **Sizing/ Chipping** (Cleaned plastic waste products should be sized/chipped to fed into the extruders for processing and palletizing and these operations depends upon the type and size of the plastic waste);

- **Agglomeration/Coloring** (Depending upon the end product, sized plastic waste is mixed with color master batch in high speed mixers/ agglomerators);
- **Extrusion/ Pelletisation**(Chipped plastics are plasticized and re-granulated to make the plastic material ready for fabrication) and finally fabrication into End Product.

4.4 Technological Disposal Options

The selection of appropriate technology for plastic waste disposal and its processes for the management of plastic wastes are available in market. Several processes and technologies have been explored and developed for plastic waste management. Some of these are:

- Chemical recycling of pet bottles into fibers
- Processing of plastic waste in Blast Furnace
- Co-incineration of plastic waste in cement kilns
- Utilization of plastic waste in road construction with bitumen
- Plasma Pyrolysis Technology for disposal of plastic waste and
- Gasification,

4.4.1 Chemical recycling of pet bottles into fibers

This method of plastic recycling, involves the breaking down of polymer chain in to their basic components, which can then be used in various industries. The feedstock plastic recycling process is flexible and more forbearing to the plastic additives, as compared to the mechanical plastic recycling. This is the most costly method of recycling. The varying end products are obtained by using following process;

Monomerization: The waste plastics are initially broken down into their constituent monomers by chemical reaction (depolymerization). These monomers are then extracted for use as the raw material in new plastic products. Monomerization produces higher quality plastic raw materials than material recycling. Which in turn enables the production of high quality plastic products with the same (or almost the same) quality as virgin raw material.
Among other products, this enables the recycling of waste PET bottles into new PET bottles, which is not possible with other recycling technologies. About 50% recovery is possible through this process. The limitations of this process is that, the large scale process setup along with clean and single resin plastic waste as input is required.

4.4.2 Processing of plastic waste in Blast Furnace

Plastic waste can be co-incinerated as fuel in the iron and steel industry. This will reduce coal consumption and hence in reduction in the consumption of energy. The proportion of

waste plastic added to coal should be about 1% by mass. Increased addition of waste plastic will reduce the heating strength of the coal/coke18. The use of plastic in coke ovens-a typical high-temperature process in the iron and steel industry was put in practice in the year2000 at Nippon Steel Corporation, Japan. In this process, the collected and baled plastic waste that has been agglomerated by pre-treatment is mixed together with coal and charged into coke oven. The mixed plastic waste and coal are carbonized in an oxygen-free reducing atmosphere at about 1,100 to 1,2000C. As a result, the waste plastic is thermally decomposed into coke (about 20%), tar/light oil (about 40%) and coke oven gas (about 40%). These products obtained by the carbonization of waste plastics have their own uses.When plastics are used together with coke, CO2 emission is significantly less. The excessive reducing gases are also used for blast furnace stove and power generation.

4.4.2.1 Blast Furnace: Plastics waste can be used as an alternative raw material in blast furnaces to generate energy for manufacturing of iron. Plastic waste can be successfully used as a reducing agent in blast furnaces for the manufacturing of iron from its ore. Use of coke in blast furnace provides only one type of reducing agent- carbon Monoxide. In contrast, use of plastic waste provides one additional type of reducing agent – Hydrogen. Advantage of this process includes use of all types of plastics including laminated plastics without creating any environmental pollution19. The high temperature inside the blast furnace around 20000C ensures that there is no possibility of any dioxins formation even if PVC is processed.

Furthermore, as the reducing atmosphere in the low- temperature region at the top of the furnace contains no oxygen, no dioxins are produced or resynthesized in the lower temperature zone also.

The plastics waste is first formed into suitable size either by crushing or pelletizing as necessary, and subsequently injected into the blast furnace from the tubers at the base of the furnace with hot air. The injected plastic waste material is broken down to form reducer gas- Carbon Monoxide (CO) and Hydrogen (H2). The reducer gas rises through the raw material layers in the blast furnace and reacts with iron ore to produce pig iron. The gas, after the reduction reaction, is recovered at the top of the blast furnace which has energy content to the tune of 800 kcal/NM3 and is reused as a fuel gas in heating furnaces within the steel plant.

4.4.3 Co-incineration of Plastics Waste in Cement Kilns

Keeping in view the problems associated with the disposal of plastic waste, CPCB initiated a study on “Co-incineration of plastic waste in cement kiln” in collaboration with Indian Centre for Plastics in the Environment (ICPE), MP Pollution Control Board and ACC Ltd. Co

incineration refers to the usage of waste materials as alternative fuels to recover energy and material value from them. The temperature in the cement kiln process is about 14000 ° C.

Excess level of oxygen and counter flow operation with the flue gases moving in a direction opposite to the materials lends a high degree of turbulence to the process. The presence of an alkaline reducing environment (lime) and the pre-heating of the raw materials by a preheated tower (>100 meter tall) acts as an ideal scrubber for hot flue gases before they are emitted into the atmosphere. The 3Ts- Time, Temperature and Turbulence in cement kilns provides extremely high destruction removal efficiency (DRE) for the plastic wastes. Co-incineration leaves no residue as the incombustible, inorganic content of the waste materials are incorporated in the clinker matrix. Therefore, after the waste is co-incinerated, it becomes a part of the product. Co-incineration ranks higher on the waste disposal hierarchy and eliminates the need for landfills and incineration.

Based on the above study, the CPCB permitted the RDF and mixed plastics to be used in cement kilns and steel furnaces, as alternative fuel, which operates above 1200 degree centigrade.

4.4.4 Utilization of plastic waste in road construction

To address the plastics waste disposal issue, an attempt has been made to describe the possibilities of reusing the plastics waste (post-consumer plastics waste) in road construction. Central Pollution Control Board (CPCB) Delhi has published “Indicative Operational Guidelines on Construction of Polymer – Bitumen Roads for reuse of waste plastics (PROBES/101/2005-06). The document explains the method of collection, cleaning process, shredding, sieving and then mixing with bitumen for road laying. This study was carried out by Thiagaraj college of Engineering, Madurai and the report was circulated to all the State Pollution Control Boards / Pollution Control Committees and other road laying agencies for References.

By using this technology (plastics waste coated aggregate bitumen mix), several roads have been laid in the States of Tamil Nadu, Maharashtra, Puducherry, Kerala,Andhra Pradesh and Goa. To evaluate the performance of the built roads using plastics waste coated aggregate (PCA) bitumen mix and also to generate data base for evolving Standards by Indian Road Congress (IRC), CPCB has instituted a study on “Performance Studies of Polymer Coated Bitumen Built Roads during 2002-2007” to Thigarajar college of Engineering, Madurai. In this report parameters suggested by Central Road Research Institute (CRRI) and Indian Road Congress (IRC) have been incorporated. Further details of each test and its comparison with the IRC Standards have also been given in this report.

4.4.4.1 Process Details

Mini Hot Mix Plant

Step I: Plastics waste (bags, cups, thermocole) made out of PE, PP, and PS cut into a size between 1.18 mm and 4.36mm using shredding machine, (PVC waste should be eliminated)

Step II a: The aggregate mix is heated to 1650°C (as per the HRS specification) and transferred to mixing chamber.

Step II b: Similarly the bitumen is to be heated up to a maximum of 160^0C (HRS Specification) to have good binding and to prevent weak bonding. (Monitoring the temperature is very important)

Step III: At the mixing chamber, the shredded plastics waste is to be added over the hot aggregate. It gets coated uniformly over the aggregate within 30 to 45 secs, giving a look of oily coated aggregate.

Step IV: The plastics waste coated aggregate is mixed with hot bitumen and the resulted mix is used for road construction. The road laying temperature is between 1100c to 1200°C. The roller used is 8-ton capacity

Central Mixing Plant: The modified process can also be carried out using central mixing plant. The shredded plastics are added along the aggregate in the conveyor belt. A special mechanical device is developed which will spray the plastics inside the chamber to coat the plastics effectively. This also can be used as an alternative method CMP helps to have better control of temperature and better mixing of this material thus helping to have a uniform coating.

4.4.5 Plasma Pyrolysis Technology (PPT)

Plasma pyrolysis is a state of the art technology, which integrates the thermo-chemical properties of plasma with the pyrolysis process. The intense and versatile heat generation capabilities of Plasma Pyrolysis technology enable it to dispose of all types of plastic waste including polymeric, biomedical and hazardous waste in a safe and reliable manner. Plasma Pyrolysis is the thermal disintegration of carbonaceous material in oxygen-starved atmosphere. When optimized, the most likely compounds formed are methane, carbon monoxide, hydrogen carbon dioxide and water molecules.

4.4.5.1 Process Technology:

In Plasma Pyrolysis, the plastics waste is fed in to primary chamber at 850^{o}C through a feeder. The waste material dissociates into carbon monoxide, hydrogen, methane, higher hydrocarbons etc. Induced draft fan drains the pyrolysis gases as well as plastic waste into the secondary chamber where these gases are combusted in the presence of excess air. The inflammable gases are ignited with high voltage spark. The secondary chamber temperature is maintained at 1500°C. The hydrocarbon, CO and hydrogen are combusted into safe carbon dioxide and water. The process conditions are maintained such that it eliminates the possibility of formation of toxic dioxins and furans molecules (in case of chlorinated waste). The conversion of organic waste into non toxic gases (CO2, H2O) is more than 99%. The extreme conditions of plasma kill stable bacteria such as bacillus sterio- thermophilus and bacillus subtilis immediately. Segregation of waste is not necessary, as the very high temperatures ensure treatment of all types of waste without discrimination (2).

4.4.6 Gasification

Gasification is a recycling method where waste plastics are processed into gases such as carbon monoxide, hydrogen and hydrogen chloride. These gases are then used as the chemical raw material for the production of chemicals such as methanol and ammonia.
Almost all types of plastics, including those containing chlorine, can be recycled under the gasification method. This method is therefore suitable for miscellaneous plastics or plastics that are hard to sort.

In this process, the long polymer chains are broken down into small molecules, for example, into synthesis gas. The process may be fixed bed or fluidized bed gasification. In the fluidized process sand is heated to 600~8000°C at first- stage low temperature gasification furnace and plastic introduced into the furnace. Waste plastic break down on contact with the sand to form hydrocarbon, carbon monoxide and hydrogen. The gas from the low-stage gasification furnace is allowed to pass in second-stage high temperature gasification furnace with a steam at a temperature of 1.300~1,5000°C to produce a gas composed primarily of carbon monoxide and hydrogen.

At the furnace outlet, the gas is rapidly cooled to below 2000 °C to prevent the formation of dioxins. The gas then passes through a gas scrubber, and any remaining hydrogen chloride is neutralized by alkalis and removed from synthetic gas (2).Slag is produced as a by-product, which can be utilized as raw material for civil engineering works and construction materials. There are problems in controlling the combustion temperature and the quantity of unburned gases.

4.5 Assessment and Quantification of Plastic Waste Quantification in Sixty Cities

CPCB has sponsored a study to CIPET for Assessment and Quantification of Plastic Waste generation in sixty major cities. The objective of study is given below;

- To assess the type, nature and quantum of plastics waste in the country through field survey and physical assessment at 60 towns and Cities.
- Establish a Co-ordination mechanism with local Municipal/Metro corporations in identifying the dump grounds/Localities of higher waste generation for the physical assessment/characterization of MSW as per the prescribed methodology.
- To report on the existing methodology for collection of waste by urban local bodies/Municipal bodies in different states of the country.
- To suggest the viable and appropriate recycling technologies at major cities with investment estimation for effective Plastics waste Management (based on "Zero Waste Concept"). The preliminary findings of the study are given in the Table no.12 below:-

Table no. 12 The preliminary findings of the study (Plastic Waste) CPCB

City	TMSW	PMSW	Total Plastic Waste (TPD)
Kavaratti	2	12.16	0.24
Dwaraka	18	8.28	1.49
Daman	25	4.554	1.14
Panjim	25	4.47	1.12
Gangtok	26	11.12	2.89
Jamshedpur	28	3.216	0.90
Silvassa	35	6.077	2.13
Port Blair	45	10.76	4.84
Kohima	45	5.013	2.26
Shimla	50	4.273	2.14
Meerut	52	6.444	3.35
Gadhinagar	97	4.361	4.23
Shilong	97	5.436	5.27
Itanagar	102	5.352	5.46
Agartala	102	5.712	5.83
Aizwal	107	7.948	8.50
Imphal	120	5.132	6.16
Ranchi	140	5.915	8.28
Kochin	150	6.288	9.43
Dhanbad	150	5.008	7.51

Guwahati	204	5.036	10.27
Asansol	210	6.017	12.64
Dehradun	220	6.665	14.66
Patna	220	5.696	12.53
Raipur	224	10.607	23.76
Rajkot	230	6.92	15.92
Tiruvanandapuram	250	6.022	15.06
Pondicherry	250	10.62	26.55
Chandigarh	264	3.098	8.18
Jammu	300	7.226	21.68
Jaipur	310	5.085	15.76
Vishakapattnam	334	9.033	30.17
Nashik	350	5.822	20.38
Bhopal	350	6.594	23.08
Allahabad	350	5.377	18.82
Jabalpur	400	5.175	20.70
Bhubaneswar	400	7.862	31.45
Madurai	450	5.059	22.77
Varanasi	450	5.78	26.01
Agra	520	7.863	40.89
Srinagar	550	5.117	28.14
Amritsar	550	4.44	24.42
Vadodara	600	4.704	28.22
Vijayawada	600	7.352	44.11
Nagpur	650	6.984	45.40
Coimbatore	700	9.473	66.31
Jhansi	700	11.65	81.55
Indore	720	8.805	63.40
Ludhiana	850	5.962	50.68
Surat	1200	12.468	149.62
Lucknow	1200	5.886	70.63
Pune	1300	7.971	103.62
Kanpur	1600	6.666	106.66
Bangalore	1700	8.483	144.21
Ahmedabad	2300	10.5	241.50
Kolkata	3670	11.59	425.35
Hyderabad	4200	4.72	198.24
Chennai	4500	9.54	429.30
Mumbai	6500	6.477	421.01
Delhi	6800	10.13	688.84

The total MSW Generated in 60 cities as in shown table no. 2, around 48592 MT/Day and the Total Plastic Waste generated in same cites around 3905.64 MT/Day

4.6 Biodegradable & Compostable Plastics

Compostable Plastics: The Plastics that undergoes degradation by biological process during composting to yield CO_2, water, inorganic compounds and biomass at rate consistent with other known compostable material and leave no visible, distinguishable or toxic residue.

Biodegradable plastics made with bio based polymers have been available for many years. Their high cost, however, has meant they have never replaced traditional non-degradable plastics in the mass market. Types of Biodegradable Plastics: There are several degradable plastic are reported such as: Biodegradable, Compostable, Hydro-biodegradable, Photodegradable and Biodegradable. Biodegradable Plastic Products: Starch-based products including thermoplastic starch, starch and synthetic aliphatic polyester blends, and starch, Naturally produced polyesters, Renewable resource polyesters such as PLA, Synthetic aliphatic polyesters, Aliphatic-aromatic (AAC) co polyesters, Hydro-biodegradable polyester such as modified PET, Water soluble polymer such as polyvinyl alcohol and ethylene vinyl alcohol, Photodegradable plastics, Controlled degradation additive master batches (2).

4.7 Plastics Waste Reduction Model

Waste Reduction Model (WARM) to estimate streamlined life-cycle greenhouse gas (GHG) emission factors for various plastics, beginning at the waste generation References point. The WARM GHG emission factors are used to compare the net emissions associated with management of plastics in the following four materials management alternatives: source reduction, recycling, land filling, and combustion (with energy recovery).

In figure no. 7 shows the general outline of materials management pathways for plastics in WARM for background information on the general purpose and function of WARM emission factors. WARM also allows users to calculate results in terms of energy, rather than GHGs. Plastics included in WARM are high-density polyethylene (HDPE), low-density polyethylene (LDPE), polyethylene terephthalate (PET), linear low-density polyethylene (LLDPE), polypropylene (PP), general purpose polystyrene (PS), and polyvinyl chloride (PVC). These plastics were chosen for WARM because they represent plastics commonly found in the MSW stream and comprehensive and complete data were available from a consistent source for these plastics due to the large number of end applications for plastics (e.g., bags, bottles and other consumer products) and the lack of data specific to the Jhansi.

4.8 Plastics recycling & sustainable development

The recycling of plastic waste can be a positive contribution to a sustainable development policy, integrating environmental, economic and social aspects, within a framework of effective legislative instruments. Continuing advances in sorting and processing technologies

is increasing the accessibility of waste previously deemed unsuitable for recycling. Greater ranges of materials are now accepted for recycling; while developments in collection and sorting systems continue to increase the quality of recycle waste generated. This is supported by R&D into new markets for secondary plastics, which is essential if plastics' recycling is to be sustainable. Research into new and existing practices will expand opportunities for secondary materials; what is currently not technically or economically viable may be so in the future. It should look towards the material needs of the present, using best available technologies and practices to meet market demands, while appreciating the impacts that future technological and material quality requirements will have on current practice (4).

The benefits of recycling can be categorized into these aspects such as; environmental, economic, social and Environmental awareness of the population. These are briefly explained below.

4.8.1 Environmental aspects

There is this one environment system, which we all share and it must be treated with the respect and care it deserves. It is already been exploited to the maximum in its resource use and it makes sense to use them again if possible. This means that reserves last longer into the future. Moreover, recycling of plastic waste conserves natural resources, particularly raw materials such as oil and energy. The more that is recycled, the longer will natural resources be available for future generations. It means that there is less environmental impact due to mining, quarrying, oil and gas drilling, deforestation and the likes. If there are fewer of these operations, the environment will be safe from continuous destruction and degradation.

Another positive effect of recycling on the environment is that it may reduce emissions of substance such as carbon dioxide (CO_2) into the atmosphere. From life- cycle analysis of reprocessed plastics and virgin plastics, it is known that the emissions of CO_2, SO_2, NO_X (NO and NO_2) are much smaller for recycled plastics compared to that for virgin materials (3). Hence the environment will be better safe from air pollution and global warming if recycling is adopted on large scales. Recycling of plastic wastes will also safe both ground and surface waters from pollution. This is because if discarded randomly, they choke gutters and even find their way into water bodies that serve as sources of drinking water for communities and towns. They also help to breed leachate that can seep into the ground there by contaminating groundwater bodies as well.

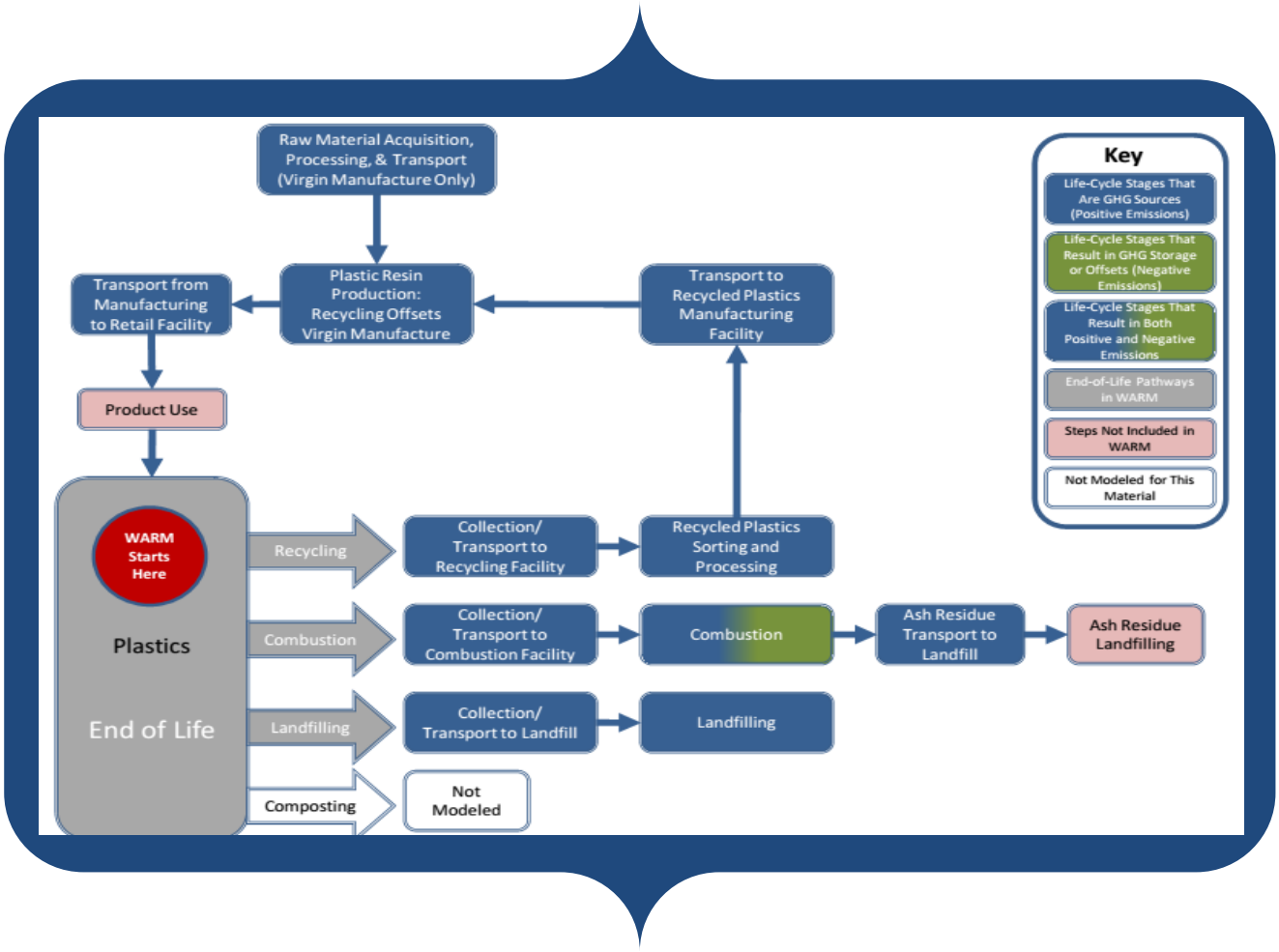

Figure no. 7 Life Cycle of Plastics in Waste Reduction Model

4.8.2 Economic aspects

Resource recovery reduces the quantity of raw material seeded in production processes. The reuse of plastic say therefore helps to reduce the dependence on ported raw materials and to save foreign currency. Due to increasing cost of virgin plastics as a result of dwindling oil reserves, the use of reprocessed pellets for product manufacture will save recycling companies from folding up as a result of high cost of importation of virgin pellets. The low energy and water consumption will save recycling companies from paying huge bills that could otherwise have adverse effect on their operations (4).

4.8.3 Creating employment

Recycling can be an opportunity to create local jobs in collection, sorting, communications, administration and reprocessing. The reprocessing can be undertaken locally, regionally or beyond, and consequently the positive economic aspects of increased employment can be local or dispersed further afield. Job creation obviously brings many positive social effects.

4.8.4 Social aspects

The introduction of an intensive recycling strategy can avoid the need of new or additional incineration or landfill capacity. The setting up of such facilities is a challenge for the public

authorities, which will inevitably face some degree of Nimby phenomenon, although this can be mitigated through effective, sustained public communications. However, in many cases recycling costs are higher than incineration; hence the cost for the citizen will go up.

Recycling of plastic wastes helps to keep the environment clean. Therefore diseases associated with filth will be prevented and this will save foreign exchange in the importation of drugs to fight cholera and malaria that may result from the rubbish heaps. Recycling will also create a healthy environment for tourists attraction Recycling is a source of job creation. Through recycling, numerous poor people will get employed particularly at the collection stage and hence be able to earn their living. This will help raise social standards and to eliminate vices in society.

4.8.5 Environmental awareness of the population

The introduction of recycling programs will heighten public environmental awareness. As a consequence, a significant fraction of population feels motivated to participate in schemes where they are offered. There often follows an increased demand – with local elected representatives targeted - to improve and extend the existing services to a wider variety of waste plastics. This enhanced awareness can be linked beneficially to plastics in general, improving the image of these materials (which are often associated with wastage, the throw-away society and litter). In addition, including plastics in multi-material collection schemes can raise the overall amount of materials collected from curbside collection schemes by between 20 – 30 per cent.

4.9 Bottlenecks of Plastic Recycling

Plastic waste recycling has increased the world over and has been largely successful. Nevertheless, much more effort must be done in order to reach terms of sustainable development. There are still some difficulties that the plastic recycling industry must overcome regarding technological bottlenecks for multilayered plastics recycling and those of demand from end-markets for the recycled materials.

4.10 References:

1. Lilliana Abarca Guerrero, Ger Maas, and William Hogland, Solid waste management challenges for cities in developing countries, Sci Verse Science Direct, Waste Management 33 (2013) 220–232
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CHAPTER 5

PLASTIC WASTE MANAGEMENT

(JHANSI)

5. PLASTIC WASTE MANAGEMENT- JHANSI

5.1 Objective

The law - Plastics Waste (Management and Handling) rules have been enacted in 2011, by Ministry of Environment, Forest and Climate Change, Government of India, and has yet not been implemented in any city or a municipal body in its correct form. For this there is a need for system designing, which encompasses the responsibility of municipal body, getting the plastics industry involved under extended producer responsibility and getting the informal sector in a formal regulated framework.

This forms the basis of this project for the first time in the country under a contract of an ULB. This replicable system is based on in-depth grass root experience in a varieties of waste streams across India and leaves a very few questionable modalities. The costs associated with the municipal waste sorting systems, which were designed for the waste having recyclable content of more than 60% have resulted in mass failures all over the country. And the diversion to waste to energy – with all its emphasis now, leaves the questions of feasibility – exactly for the same reason. If recyclable content having combustible values, remains less than 50% in our waste — the feasibility will always be questionable. The major hurdle is realization by the same regulatory agencies, and resistance of ULB operatives, for reasons best known to them. The proactive initiatives by city managers can make it successful with right understanding, commitment and enthusiasms.

We believe this customized system will be set a trend to address the plastics litter problem, and plug in the loopholes in the most of the waste streams, where the laws are plastic centric. As of now, not one ULB in the Country transports the recyclable waste, an activity, which we see everywhere in urban landscape run by informal sector. The focus here is all based on contribution made by informal recycling network and their better participation in this innovative system, making rag picking a phenomenon on the verge of extinction.

This reverse supply chain network has all its dimensions of retail management – a contemporary foray of corporate world. The systems management, the operative protocols, the technology intervention, the engineering conceptualizations, all goes with advance understanding of inclusive growth. The compulsive contribution of populace has sentimental base in the guilt of awareness to cause of death to our birds, livestock, harm to earth and waters, rivers and oceans.

The over-all objective of this work is three-fold.

i. To investigate the actual supply chain network of plastic waste from households to commercial units along with the other recyclables.
ii. To identify and propose a sustainable plastic waste management by installing Waste Exchange centers and bins for collection of recyclables with all the plastic waste and a Waste Processing Unit for primarily non-recyclable plastics waste.

iii. Preparation of a Project Report, system design, sourcing of equipment, and necessary modalities for implementation and monitoring.

5.2 Scope of the work.

I. Conduct a survey and mark suitable places for opening waste exchange centers, earmark the populace, which can be served with each of them, and identify and register the informal recyclable waste traders and collectors to be connected with them.

II. Design and execute a customizable system, for plants and machinery, and norms of regulatory clearances.

III. Source the equipment, install and commission, and stake holders meet, and awareness campaign.

IV. Source a part of the funding for the project under EPR, CSR & VGF.

V. Monitor the operations for 10 year.

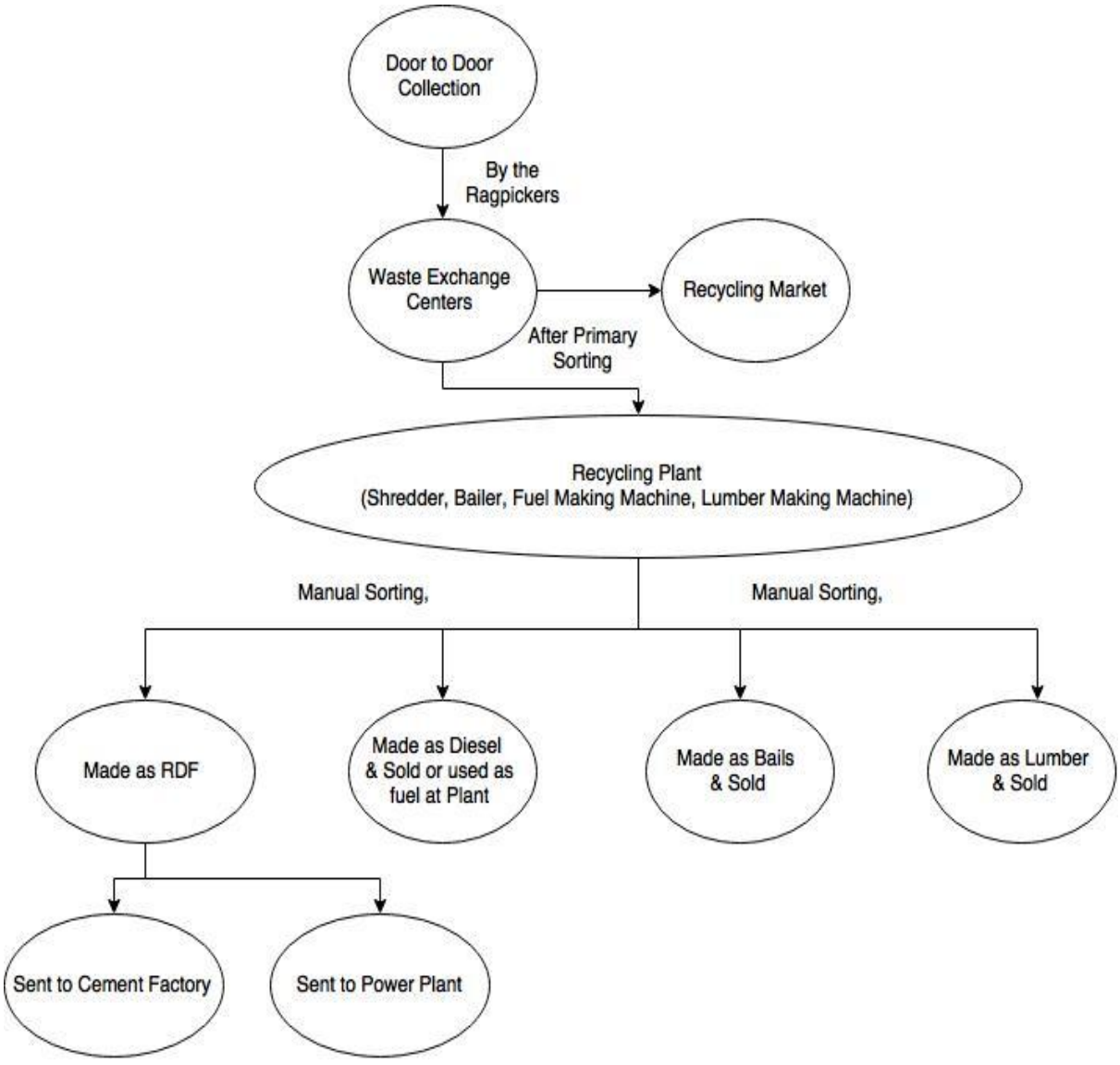

Figure: Approaches to Plastic Waste Management

5.3 Approaches

Plastic Waste Management is a crucial problem not only for developing countries but for the developed countries as well. Enormous amount of Waste is generated throughout the world and the most crucially posed question is how to manage these wastes effectively and efficiently to save the environment and the continuous existence of mankind. Many municipalities, cities and towns continue to grapple with the problem of Plastic Waste Management. This figure no. 8 of approaches of the work shows the working way out of this work.

The organic component of Municipal Solid Waste may not be too much of a problem, since that is bio-degradable. However, the Plastic Waste component of the Municipal Solid Waste is quite problematic because this is non-biodegradable and therefore can stay in the environment for a considerable length of time causing all sorts of problems. The management of Plastic Waste through combustion (incineration) is not environmentally friendly and sustainable since this may release carbon dioxide, a major contributor to global warming (greenhouse effect). Land filling with Plastic Waste is also not desirable since plastic is non degradable and no economic value would have been derived from the waste in that case. The best option for Sustainable Plastic Waste Management is through recycling. This is because the benefits of recycling of Plastic Waste are numerous and also environmentally friendly compared to the other methods of waste disposal. Through recycling of Plastic Waste, we can have material and energy recovery and therefore value will be derived from the waste instead of regarding it as garbage or trash.

The approach for the present study is presented in above flow diagram. Based on desk research, the parameters such as source and type of plastic used/consumed were identified for data collection and surveys in Jhansi. The quantification and categorization were conducted for each site. The method of plastic waste collection, transportation and disposal were studies at sites. The recommendations were made based on study.

5.4 Study Methodology

The methodology adopted for assessment of plastic waste and its management in Jhansi was achieved by following the standard approach for desk research, field studies, data collection, analysis and interpretations. The acts, legislations and standards were also consulted. Meetings were conducted with individuals and organizations involved in the plastic sector. The approach and methodology adopted is discussed in subsequent sections which will come under the environmental issues and CPCB guideline Salient Features of the PWM Rules, 2011 (1), shown in **Appendix- 1**.

Thermo plastics are re-usable and recyclable, and hence there is no problem of disposal of the plastic waste, however due to poor littering habits inadequate waste management system / infrastructure, plastic waste management/ disposal continue to be a major problem for the civic authorities, especially in the urban areas. The quantity of actual plastic

waste generated from source and reaching to dumping site for final disposal is not same and It depends on efficiency of collection and transportation of plastic waste along with MSW, picking of recyclable material by rag-pickers at different level are other factors. For assessment of plastic waste generation Jhansi, Three main sources are identified for the study (1). These are Residential area, Commercial area and industrial area.

The field team has conducted the vendor's survey at each ward. In addition, surveys were also conducted for rag-pickers and kabadis for actual quantification of plastic waste generation in Jhansi. The GPS coordinates for placement of waste exchange centers were also determined with JNN and permission for its use for WEC was applied. The Population to be served was determined by each of these WECs.

An assessment of percentage of plastic waste in Municipal Waste in Jhansi was carried out by the PMA. The study is published in Volume 1 of this DPR under Chapter 8.

5.5 Plastic waste management:

Pertaining to the objectives of the study, plastic waste management system was studied in more detail. There is no separate institutional mechanism for management of plastic waste. However, due to commercial value of waste plastic, there is large scale involvement of informal sector in management.

5.5.1 Plastic waste generation

Urbanization and increased incomes have led to rampant use of resources and therefore, more generation of waste. Enhanced plastic waste generation is one such waste stream which has increased manifold because of these factors.

The major sources of plastic waste are:

- Municipal sources like households, commercial establishments, hotels, etc
- Industry sector like packaging films, pipes, food, etc

5.6 Plastic waste collection and disposal:

- Plastic waste like regular municipal waste is disposed at roadsides and can be found littered all over. The biodegradable waste along with the uncollected non-biodegradable mixed waste is deposited by consumers and is taken care of by the municipal corporations. Since, plastic waste has a commercial value; it is picked up by informal sector from street dumps and also at municipal waste collection points. The unutilized waste along with municipal waste is disposed at processing site.
- This system will discourage these practices and eventually eliminates it. It is intended to be collected from every house hold and in Jhansi, 33 collection points have been identified (for initial phase) and to be supplied with portacabins, community bins, open bins, dumper, etc. They will operate under a system protocols described in these pages.

5.6.1 Two-Bin/bag System

Plastic waste needs to be collected from the all old over city roads, and lanes drains, and trees besides the households and commercial complexes. Apart from those sites, where the door to door waste collection is not done, such as near bus stands, cinema halls, shopping malls, hospitals and other public places, covered bins should be placed. The recyclable waste will be separated from food waste and other biodegradable waste, in separate bags at the source of waste generation, and from these bins. The bins wherever placed should be clearly labeled/marked on them "Recyclable Waste" and "Bio-degradable Waste". The plastic waste will be separated out from other traded or sent to recycling site. The bio-degradable waste goes to the Municipal processing site and recyclable waste can be handed over for further reuse. The reuse of recyclable waste material will reduce processing cost and environment pollution and as such, it is necessary to operate this system for the whole city. The allocation of around 33 waste exchange centers for plastic waste collection of size of 5X5 square meters in every 3 sq. km. within Jhansi is done for the purpose of this project.

5.6.2 Porta cabin as waste exchange center

A WEC is a recyclable waste collection facility, where a local waste trader can manage sale and purchase of recyclable waste. It has to be whole of recyclable waste since waste plastics alone is not of the interest of the waste pickers and all kind of recyclable waste adds to value to their labor and efforts. There has to be separate containers for the collection of plastics, which are subsequently sorted into valuable and refuse fractions. Some polymers, where cleanliness of the material is important for plastic may be collected separately. Large sized containers and disposal apertures permit the collection of bulkier goods such as furniture, pipes, windows etc. They also enable some degree of control to be exerted over the types of waste deposited.

A 400 sq. ft of covered area is required for storage of 200 kg of plastic waste, due to its volume. Approximately 200 kg of plastic waste will be collected and store every day and transported to the recycling unit. We have identified approximately 33 Porta Cabin places in Jhansi. Their ward wise distribution and the location detail with GPS Locations are shown in **Appendix no.2.**

5.7 Plastic waste recovery and recycling

An important feature of waste recovery and recycling is the involvement of the informal sector. This sector is mainly engaged in the recovery and re-sale of most of the recyclables and is highly labor intensive. The informal sector constitutes a chain of actors who are involved in the trade of plastic waste and recycling.

5.7.1 Informal sector

The informal sector works parallel to the formal municipal waste management system, and is largely an economic driven activity. The key players in informal management are:

5.7.2 Waste pickers

The rag pickers carry out scavenging with bare hands which makes them susceptible to a wide range of infections, cuts and wounds. Secondary research estimates that the rag pickers feed into the recycling chain between 12 and 15% of the total waste generated. These rag pickers are generally children from very low socio-economic backgrounds. The average earning of the rag pickers varies from Rs 30 - Rs 200 per day depending on the quantity and quality of plastic collected. Clear, transparent and soft plastics are sold for better price. Their earnings are also dependent on seasonal variations. Since they endanger themselves physically by entering disposal sites and collection bins without any protection equipments like gloves, masks, boots, etc. they are exposed to injury by iron and glass pieces. It is intended to connect these waste pickers to each waste exchange center with biometric identification and defined area litter free management. They can be called as WECANGELS under this program.

5.7.3 Scrap Dealers (Kabariwala/Feriwalas)

Some good quality plastics like (kitchen ware, buckets, etc) are sold to the kabariwalas directly by households and small shops, as they fetch better price. Since this material has not been mixed with the disposable waste, the quality of plastics is much higher than that gathered by the rag pickers. These kabariwalas collect the waste and sell it to scrap dealers. Scrap dealers generally collect one type of scrap (for instance plastics only). This trade is still an informal activity because the traded materials are unregistered. The dealer sorts the waste, bundles it, and sells it to the bulk buyers. It is intended that these waste traders will be engaged to run the waste exchange centers under a profit sharing arrangement and standard operating protocol.

Therefore the work design stands as: The work of establishing & operating at least 1 modern plastic waste Exchange centers (WEC's) in every 5 – 10 Sq. Km of municipal area (approx.), erecting recyclable waste collection bins 5 or more with each waste exchange center at public places and constructing plastic recycling/recovery unit and ensuring Jhansi city is plastic litter-free shall be undertaken with a proper arrangement with the local waste traders, waste purchasers, and waste pickers.

5.7.4 Rag Pickers (WEC-ANGELS)

It is proposed that Jhansi Nagar Nigam under this program will ensure that all the existing certified and registered Rag Pickers are given charge for a number of houses for recyclable waste collection in their area of operation. They will be responsible from 100 to 1000

houses and shops etc. These people will have their bank accounts and insurance and poverty alleviation programs and their children from age 12 to 18 will be educated in special classes along with skill development process for recycling project operations. Every Rag Picker has been given bags to distribute and collect for the number of houses he/she is responsible. Safety jackets, bicycle rickshaws, waste storage bags, Identity cards etc are pre-requisite tools required for this job.

5.7.5 The operating protocols could be as follows for executing the project:

a) *Installing of minimum one state-of-art porta-cabins called Waste Exchange Centers (WEC) at every 5 – 10 Sq. Km of Municipal area (approx.) or more as per the availability of space.*

b) *The Nagar Nigam may enter into a mutually beneficial agreement with local waste traders, to operate these waste Exchange center as per the Standard operating procedures mutually developed with Project Management Agency.*

c) *These Waste exchange center operators (WECOP's) may deploy house to house waste purchasers called waste exchange center guides (WECGUIDES) and Waste pickers called (WEC-ANGELS) to carry out litter free area management.*

d) *All the associates working at each WEC's should have BIOMETRIC identification and attendance systems.*

e) *All the residents being served for recyclable waste collection systems should be provided the phone numbers of these WECOP's and WECGUIDES.*

f) *Each house hold may be provided a plastic bag free of charge for collecting recyclable waste, which will be periodically replaced when full and collected by WECGUIDES.*

g) *An awareness campaign has to be done by the firm to make public participate in this municipal authorized recycling program.*

h) *Placing adequate number of collection Bins with bags.*

i) *Establishing, running and maintenance of one modern plastic recycling/recovery unit for entire city in 1 acre of land so provided.*

j) *The space for above activities is earmarked by the PMA for Jhansi Nagar Nigam. A rent will be levied for the space provided for Waste exchange Centers (WEC's).*

k) *Purchasing recyclable waste from every house hold periodically and collecting non commercial recyclable waste from every house hold.*

l) *Collection of all kinds of plastic waste from bins, parks, curbside and all other the public places.*

m) *Transporting the plastic waste to the WEC's and selling to authorized recyclers of pollution control boards, and/or further to the project recycling unit.*

n) *Operation of the recycling center and recovery of oil, lumber and other products from the recyclable waste and shall meet the norm of Pollution control boards.*

o) *Maintenance of all secondary collection points/bins in absolutely spick and span condition.*

p) *Making sure the city area if completely plastic litter-free during daytime.*

5.7.5 Bulk Buyers & Granulators

They are the traders and collect material until it is sufficient to be sent to the recycling plant. Since the investment is very low, and the quantities of waste are very high, some of the bulk buyers are also the granulators. They feed the granules into the recycling sector.

5.7.6 Recyclers

The plastic acquires a fairly high value before it is fed into the recycling chain. Interactions with scrap dealers in Agra revealed that even without any reprocessing, the value of the plastic waste within the trade increases by more than triple. It is intended that these waste traders will be engaged to run the waste exchange centers under a profit sharing arrangement and standard operating protocol.

5.7.7 Transportation of Waste

In Jhansi, transportation of recyclable waste is carried out by the traders in all kinds of vehicles. It is intended that the waste collected by the waste exchange centers will be transported as usual, except the waste, which has to go to the recycling plant of the project. Besides the recyclable and plastics waste vehicle from Nagar Nigam will run on call basis and carry such waste directly to the recycling plant of the Nagar Nigam. It is proposed that Jhansi Nagar Nigam will depute at least 8 to 10 vehicles of medium and big sizes for recyclable waste collection along with 100 rickshaw's and 50 bicycles and other tools for collection and storage of recyclable waste.

5.8 Public Private Partnership

There is no Public Private Partnership (PPP) module as envisaged in the government directives and policies for this project. The whole project is conceptualized based on the ULB's, ownership and ULB's operations. There is no private investment neither private operation. The knowledge partner for the subject, technology and management is the Project Management Agency, which will work through the ULB's resources and costs for a fixed fee and incentive. This is again unique in terms of the current practices of solid waste projects, which have almost all failed. Public participation and public contribution is for the ULB's initiative and work, to meet its service level benchmarking.

5.9 Bye-Laws for Plastic Waste Management in Municipal Act.

These draft bye-laws have been submitted with the Jhansi Nagar Nigam and is under deliberation by the Municipal Committee to be implied and applied under the Municipal Act for the city:

In exercise of the powers conferred under Rule 4(b) of The Plastic Waste (Management and Handling) Rules 2011, framed under The Environment (Protection) Act, 1986, Jhansi Nagar Nigam shall act as Prescribed Authority for enforcement of the provisions of these rules relating to the use, collection, segregation, transportation and disposal of the plastic waste, under his jurisdiction and following the Rules the Bye-Laws are as follows: -

1. During the course of manufacture, stocking, distribution, sale and use of carry bags and sachets, the following conditions shall be fulfilled, namely:-

   (a) Carry bags shall either be in natural shade (Colorless) which is without any added pigments or made using only those pigments and colorants which are in conformity with Indian standard: IS : 9833: 1981 titled as List of pigments and colorants for use in plastics in contact with foodstuffs, pharmaceuticals and drinking water, as amended from time to time.

   (b) No person shall use carry bags made of recycled plastics or compostable plastics for storing, carrying, dispensing or packaging food stuffs;

   (c) No person shall manufacture, stock, distribute or sell any carry bag made of virgin or recycled or compostable plastic, which is less than 40 microns in thickness.

   (d) Sachets using plastic material shall not be used for storing, packing or selling gutkha, tobacco and pan masala;

   (e) Recycled carry bags shall conform to the Indian standard IS 14534:1998 titled as Guidelines for Recycling of Plastic, as amended from time to time;

   (f) Carry bags made from compostable plastics shall conform to the Indian Standard : IS/ISO 17088:2008 titled as specifications for Compostable plastics, as amended from time to time;

   (g) Plastic material, in any form, shall not be used in any package for packing gutkha, pan masala and tobacco in all forms.

2. The plastic waste management shall be as under:-

   (a) recycling, recovery or disposal of plastic waste shall be carried out as per the rules, regulations and standards stipulated by the Central Government from time to time;

   (b) recycling of plastics shall be carried out in accordance with the Indian Standard IS 14534: 1998 titled as Guidelines for Recycling of Plastics, as amended from time to time;

(c) this municipality shall set up, operate and co-ordinate the plastic waste management system and for performing the associated function, namely:-

a. to ensure safe collection, storage, segregation, transportation, processing and disposal of plastic waste;
b. to ensure that no damage is caused to the environment during this process;
c. to ensure setting up of collection centers for plastic waste involving manufactures;
d. to ensure its channelization to recycles;
e. to create awareness among all stakeholders about their responsibilities;
f. to engage agencies or groups working in waste management including waste pickers, and
g. to ensure that open burning of plastic waste is not permitted;

(d) (i) Since the responsibility for setting up collection systems for plastic waste shall be of this municipality and for this purpose, this municipality may seek the assistance of manufacturers of plastic carry bags, multilayered plastic pouches or sachets or of brand owners using such products;

(ii) This municipality may work out the modalities of a mechanism based on Extended Producer's Responsibility involving such manufacturers, registered within its jurisdiction and brand owners with registered offices within its jurisdiction either individually or collectively, as feasible or setup such collection systems through its own agencies;

(e) Recycler shall ensure that recycling facilities are in accordance with the Indian Standard: IS 14534: 1998 titled as Guidelines for Recycling of Plastics and in compliance with the rules under the Environment (Protection) Act, 1986 as amended from time to time;

(f) This municipality shall encourage the use of plastic waste by adopting suitable technology such as in road construction, co-incineration etc. This Municipality or the operator intending to use such technology shall ensure the compliance with the prescribed standard including pollution control norms prescribed by the competent authority in this regard.

3. In respect of Marking or Labeling it shall be ensured that: -

(a) each plastic carry bag and multilayered plastic pouch or sachet shall have the following information printed in English or in local language, namely:-

(i) Name, registration number of manufacturer and thickness in case of carry bag.

(ii) Name and registration number of the manufacturer in case of multilayered plastic pouch or sachet.

(b) each recycled carry bag shall bear a label or a mark " recycled" and shall conform to the Indian Standard : IS 14534: 1998 titled as Guidelines for Recycling of Plastics , as amended from time to time;

(c) each carry bag made from compostable plastics shall bear a label " compostable" and shall conform to the Indian Standard : IS/ISO 17088: 2008 titled as Specifications for Compostable Plastics;

(d) Retailers shall ensure that plastic carry bags and multilayered plastic pouch or sachet sold by them are properly labeled as per stipulations under these rules.

4. For the purpose of Registration of Manufacturers and Recyclers it shall be ensured that: -

(a) any person recycling or proposing to recycle carry bags or multilayered plastic pouch or sachet or any plastic waste shall apply to the SPCB or PCC for grant of registration or renewal of registration for the recycling unit using Form 2 appended to these rules;

(b) no person shall manufacture plastic carry bags, multilayered plastic pouch or sachet or recycle plastic carry bags or multilayered plastic pouch or sachet or any plastic waste without obtaining registration certificate from the State Pollution Control Board or Pollution Control Committee, as the case may be, prior to the commencement of its production;

5. Besides no carry bag shall be made available free of cost by retailers to consumers. The minimum price for carry bags depending upon their quality and size which covers their material and waste management costs in order to encourage their re-use so as to minimize plastic waste generation. The price of the carry bag shall not be less than Re. 1.00 which shall be realized from the customers.

6. For effective control of use of unauthorized carry bags, "Pollution Cost" will be realized in a manner as notified:

a. In respect of shop owners Rs. 500.00

b. In respect of users Rs. 50.00

7. Besides Manufacturers and Stockiest of unauthorized plastic carry bags are liable to face prosecution and other regulatory orders as conferred under Environment (Protection) Act, 1986 and rules made there under, apart from the aforementioned payment of pollution cost.

8. In addition raids will be conducted by this Municipality with the assistance of local police as and when necessary.

9. As per this bye laws no person shall use sale and distribute plastics bags within this municipal area or throw in public streets and tanks, whether private or public and defile water of public and private tanks.

10. Since the plastics waste is to be collected by Jhansi Nagar separately, mixing organic – biodegradable waste with plastics waste, or throwing organic waste will also call for punishment as per this municipal bye laws as above..

These Bye-Laws are given effect from the date of acceptance by the Board of Councilors of Jhansi Nagar Nigam in its meeting held on ……

5.9.1 Example of Bye-laws already in place. *(1)*

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Burdwan Municipality

Bye Law for Plastic Waste (Management and Handling)

In exercise of the powers conferred under Rule 4(b) of The Plastic Waste (Management and Handling) Rules 2011, framed under The Environment (Protection) Act, 1986, , Burdwan Municipality shall act as Prescribed Authority for enforcement of the provisions of these rules relating to the use, collection, segregation, transportation and disposal of the plastic waste, under his jurisdiction and following the Rules the Bye-Laws are as follows: -

1. During the course of manufacture, stocking, distribution, sale and use of carry bags and sachets, the following conditions shall be fulfilled, namely:-

(a) Carry bags shall either be in natural shade (Colourless) which is without any added pigments or made using only those pigments and colourants which are in conformity with Indian standard: IS : 9833: 1981 titled as List of pigments and colourants for use in plastics in contact with foodstuffs, pharmaceuticals and drinking water, as amended from time to time.

(b) No person shall use carry bags made of recycled plastics or compostable plastics for storing, carrying, dispensing or packaging food stuffs;

(c) No person shall manufacture, stock, distribute or sell any carry bag made of virgin or recycled or compostable plastic, which is less than 40 microns in thickness.

(d) Sachets using plastic material shall not be used for storing, packing or selling gutkha, tobacco and pan masala;

(e) Recycled carry bags shall conform to the Indian standard IS 14534:1998 titled as Guidelines for Recycling of Plastic, as amended from time to time;

(f) Carry bags made from compostable plastics shall conform to the Indian Standard : IS/ISO 17088:2008 titled as specifications for Compostable plastics, as amended from time to time;

(g) Plastic material, in any form, shall not be used in any package for packing gutkha, pan masala and tobacco in all forms.

2. The plastic waste management shall be as under:-

(a) recycling, recovery or disposal of plastic waste shall be carried out as per the rules, regulations and standards stipulated by the Central Government from time to time;

(b) recycling of plastics shall be carried out in accordance with the Indian Standard IS 14534: 1998 titled as Guidelines for Recycling of Plastics, as amended from time to time;

(c) this municipality shall set up, operate and co-ordinate the waste management system and for performing the associated function, namely:-

a. to ensure safe collection , storage, segregation, transportation, processing and disposal of plastic waste;

b. to ensure that no damage is caused to the environment during this process;

c. to ensure setting up of collection centers for plastic waste involving manufactures;

d. to ensure its channelization to recycles;

e. to create awareness among all stakeholders about their responsibilities;

f. to engage agencies or groups working in waste management including waste pickers, and

g. to ensure that open burning of plastic waste is not permitted;

(d) (i) Since the responsibility for setting up collection systems for plastic waste shall be of this municipality and for this purpose, this municipality may seek the assistance of manufacturers of plastic carry bags, multilayered plastic pouches or sachets or of brand owners using such products;

(ii) This municipality may work out the modalities of a mechanism based on Extended Producer's Responsibility involving such manufacturers, registered within its jurisdiction and brand owners with registered offices within its jurisdiction either individually or collectively, as feasible or setup such collection systems through its own agencies;

(e) Recycler shall ensure that recycling facilities are in accordance with the Indian Standard: IS 14534: 1998 titled as Guidelines for Recycling of Plastics and in compliance with the rules under the Environment (Protection) Act, 1986 as amended from time to time;

(f) This municipality shall encourage the use of plastic waste by adopting suitable technology such as in road construction, co-incineration etc. This Municipality or the operator intending to use such technology shall ensure the compliance with the prescribed standard including pollution control norms prescribed by the competent authority in this regard.

3. In respect of Marking or Labeling it shall be ensured that: -

(a) each plastic carry bag and multilayered plastic pouch or sachet shall have the following information printed in English or in local language, namely:-

(i) Name, registration number of manufacturer and thickness in case of carry bag.

(ii) Name and registration number of the manufacturer in case of multilayered plastic pouch or sachet.

(b) each recycled carry bag shall bear a label or a mark " recycled" and shall conform to the Indian Standard : IS 14534: 1998 titled as Guidelines for Recycling of Plastics , as amended from time to time;

(c) each carry bag made from compostable plastics shall bear a label " compostable" and shall conform to the Indian Standard : IS/ISO 17088: 2008 titled as Specifications for Compostable Plastics;

(d) Retailers shall ensure that plastic carry bags and multilayered plastic pouch or sachet sold by them are properly labeled as per stipulations under these rules.

4. For the purpose of Registration of Manufacturers and Recyclers it shall be ensured that: -

(a) any person recycling or proposing to recycle carry bags or multilayered plastic pouch or sachet or any plastic waste shall apply to the SPCB or PCC for grant of registration or renewal of registration for the recycling unit using Form 2 appended to these rules;

(b) no person shall manufacture plastic carry bags, multilayered plastic pouch or sachet or recycle plastic carry bags or multilayered plastic pouch or sachet or any plastic waste without obtaining registration certificate from the State Pollution Control Board or Pollution Control Committee, as the case may be, prior to the commencement of its production;

5. Besides no carry bag shall be made available free of cost by retailers to consumers. The minimum price for carry bags depending upon their quality and size which covers their material and waste management costs in order to encourage their re-use so as to minimize plastic waste generation. The price of the carry bag shall not be less than Re. 1.00 which shall be realized from the customers.

6. For effective control of use of unauthorized carry bags, "Pollution Cost" will be realized in the following manner as notified in Notification No. EN/355/1C-03/2008 dt. 18.02.2008 issued by Principal Secretary to the Government of West Bengal, Dept. of Environment and Chairman, State Plastic Management Committee, this municipality shall realize the cost as follows: -

a. In respect of shop owners Rs. 500.00

b. In respect of users Rs. 50.00

7. Besides Manufacturers and Stockists of unauthorized plastic carry bags are liable to face prosecution and other regulatory orders as conferred under Environment (Protection) Act, 1986 and rules made there under, apart from the aforementioned payment of pollution cost.

8. In addition raids will be conducted by this Municipality with the assistance of local police as and when necessary.

9. As per Section 340(f) of The West Bengal Municipal Act 1993 no person shall use sale and distribute plastic within this municipal area or throw in public streets and tanks, whether private or public and defile water of public and private tanks.

These Bye-Laws are given effect from the date of acceptance by the Board of Councilors of Burdwan Municipality in its meeting held on 24th August 2011.

Sd/- Ainul Haque, 24.08.2011
Chariman

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Burdwan Municipality

5.10 References

1. Burdwan Municipality (http://burdwanmunicipality.gov.in)

CHAPTER 6

PLASTIC WASTE RECYCLING PLANT, MACHINERY AND EQUIPMENTS

6. PLASTIC WASTE RECYCLING PLANT, MACHINERY AND EQUIPMENTS

The primary engineering is done with industry interaction and focus has been on sorting systems with the technology intervention. Once sorted the products will be sent to recycling Industry and processed in house which does not sell routinely.

After the tendering and selection of the bidders as supplier, we have found the cost quoted as L1 (Lowest 1) is Rs.3, 25,000/- for the porta-cabins (Per Unit) and Rs. 1,76,90,000/- for the integrated sorting, bailing, shredding and conveyor belts (1 Unit). This price does not include excise duty of 12.5% and central sales tax of 5.25% besides other costs.

6.1 ELECTRICAL ITEMS AND DETAILS

For the Turnkey solution for the Waste Collection, Sorting and Recycling Facility following electrical items will be needed for proper and smooth operation.

Electrical Items and Details		
S. No	**Items**	**Details**
1	Transformer	• A 90KVA Transformer will be needed with necessary civil work, area coverage and earthing etc.
2	Main Control Panel	• A Main Control Panel (Distribution) inside the shed will be needed to distribute power to the different motors and the lights. • The Distribution Panel should have all the safety features for Overload, Short facing and should have necessary controls, buttons and bulbs. • It should also have provision for controlling the Power Factor etc.
3	Cabling/ Wiring	• All the Cables from Transformer to Distribution Panel, Distribution Panel to all Motors and equipment's should be provided along with proper cable trays or associated civil work. • Electrical wiring and fittings for light load inside and outside the shed.
4	Safety Features	• All safety features and latest systems and norms should be used to install and commission the electrical systems.

6.2 MACHINERY AND EQUIPMENT'S WITH BASIC DETAILS:

Complete System Requirements			
S. No.	**Equipment**	**Quantity**	**Working Details**
1	**VIBRATOR**	**1**	A Vibratory Screen is needed to separate dust from the waste which is to be fed on to the Sorting Conveyor. All the collected waste is loaded on to this vibrator to remove dust.
2	**FEED CONVEYOR**	**1**	A Feed Conveyor will needed to convey the waste from the vibrator to the Sorting Conveyor
3	**SORTING CONVEYOR**	**1**	This is a slow moving 600mm wide Flat conveyor. The plastic/waste which can be monetized will be picked from the conveyor and will be dumped on any of the side conveyors (1 TO 3). All the waste which is of value will be hand sorted and the rest will go to the other side for shredding.
4	**SIDE CONVEYORS**	**3**	Side conveyors will be provided to convey the sorted waste to the bailing presses.
5	**BAILING PRESS**	**2**	Vertical Type Pressing balers will be needed to bale the sorted waste. Tied bales will be made and stored for selling.
6	**SHREDDER CONVEYOR**	**1**	An input conveyor for the shredder is required to charge the shredder. The waste will fall on this conveyor from the Sorting Conveyor and will primarily all waste which cannot be monetized.
7	**SHREDDER**	**1**	Shredder with a capacity of 500 Kg/hr is required to shred the waste. The shredded waste will be sold as RDF (Residual Derived Fuel) to any cement plant nearby Jhansi.
8	**DISCHARGE CONVEYOR**	**1**	A discharge conveyor will carry the shredded waste to one of the Bin for final removal from the Collection Facility.
9	**BINS**	**14**	Numbers of Collection Bins will be needed next to the sorting conveyors for collecting any foreign material which needs sending for land filling, dust and shredded waste. Some Bins will be used to collect material from side conveyors before bailing.

OPTIONAL EQUIPMENTS			
10	**BIO-CLAVE**	**1**	This is state of the art equipment which is optional and can be used if the waste coming from the Collection Centers is wet. This equipment removes all the moisture from the waste before it is transferred to the Vibrator. Depending on the Height of the shed this unit will be provided with a Vibrator conveyor to take its output to the vibrator.
11	**FINE SHREDDER**	**1**	The fine shredder can be used to further shred the output of the shredder. This is primarily to make it compatible for to be used in Road Laying.
12	**PELLETIZING LINE**	**1**	In future if the quantity of the waste is very high then a complete Pelletizing line can be established to make granules which can be used to make products of Second Generation of Plastics. The complete line will include Washing Equipment, Associated ETP plant, Storage Tanks for water, Agglomerator, Extruder, Rotary Pelletizer.
13	**LUMBER MAKING MACHINE**	**1**	• Plastic Extrusion Plant & Machinery (with standard accessories) •**Production:** 80-100 Kg/Hr •**Power:** 300 HP •**Area:** 5000 Sq.Ft. •**Water:** 8-10Ltrs (80% reusable) •**Manpower:** 5 Skilled
14	**FUEL OIL MAKING MACHINE**	**1**	Gasolysis (Pyrolysis) is the decomposition of a condensed substance by heating. It does not involve reactions with Oxygen, or any other regents, but can take place in their presence. With this technology shredded plastic can be used to make fuel. With approximate batch of 100Kg of Plastic we can get approximately 30-40 Liters of fuel in 4 Hrs of cycle time.

6.3 SPECIFICATIONS ABOUT THE EQUIPMENTS AND MACHINERY:

SORTING CONVEYOR

It is a flat Belt Conveyor of length 25meter of width 600mm. The technical specification of the conveyor is as under:

1.	Width	-	600mm
2.	Length	-	25 meters
3.	Height from FFL	-	800mm
4.	Belt Specification	-	8mm thick 3 ply cotton
5.	Power	-	5HP
6.	Drive	-	Electric drive with suitable Gear Box for slow speed operation
7.	Control	-	ON/OFF switches at two points are provided to control the motion of the conveyor.

SIDE CONVEYOR – 3 No.

It is a flat Belt Conveyor of length 5meter of width 600mm and will be placed perpendicular to the Segregation Conveyor. The technical specification of the conveyor is as under:

1.	Width	-	600mm
2.	Length	-	5 meters
3.	Height from FFL	-	800mm
4.	Belt Specification	-	8mm thick 3 ply cotton
5.	Power	-	2HP
6.	Drive	-	Electric drive with suitable Gear Box for slow speed operation
7.	Control	-	ON/OFF switch is at provided to control the motion of the conveyor.

BAILING PRESS – 2 No

The bailing presses will be Vertical top pressing type of capacity 30 Tons. The specification of the press is as under:

1.	Chamber Size	-	23” x 20” x 40”
2.	Bale Size	-	23” x 20” X T
3.	Bale thickness (T)	-	It depends on the type and quantity of waste
4.	Bale Weight	-	Adjustable from 20 Kg to 50 Kg as per requirement.
5.	Power	-	5 HP
6.	Controls	-	Push Button operated, Electrically Controlled
7.	Production	-	1-3 Tons per 8 Hrs shift and depends on weight of bales
8.	Capacity	-	30 Tons

9. Bale Tying - Manual by Plastic / Steel Strap
10. Loading of scrap - From front
11. Bale Ejection - By opening the front door and operating bottom plate
12. Hydraulics Safety - Hydraulic Relief Valves are provided against over load.
13. Electrical Safety - Overload switches are provided against over loads.

Description

The Bailing Press is robust in design and is designed to take 200% of the rated load. The press is provided with closed wall on two sides, the back side of the press is provided with groves to enable movement of the straps during tying. The front of the press is provided with a door of 500mm height. The gap between the top pressing plate and the door acts as a loading space of the scrap.

The operation of the machine is as under:

1. The front door is closed.
2. The scrap is loaded in the chamber till the height of the door.
3. Auto On switch is pressed, the hydraulic cylinder starts pressing form the top.
4. The pressure is exerted till the set limit.
5. The pressing plate moves back for next fill of the scrap.
6. Scrap is reloaded in the machine
7. The operation in Pint 2-5 is repeated till the set weight is not achieved.
8. Once the set weight is achieved the press locks.
9. The door is opened manually and the bale is strapped manually.
10. A hinged plate provided at the bottom of the press is attached to the pressing plate.
11. Reverse button is pressed and the hinged plate ejects the bale from the pressing chamber.
12. The above cycle is repeated for next charge of scrap.

INPUT CONVEYOR

An input conveyor for the Shredder is provided to charge the scrap. The specification of the conveyor is as under:

1. Width - 600mm
2. Length - App. 13 meters
3. Input height from FFL - 400mm
4. Output Height - To match the shredder feeding mouth
5. Design - Trough Type
6. Belt Specification - 10mm thick 4 ply cotton
7. Power - 3HP
8. Drive - Electric drive with suitable Gear Box for slow speed operation

9. Control - ON/OFF switch is at provided to control the motion of the conveyor.

SHREDDER

A state of the art, Single Shaft design shredder (Hammer Mill) is provided to shred the plastic, wood, cloth and other combustible waste into a size of less than 40mm. The technical specification of the shredder is as under:

1. Design - Single Shaft
2. Shaft design - 150mm thick with three bearings
3. Pins - 4 Pins for mounting Hammers
4. Hammers - Bell Design of Hardness 400BHN
5. Mesh - Welded arc design with High Manganese steel flats
6. Shredding Area- - 500 square centimeter
7. Power - 30 HP
8. Output - Size of shredded waste is less than 40mm for 80% of the waste.
9. Drive - Electric Motor with Belt Drive
10. Flywheel - App. 1000 Kg

SPECIFICATIONS OF SINGLE SHAFT SHREDDER FOR MSW (4-5 TPD)

1. DESIGN	-	Single Shaft
2. NO OF SECONDRARY PINS	-	Four
3. QTY / SPEED OF MAIN SHAFT	-	ONE Nos. / 580-600 RPM
4. CAPACITY	-	4 - 5 TPD
5. MESH AREA	-	1.2 sq.mt. or 120000 sq.cm
6. LOADING AREA	-	0.7 sq. mt or 7000 sq.cm
7. MESH HOLE	-	65mm
8. NO. OF DISCS	-	3 Nos.
9. NO OF HAMMERS	-	24 Nos.
10. HAMMER DESIGN	-	Bell Shaped, Out Balanced
11. HAMMER MATERIAL	-	High Abrasion Steel
12. HAMMER HARDNESS	-	400 BHN
13. MAIN MOTOR	-	30HP
14. HYDRAULIC MOTOR	-	3 HP
15. FLYWHEEL	-	One, for reducing the Power requirement.
16. WEIGHT OF MACHINE	-	Appx. 5.5 Tons

SALIENT FEATURES OF THE SHREDDER

The Single Shaft Shredder (Hammer Mill) for Pre-Treated MSW or Sorted Plastic has been designed keeping the following factors in mind:

1. The Input Material although is not very large as it has already passed through a Trammel but still it can have small batteries, stone and hard items. To ensure that there is not breakage of the Hammers, it has been designed to also have high Impact strength besides High Abrasion Resistance quality.
2. The machine is designed to process all types of plastic, cloth, vegetation etc.
3. The mesh is also made out of High Manganese Steel to have a very high wear life and is also resistant to high Impact loads if any.
4. The machine is made out of Prime Rolled Plates to carry the load of the Main Shaft along with its accessories. The Base of the machine is made out of 32mm plates and helps in transferring all the dynamic and static loads of the machine to the foundation.
5. A Flywheel is also provided to store the energy and use it when it is required by the machine.
6. Three Nos. Double Taper Roller Bearings are provided to support the main shaft.
7. The Main shaft houses 3 Nos. main discs, which supports pins which holds the Hammers. All the shafts and the pins are made of High Quality alloy steel and are Heat Treated as per the requirement of the design and the usage.
8. A Hydraulic System is provided to open the side panel of the machine. This helps in reducing huge downtime which the present day machine faces in case of any blockage or maintenance of the hammers.

OPERATIONS OF THE SHREDDER

The waste is charged into the shredder through a Side Top Door, the loading chute is designed to enable the rotor of the machine to grab the material easily and the charged waste is not pushed out of the shredder.

Once the waste is fed the rotor makes the material starts rotating inside the chamber and grinds it on one of the side faces of the machine, the grinding face is made of High quality Abrasion Resistant steel. After this the material comes in contact with the mesh which also grinds the waste and breaks it further into smaller pieces.

The reduced size pieces falls through the mesh and any material which remains larger than the mesh keeps revolving in the shredder till it is not smaller than the mesh holes.

The material gets shredded in the chamber due to the centrifugal action of the hammers. The hammers are designed in a way that they are out massed and when they start rotating the Hammers opens up like feathers into their maximum position and due to the centrifugal force breaks the waste into smaller pieces. This design also gives a Hammering load which acts on the waste to further break it. The flywheel action helps in reducing the power requirement of the machine and provides the torque whenever required.

The Machine is provided with a Hydraulic system to open the top side cover. This makes the operator access the chamber without removing any part of the machine. This helps the operator to remove any blockage or maintain the rotor without dismantling the machine.

FINE SHREDDER UNIT

Fine Shredder, if desired will be installed after the Main Shredder. All the plastics which are fit for Road Laying will be shredded in the Main Shredder and after that it will be charged in the fine shredder manually.

Fine shredder will shred the plastic to a size of 5-6mm and one unit can produce approximately 500Kg per day.

SPECIFICATIONS OF FINE SHREDDER

1. DESIGN	-	Single Shaft
2. QTY / SPEED OF MAIN SHAFT	-	ONE Nos. / 580-600 RPM
3. CAPACITY	-	500 kg per Day
4. NO OF HAMMERS	-	12 Nos.
5. HAMMER DESIGN	-	Bell Shaped, Out Balanced
6. HAMMER MATERIAL	-	High Abrasion Steel
7. HAMMER HARDNESS	-	400 BHN
8. MAIN MOTOR	-	20HP
9. MESH	-	10X10MM
10. WEIGHT OF MACHINE	-	Appx. 1.5 Tons

OPERATIONS OF THE FINE SHREDDER

The waste is charged into the shredder through a Side Top Door, the loading chute is designed to enable the rotor of the machine to grab the material easily and the charged waste is not pushed out of the shredder.

Once the waste is fed the rotor makes the material starts rotating inside the chamber and grinds it on one of the side faces of the machine, the grinding face is made of High quality Abrasion Resistant steel. After this the material comes in contact with the mesh which also grinds the waste and breaks it further into smaller pieces.

The reduced size pieces falls through the mesh and any material which remains larger than the mesh keeps revolving in the shredder till it is not smaller than the mesh holes.

COLLECTION BINS

Collection Bins of 0.25 cubic meter volume should be provided. The bins will have four wheels for easy movement by one person and are capable to hold 200-250 Kg. of material. The numbers of bins provided are total 14 in numbers.

FEED CONVEYOR

It is an Inclined belt Conveyor of length 5meter of width 600mm and will be placed perpendicular to the Sorting Conveyor. The technical specification of the conveyor is as under:

1.	Width	-	600mm
2.	Length	-	5 meters
3.	Height from FFL	-	800mm
4.	Belt Specification	-	8mm thick 3 ply cotton
5.	Power	-	2HP
6.	Drive	-	Electric drive with suitable Gear Box for slow speed operation
7.	Control	-	ON/OFF switch is at provided to control the motion of the conveyor.

DISCHARGE CONVEYOR

It is an Inclined belt Conveyor of length 5meter of width 600mm and will be placed below the shredder. The technical specification of the conveyor is as under:

1.	Width	-	600mm
2.	Length	-	5 meters
3.	Height from FFL	-	800mm
4.	Belt Specification	-	8mm thick 3 ply cotton
5.	Power	-	2HP
6.	Drive	-	Electric drive with suitable Gear Box for slow speed operation
7.	Control	-	ON/OFF switch is at provided to control the motion of the conveyor.

AIR DENSITY SEPARATOR

This is state of the art equipment which is made to sterilize Hospital Waste to a level of Log6. In this equipment, modifications will be made to suit the requirement of JNN Recycling facility of drying the waste before it is charged on to the vibrator.

Bio-clave is a three walled Circular vessel of length 5000mm. In the gap between the inner wall and the center wall hot oil is rotated at a temperature of 120 degree centigrade. The inner wall attains a temperature of around 110-115 degree centigrade which is enough to remove the moisture from the charged waste.

The gap between the center wall and the outer wall is stuffed with insulating material to keep the skin temperature of the vessel to ambient conditions.

A rotating shaft is provided to rotate the waste in the chamber and bring the waste in contact with the hot inner walls. The waste gets heated and all the moisture evaporates in the atmosphere. A charge door at the top of the vessel is provided to load the waste. The vessel is placed at an incline to move the waste due to gravity towards the discharge door. The rotating arm is also designed to move the waste towards the discharge door.

The technical specifications of the Bio-Clave are as under:

1.	Outer Diameter of the Chamber	-	1525mm
2.	Inner Diameter of the Chamber	-	1200mm
3.	Inlet Door Size	-	Diameter of 950mm
4.	Discharge outlet size	-	Diameter of 1200mm
5.	Length of the Chamber	-	5080mm
6.	Total length of the equipment	-	6325mm
7.	Height of the equipment	-	3675mm as per P.S.S-02 Dwg
8.	Height of the equipment	-	42305mm as per P.S.S-01 Dwg
9.	Motor Power	-	25 HP for the rotor
10.	Connecting load for Oil Boiler	-	40 HP for electrical elements

WASHING EQUIPMENT WITH ETP

A Complete Washing Line with a capacity of 1.5-2 Ton per day will have all the basic equipment's like:

1. Vibrator / Centrifuges for Free Dust Separation.
2. Washing machine
3. Drying Machine.
4. Storage Tanks for Water
5. Effluent Treatment Plant as per the line diagram attached
6. On line Monitoring Devices as per CPCB Norms

All the plastic which is required to be washed is loaded on to a Vibrator/Centrifuge for Loose dust separation. Once the same is done the plastics are charged in a Washing machine in batches. The effluent from the washing machine is transferred to the Effluent Treatment Plant.
After washing the plastic is send to a dryer machine for removing the residual moisture. All the moisture collected by the dryer is sent to the Effluent Treatment Plant.

All the water discharged in the Sewer lines are checked with On-Line Monitoring devices and strict standards of discharge will be followed and ensured.

PELLETZING LINE

A State of the art Plastic Processing Line of capacity 70-100 Kg/Hr (500Kg/Day) is designed for JNN. The specification of the equipment is as under:

1.	Capacity	-	500 Kg/ Day
2.	Heating Load of Extruder	-	24 KW
3.	Main Motor Capacity	-	20 HP
4.	Rotary Pelletized Power	-	2 HP
5.	Screw Diameter	-	75mm

The Washed plastic is charged in this machine which extrudes the plastic and then the rotary Pelletizer cuts into even shaped granules which is used for molding various Plastic parts and accessories.

VIBRATOR

Vibrator is primarily a vibrating screen with spun mesh of size 2.5mm and with the vibration the loose dust in the plastic waste is separated. This improves the quality of the shredded waste and the plastic which will be going for recycling.

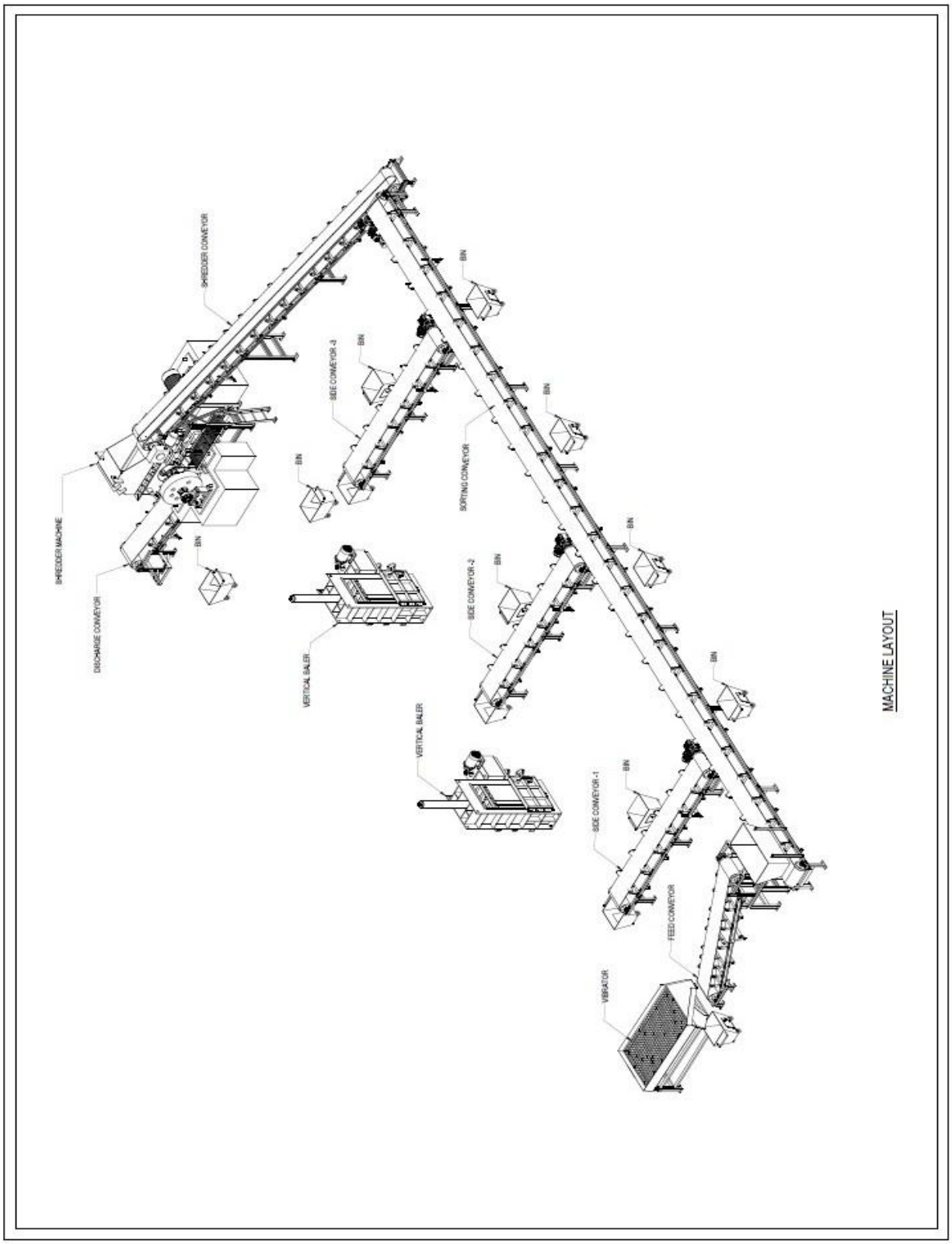
The technical details of the vibrator are as under:

1.	Down Inclination		
2.	Mesh size	-	2.5mm
3.	Size of mesh	-	1500mm x 2500mm
4.	Power	-	2 HP
5.	Handling capacity	–	5-6 Tons/Hr

CIVIL WORK

In the project costs, the civil work is considered to be provided by the Nagar Nigam. This includes office, servant quarters, routine industrial sheds and platforms etc, under their normal civil work development activity. Only the cost of foundation of the machines is considered in the project costs, and that is defined and included in the cost of machines. In the project report it is estimated to be approximately Rs.3.3 Crores.

6.4 Plastic Waste Recycling Plant Design



CHAPTER 7

ZERO WASTE CONCEPT

7. ZERO WASTE CONCEPTS

Humanity has to evolve to Zero Waste Management system for sustainability. How long and where all can we keep dumping our waste or keep releasing in air and water when it is very much possible to process every waste - solid liquid or in gaseous form in a way so to render it harmless to the nature, why are we not doing it and whenever it is difficult, the technology development for it, is not only possible, but is within our means to do so, then why don't we do it. We should work together in this direction: The climate crime update series is for sharing information on these issues.

Total recycling of waste i.e. of every useful product at the end of its usable life, and useless by products of its production process, may it be in gaseous, liquid or solid form or their combinations, should be given back to the nature in the naturally harmless forms. In 1962 it took 0.7 years for the earth's annual biological harvest to regenerate and now it takes 1.25 years (1). Global ecosystem services have been over-used significantly in parallel with world economic growth. Global economic growth has increased 5 times since the mid-twentieth century and 60% of the world's ecosystem services have been degraded during the same period (2). It is estimated that by 2050 we will have 9 billion people on earth. Global non-renewable resources are depleted as a result of over consumption. Continuous depletion of natural finite resources by urban populations is leading to an uncertain future. Therefore, to prevent further depletion of global resources, we need sustainable consumption and strategic Plastic waste management systems based on (i) waste avoidance, (ii) material efficiency and (iii) resource recovery (3).

Waste is the symbol of inefficiency of any modern society and a representation of misallocated resources. More than 50% of the world's population live in urban areas (4), and some estimates have suggested that 80% of the human population will dwell in urban areas by 2030. Cities cover only around 2% of the world's surface, consume over 75% of the world's natural resources and generate 70% of all the waste produced globally (5)(6). Creation of any waste depletes natural resources, uses energy and water, places pressure on land, pollutes the environment and, finally, creates an additional economic cost for managing the waste. We need to move to a position where there will be no such thing as waste, merely transformation; this position is called **zero waste**.

'Zero waste' is one of the most visionary concepts for solving waste problems. Many cities around the globe such as Adelaide, San Francisco and Stockholm have declared their zero waste vision and these cities are working to be the world's first zero waste city. But how to transform our existing cities into zero waste cities and how to measure the performance of a zero waste city are the prime questions to answer in zero waste research. The products that we consume every day are primarily produced using virgin materials, energy and water. From resources extraction to waste generation, consumption depletes the environment by contributing greenhouse gases (GHG) to the atmosphere.

7.1 Development of the zero waste concepts

From outer space to the bottom of the ocean, generations of waste is accumulating over time. On one hand, the estimated amount of debris put into space by humans and no longer in function has increased from 14,000 pieces in 2007 to 18,000 pieces in 2008. On the other hand, accumulation of waste in the great Pacific Garbage Patch (currently 1,760,000 sqkm, 12 times bigger than Bangladesh) is getting larger every day (7)(8). Currently, the world's cities generate about 1.3 billion ton of solid waste per year and the volume is expected to increase to 2.2 billion ton by 2025 (9). Waste generation rates will more than double over the next twenty years in lower income countries. However, this current trend of generating waste is not a recent practice; it comes from the very early stages of modern society. So how would it be possible to transform current society into a zero waste society?

7.2 Zero waste concepts

Zero waste means designing and managing products and processes systematically to avoid and eliminate waste, and to recover all resources from the waste stream (10). Working towards zero waste has become a worldwide movement that motivates changes in design that make it possible to disassemble and recycle products. To put it simply, zero waste means no unnecessary and unwanted waste from a product at any stage of its life cycle. The scope of zero waste comprises many concepts that have been developed for sustainable waste management systems, including avoiding, reducing, reusing, redesigning, regenerating, recycling, repairing, remanufacturing, reselling and re-distributing waste resources. Hence, a zero-waste strategy is growing in popularity as best practice. It not only encourages recycling of products but also aims to restructure their design, production and distribution to prevent waste emerging in the first place (11).

Most modern societies have been implementing integrated waste management systems to recycle and recover resources from waste. However, the concept of zero waste is not limited to optimum recycling or resource recovery; in addition to that zero waste requires elimination of unnecessary waste creation at the first stage of designing a product. Therefore, zero waste design principles go beyond recycling to focus firstly on avoidance and reduction of waste by innovative product design and then recycling and composting the rest (12).

Figure no.9 Drivers for transforming current cities into zero waste cities

With proper implementation of all these principles, current cities could be transformed into zero waste cities. The key drivers are based on short-term and long-term implementation strategies. Awareness and education, behavior change and systems thinking are long-term strategies, whereas innovative industrial design, legislation and 100% recycling are the short-term strategies to implement in a city.

One of the important aspects of the zero waste cities is the conversion of the linear city metabolism to a circular city metabolism. This transformation requires a series of holistic strategies based on key development principles. Education and research is on the top of the zero waste hierarchy. Without proper environmental awareness and advanced research on waste, it would not be possible to achieve zero waste goals. Sustainable consumption and behavior is placed second in the zero waste hierarchy. As the current trend of consumption is unsustainable and cannot be continued for ever, it is important to understand the reality and act accordingly. The next on zero waste hierarchy is transformed industrial design for example, cradle-to-cradle design, eco-design or cleaner production combined with extended producer responsibility. It is important to have specific zero depletion legislation and incentive policies as part of the strict environmental legislations. If products are designed in such a way that everything can be recycled, then achieving optimum recycling and resource recovery will not be impossible in the long run.

In a zero waste city material flow is circular, which means the same materials are used again and again until the optimum level of consumption. No materials are wasted or under used in circular cities. Therefore, at the end of their lives products are reused, repaired sold or redistributed within the system. If reuse or repair is not possible then they are recycled or recovered from the waste stream and used as inputs, substituting the demand for the extraction of natural resources. Fig. 10 shows the symbolic material flow of a circular city, where the end of-life product or output waste are treated as resources and used as inputs in the city's metabolism.

From Fig. 10, it is clear that a city's performance is reflected by its waste management systems. Material flow in a zero waste city should be circular and resources should be used efficiently. The performance of waste management systems therefore symbolizes the performance of a zero waste city. Hence, it is important to development a zero waste measurement tool for cities. Finally, a new system thinking approach and innovative technologies are needed to transform current cities into zero waste cities.

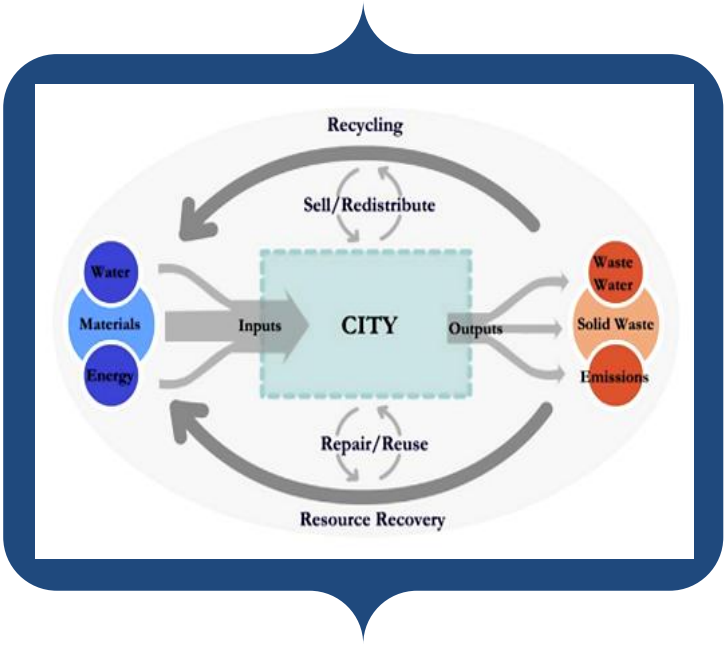


Figure no. 10 Material flow in a zero waste city (adapted from Girardet. 1992, 1999)

7.3 Materials and methods

Practice-based built environment research includes case-based, evidence-based and performance-based research modes (13). In this report a plastic or waste management performance index called the zero waste index is developed based on the evidenced-based research methodology through peer reviewed literature, reports, the life cycle analysis (LCA) database and other secondary online sources. Finally, the proposed zero waste index is analyzed by measuring the performance of waste management systems in the cities of Adelaide, San Francisco and Stockholm.

There are many ways to measure the waste management systems in a city. Decision makers and waste experts use various indicators such as the per capita generation rate, collection rate and recycling rate to measure the performance of the waste management systems. In the last decade, the waste diversion rate has been used as an important indicator to measure the performance of a city. Waste diversion from landfill has been widely accepted by local governments, waste authorities and city corporations. Therefore, a higher diversion rate from landfill has been considered as a benchmark of success.

7.4 Waste diversion rate

The waste diversion rate is one of the key indicators used by municipalities today to measure the performance of waste management systems. The diversion rate can be defined as the percentage of total waste that is diverted from disposal at permitted landfills and transformation facilities such as incineration, and instead is directed to reduction, reuse, recycling and composting programs (14). The diversion rate can be measured by a generation-based measurement system or a disposal based measurement system. In a generation-based measurement system, disposal and diversion are measured and added together to determine generation. In a disposal-based measurement system, the definition of waste generation is the same (disposal plus diversion), but what is measured changes. In the disposal-based measurement system, waste generation is estimated and then measured disposal is subtracted from generation to estimate diversion (15). Therefore, traditional waste diversion rate can be formulated as in Equation (1).

$$Diversion\ rate = \frac{Weight\ of\ recyclable}{Weight\ of\ garbage + Weight\ of\ recyclable} \times 100 \ldots . (1)$$

Currently, many cities such as Adelaide, San Francisco and Stockholm are trying to be zero waste cities by achieving 100% diversion of waste from landfill. However, diversion from landfill and recycling are not sufficient for zero waste initiatives. The diversion rate as per Equation (1) does not consider waste avoidance through industrial design, effective policies and behavior change; hence the diversion rate of waste is not sufficient to measure the zero waste performance of a city. The diversion rate is merely an indicator of recycling performance. It does not give the full picture of the recycling initiatives and does not tell us how much of the waste stream is recyclable, whether or not all recyclables are recycled, and how much less waste is generated overall (16).

A holistic waste management performance tool is therefore needed. Waste avoidance is one of the key aspects that should be considered in measuring the performance of a waste management system. A new index is therefore needed that can measure more than the diversion rate to assess the performance of the waste management system. This repot presents a new index system called the zero waste index (ZWI) as an indicator to measure the waste management system holistically.

7.5 Zero waste index

The zero waste index is a tool to measure the potentiality of virgin materials to be offset by zero waste management systems. One of the important goals of the zero waste concept is zero depletion of natural resources. Therefore, measuring the performance of the zero waste city would eventually measure the resources that are extracted, consumed, wasted,

recycled, recovered and finally substituted for virgin materials and offset resource extraction by the waste management systems. The zero waste index can be formulated as in Equation (2).

However, the waste diversion rate does not indicate the virgin material replacement efficiency of the waste management system, which is very important in conservation of global natural resources. Thus, the zero waste index is a cutting-edge tool to measure virgin material substitution by waste management systems. By introducing the zero waste index globally, we could measure the virgin material offset potentiality and the potential depletion of natural resources.

The ZWI is also a useful tool to compare different waste management systems in different cities and it gives a broader picture of the potential demand for virgin materials, energy, carbon pollution and water in a city. The ZWI is thus a performance indicator to assess the overall performance of waste management systems.

$$\textit{Zero waste index (ZWI)} = \frac{\Sigma\ \textit{potential amont of waste managed by the city} \times \textit{substitution for the system}}{\textit{Total amount of waste generated in the city}} \ldots (2)$$

The zero waste index is based on the value of material that can potentially replace the virgin material inputs. The substitution of energy, water and greenhouse gas emissions is also considered with the material substitutions. Substitution values for material, energy, water and GHG emissions have been extracted from the life cycle database of different life cycle assessment tools and database sources. The amount of materials and resources substituted is positively related to the advancement of technology used in the material recovery process; therefore, the substitution value varies for different materials and for different waste management systems. Even though, waste prevention is one of the core components in the zero waste concept, but quantitative measurement of waste prevention by behavior change has not been considered in this research due to limited scientific quantitative measurement data. Six major waste streams are considered based on waste data availability in Adelaide, San Francisco and Stockholm. Due to high dissimilarities in waste streams and data collection systems only six waste streams paper, glass, plastic, metal, organic and mixed municipal solid waste are considered for this study.

7.6 Concluding remarks

From the previous discussion it is clear that the zero waste index provides a better picture of the overall waste management performance of a city than the diversion rate. Moreover, a 100% diversion of waste from landfill would obviously be a milestone for a waste authority but would not necessarily achieve zero waste goals. The diversion rate does not give an indication of resources that have been recovered and substituted, which eventually avoids extraction of further resources. The zero waste index forecasts the amount of resources that

are recovered from the waste streams and substituted for virgin materials. In addition, the ZWI also forecasts the demand substitution of energy, water and emissions by the waste management systems.

The overall performance of waste management systems in Adelaide is higher compared to Stockholm. This difference is due to the virgin material recovery and energy substitution by the waste management systems. Adelaide substitutes more virgin materials than Stockholm. The overall performance of the three cities was analyzed and San Francisco was found to be top among the three cities.

The study aimed to develop a holistic tool for measuring the waste management performance of a city. From the study results it is evident that San Francisco has a higher zero waste index than Adelaide and Stockholm. Virgin materials substitution, energy savings, emissions saving and water savings were also higher than the other two cities. This study was limited to the municipal waste management (including plastic waste) systems in 6 broad waste categories: paper, plastic, metal, glass, organic and mixed municipal solid waste. Further research is required to develop a zero waste index system for other types of waste such as commercial and institutional waste, industrial waste, and construction and demolition waste

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CHAPTER 8

ASSESSMENT OF PLASTIC WASTE

8. ASSESSMENT OF PLASTIC WASTE

A study was carried out in the city of Jhansi by the PMA to collect the data about the percentage (%) of Plastic Waste that is found in the Municipal waste being generated in the city. Listed below are the bullet points that were worked upon, to retrieve the correct data of plastic waste coming to landfill daily, which will be of use in the recycling plant that is being set up the Jhansi Nagar Nigam.

1. The PMA designated four persons as two teams each, to collect the estimated data about plastic waste thrown daily and reaching land fill area.

2. There are two agencies working for door to door Municipal solid waste collection in Jhansi municipal area and dumping waste at the same landfill.

3. The PMA did study of 8 vehicles in a single day at the landfill and tabulated it

4. The teams did this study on camera, the videos of which are uploaded on YOUTUBE.

- Part 1: https://www.youtube.com/watch?v=z9wMklxXsjg
- Part 2: https://www.youtube.com/watch?v=hiZZiGjCX7E
- Part 3: https://www.youtube.com/watch?v=-d_08nKPINM

5. First they took the total weight of the vehicle carrying the MSW to the landfill at a weigh bridge (Dharam - kanta).

6. They unloaded the total waste in a clean area. Cleaning was done by a JCB to ensure that there is no mix up with the sample.

7. They took the weight of empty truck to arrive at the total quantum of MSW collected.

8. They hired waste pickers to segregate all the plastic waste from the MSW.

9. Then they segregated saleable and non-saleable, but recyclable plastic waste through the waste pickers.

10. All the recyclable saleable plastic waste taken by the waste pickers was sold to the local scrap dealers.

11. All recyclable non-saleable plastic waste was taken by the PMA from the Waste Pickers @ Rs.5/kg. to process with the network.

12. The total amount of plastic waste which wasn't sold to the scrap dealers or taken by the rag-pickers is the amount that will be sent to the recycling plant. However, currently the same amount is what was left at the landfill due to the lack of a processing facility.

Generally all plastic waste which does not have a monetary value is burned and/or left in open. This quantity makes feasibility of the recycling plant for the regular raw material supply.

Please find the complete survey report mentioned in the following pages:

- The survey was conducted without informing the Collectors to ensure that there is no manipulation.
- The survey was conducted in unison with Jhansi Nagar Nigam staff and force.
- All the plastic from the truck was manually sorted and weight taken as tabled below.

Other Findings during Survey:

- In all these areas a sort of Official/Un-official organized Collection Door to Door Collection system is used.
- These people charge little from each households/Shops etc.
- Besides plastic, they also get Paper/Cardboard/Glass bottles which have saleable value.
- Some clothes are also found, usage depends on conditions.

Points to be considered:

- In some areas of Jhansi these collectors dump their waste in Areas within the city limits.
- Construction Waste and swept waste etc. are also found at these sites.

- The percentage of plastic dips in a processing plant when the construction waste/swept waste is also mistakenly collected.
- This study was conducted solely to find the composition of Plastic Waste in the Municipal Solid Waste that reaches a landfill.
- The weight and percentage numbers for Plastic Waste in this study are the ACTUAL FINDINGS.
- The weight and percentage of the rest of the waste types are on the basis of "**REPORT ON THE TASK FORCE ON WASTE TO ENERGY (VOLUME I) (IN THE CONTEXT OF INTEGRATED MSW MANAGEMENT)** by ***the PLANNING COMMISSION (GOVERNMENT OF INDIA) published on May 12, 2014***.
- As per the above mentioned document, **the recyclable waste composition in MSW is 17%, Organic Waste is 51%**, **Inert & Non-organic is 32%.**
- Based on these facts and the actual composition of the Plastic Waste found, the 'Other Recyclable Waste' is deduced by subtracting the % of Plastic Waste from 17% - which is said to be the Total Recyclable Waste found in MSW.
- **Inert & Non-Recyclable** Waste is the waste consisting of C&D Waste (Construction & Debris Waste), sludge from the drains, dust & sand etc.
- The **Other Recyclable Waste** consists of leather, clothes, steel, iron, metals, glasses etc.

S.No	Area	Total MSW (Kg.)	Organic Waste (Kg.)	Organic Waste (%)	Inert & Non-Organic (Kg.)	Inert & Non-Organic (%)	Other Recyclable (Kg.)	Other Recyclable (%)	Plastics (Kg.)	Plastics (%)	P.W. sold (Kg.)	% of P.W. sold (From Total M.S.W.)	% of P.W. sold (From Total P.W.)	P.W. Left at Landfill (kg.)	% of P.W. left at Landfill (From Total M.S.W.)	% of P.W. left at Landfill (From Total P.W.)
1	Shakti Nagar Colony	250	127.5	51.00	80	32.00	7.5	3.00	35	14.00	10	4.00	28.57	25	10.00	71.43
2	Bahar Khanderao Gate Civil Lines Ashiq Chauraha	200	102	51.00	64	32.00	10	5.00	24	12.00	7	3.50	29.17	17	8.50	70.83
3	Civil Lines Jhokan Bagh	430	219.3	51.00	137.6	32.00	19.1	4.44	54	12.56	12	2.79	22.22	42	9.77	77.78
4	Civil Lines South Part-2 Gondu Compound	350	178.5	51.00	112	32.00	14.5	4.14	45	12.86	10	2.86	22.22	35	10.00	77.78
5	Civil Lines West Part Refugee Colony - Satish Nagar	400	204	51.00	128	32.00	26	6.50	42	10.50	15	3.75	35.71	27	6.75	64.29
6	C P Mission Compound	400	204	51.00	128	32.00	28	7.00	40	10.00	12	3.00	30.00	28	7.00	70.00
7	Rajiv Nagar - Nainagarh	420	214.2	51.00	134.4	32.00	26.4	6.29	45	10.71	22	5.24	48.89	23	5.48	51.11
8	Nainagarh Part-2 Manoharpura	400	204	51.00	128	32.00	36	9.00	32	8.00	12	3.00	37.50	20	5.00	62.50
	Grand Total	**2850**	**1453.5**	**51.00**	**912**	**32.00**	**167.5**	**5.88**	**317**	**11.12**	**100**	**3.51**	**31.55**	**217**	**7.61**	**68.45**

1. TOTAL MUNICIPAL SOLID WASTE SAMPLED FOR STUDY					
S.No	**Area**	**Area Details**	**Loaded weight of the Truck**	**Empty Vehicle Weight**	**Total MSW Weight**
1	Shakti Nagar Colony	Middle Class Colony	1450	1200	250
2	Bahar Khanderao Gate Civil Lines Ashiq Chauraha	Posh Area	1400	1200	200
3	Civil Lines Jhokan Bagh	Upper Middle Class/ Shops	1630	1200	430
4	Civil Lines South Part-2 Gondu Compound	Govt officers/Bussiness Class	1550	1200	350
5	Civil Lines West Part Refugee Colony - Satish Nagar	Upper Middle Class/Shops	1600	1200	400
6	C P Mission Compound	Upper Middle Class/Shops	1600	1200	400
7	Rajiv Nagar - Nainagarh	Lower Middle Class, Densely populated	1620	1200	420
8	Nainagarh Part-2 Manoharpura	Lower Middle Class, Densely populated	1600	1200	400
	GRAND TOTAL		**12450**	**9600**	**2850**

2. % OF PLASTIC WASTE IN MUNICIPAL WASTE				
S.No	**Area**	**Total MSW Weight**	**Total P.W. Weight**	**% of Total P.W.**
1	Shakti Nagar Colony	250	35	14.00
2	Bahar Khanderao Gate Civil Lines Ashiq Chauraha	200	24	12.00
3	Civil Lines Jhokan Bagh	430	54	12.56
4	Civil Lines South Part-2 Gondu Compound	350	45	12.86
5	Civil Lines West Part Refugee Colony - Satish Nagar	400	42	10.50
6	C P Mission Compound	400	40	10.00
7	Rajiv Nagar - Nainagarh	420	45	10.71
8	Nainagarh Part-2 Manoharpura	400	32	8.00
	GRAND TOTAL	**2850**	**317**	**11.12**

3. % OF PLASTIC WASTE SOLD TO SCRAP DEALERS (FROM TOTAL MUNICIPAL WASTE)

S.No	Area	Total MSW Weight	Total P.W. Weight	P.W. Sold**	% of P.W. Sold** (From Total M.S.W.)
1	Shakti Nagar Colony	250	35	10	4.0
2	Bahar Khanderao Gate Civil Lines Ashiq Chauraha	200	24	7	3.5
3	Civil Lines Jhokan Bagh	430	54	12	2.8
4	Civil Lines South Part-2 Gondu Compound	350	45	10	2.9
5	Civil Lines West Part Refugee Colony - Satish Nagar	400	42	15	3.8
6	C P Mission Compound	400	40	12	3.0
7	Rajiv Nagar - Nainagarh	420	45	22	5.2
8	Nainagarh Part-2 Manoharpura	400	32	12	3.0
	GRAND TOTAL	**2850**	**317**	**100**	**3.5**

4. % OF PLASTIC WASTE SOLD TO SCRAP DEALERS (FROM TOTAL PLASTIC WASTE)

S.No	Area	Total MSW Weight	Total P.W. Weight	P.W. Sold**	% of P.W. Sold** (From Total P.W.)
1	Shakti Nagar Colony	250	35	10	28.6
2	Bahar Khanderao Gate Civil Lines Ashiq Chauraha	200	24	7	29.2
3	Civil Lines Jhokan Bagh	430	54	12	22.2
4	Civil Lines South Part-2 Gondu Compound	350	45	10	22.2
5	Civil Lines West Part Refugee Colony - Satish Nagar	400	42	15	35.7
6	C P Mission Compound	400	40	12	30.0
7	Rajiv Nagar - Nainagarh	420	45	22	48.9
8	Nainagarh Part-2 Manoharpura	400	32	12	37.5
	GRAND TOTAL	**2850**	**317**	**100**	**31.5**

5. % OF PLASTIC WASTE LEFT AT THE LANDFILL* (FROM TOTAL MUNICIPAL WASTE)

S.No	Area	Total MSW Weight	Total P.W. Weight	P.W. Left at Landfill*	% of P.W. left at Landfill* (From Total M.S.W.)
1	Shakti Nagar Colony	250	35	25	10.00
2	Bahar Khanderao Gate Civil Lines Ashiq Chauraha	200	24	17	8.50
3	Civil Lines Jhokan Bagh	430	54	42	9.77
4	Civil Lines South Part-2 Gondu Compound	350	45	35	10.00
5	Civil Lines West Part Refugee Colony - Satish Nagar	400	42	27	6.75
6	C P Mission Compound	400	40	28	7.00
7	Rajiv Nagar - Nainagarh	420	45	23	5.48
8	Nainagarh Part-2 Manoharpura	400	32	20	5.00
	GRAND TOTAL	**2850**	**317**	**217**	**7.61**

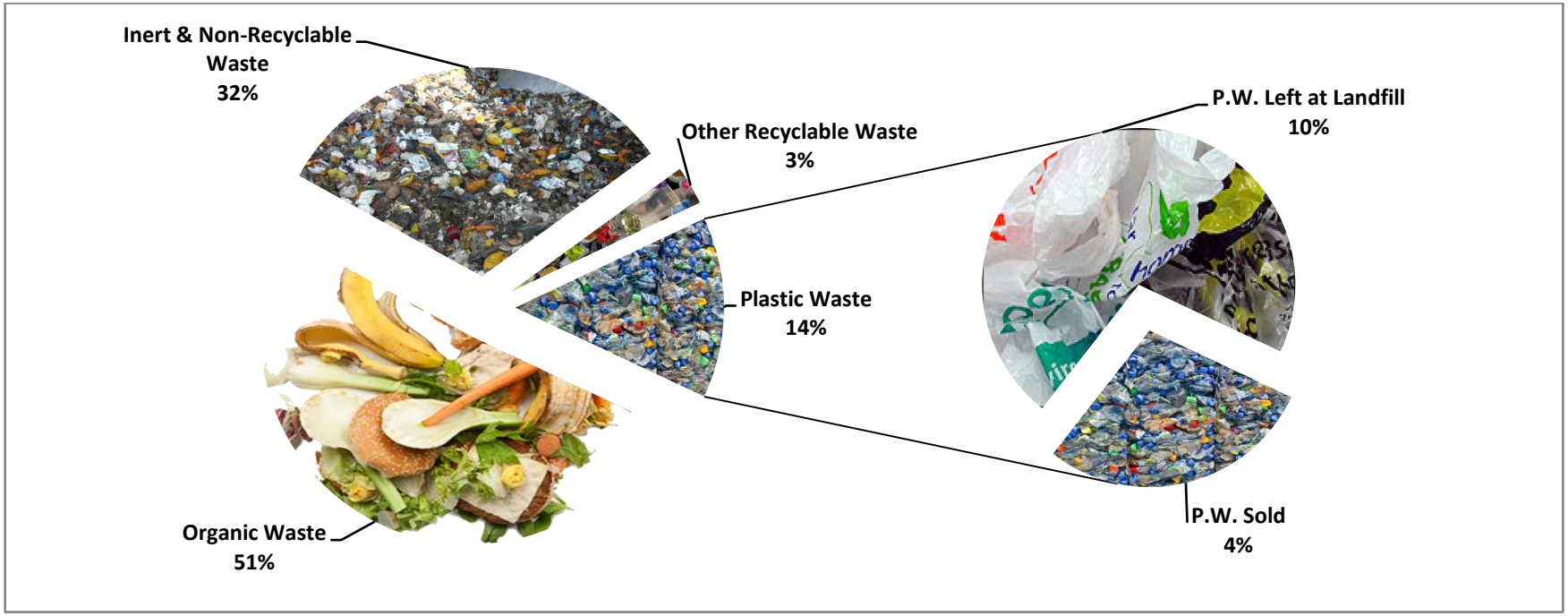
6. % OF PLASTIC WASTE LEFT AT THE LANDFILL* (FROM TOTAL PLASTIC WASTE)

S.No	Area	Total MSW Weight	Total P.W. Weight	P.W. Left at Landfill*	% of P.W. left at Landfill* (From Total P.W.)
1	Shakti Nagar Colony	250	35	25	71.4
2	Bahar Khanderao Gate Civil Lines Ashiq Chauraha	200	24	17	70.8
3	Civil Lines Jhokan Bagh	430	54	42	77.8
4	Civil Lines South Part-2 Gondu Compound	350	45	35	77.8
5	Civil Lines West Part Refugee Colony - Satish Nagar	400	42	27	64.3
6	C P Mission Compound	400	40	28	70.0
7	Rajiv Nagar - Nainagarh	420	45	23	51.1
8	Nainagarh Part-2 Manoharpura	400	32	20	62.5
	Grand Total	**2850**	**317**	**217**	**68.5**

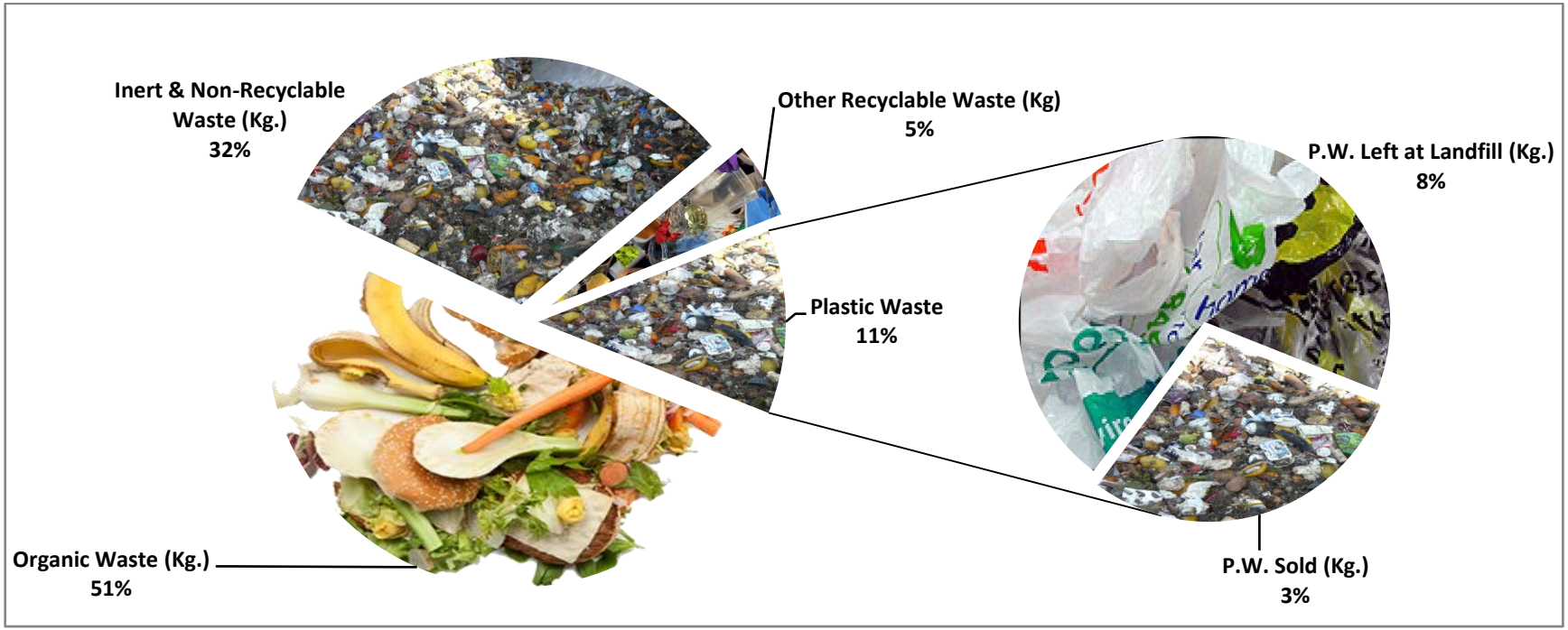
**** WILL BE SENT TO RECYCLING PLANT – ONCE OPERATIONAL.***
***** SOLD TO SCRAP DEALERS OR TAKEN BY THE RAG-PICKERS.***

COLONY WISE SEGREGATED DATA OF PLASTIC WASTE FOUND IN MUNICIPAL WASTE

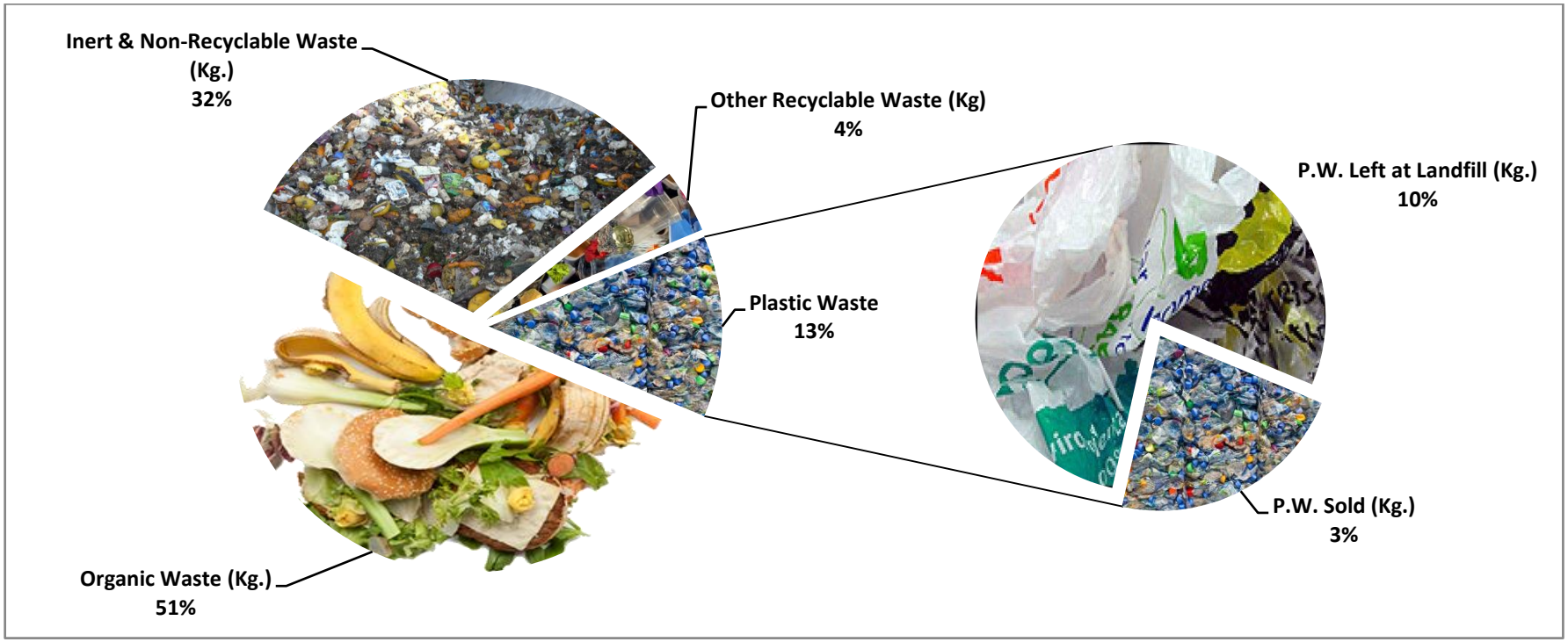
SHAKTI NAGAR COLONY	
ORGANIC WASTE (KG.)	127.5
INERT & OTHER RECYCLABLE WASTE (KG.)	80
OTHER RECYCLABLE WASTE (KG)	7.5
PLASTIC WASTE SOLD (KG.)	10
PLASTIC WASTE LEFT AT LANDFILL (KG.)	25



BAHAR KHANDERAO GATE CIVIL LINES ASHIQ CHAURAHA	
ORGANIC WASTE (KG.)	102
INERT & NON-RECYCLABLE WASTE (KG.)	64
OTHER RECYCLABLE WASTE (KG)	10
PLASTIC WASTE SOLD (KG.)	7
PLASTIC WASTE LEFT AT LANDFILL (KG.)	17

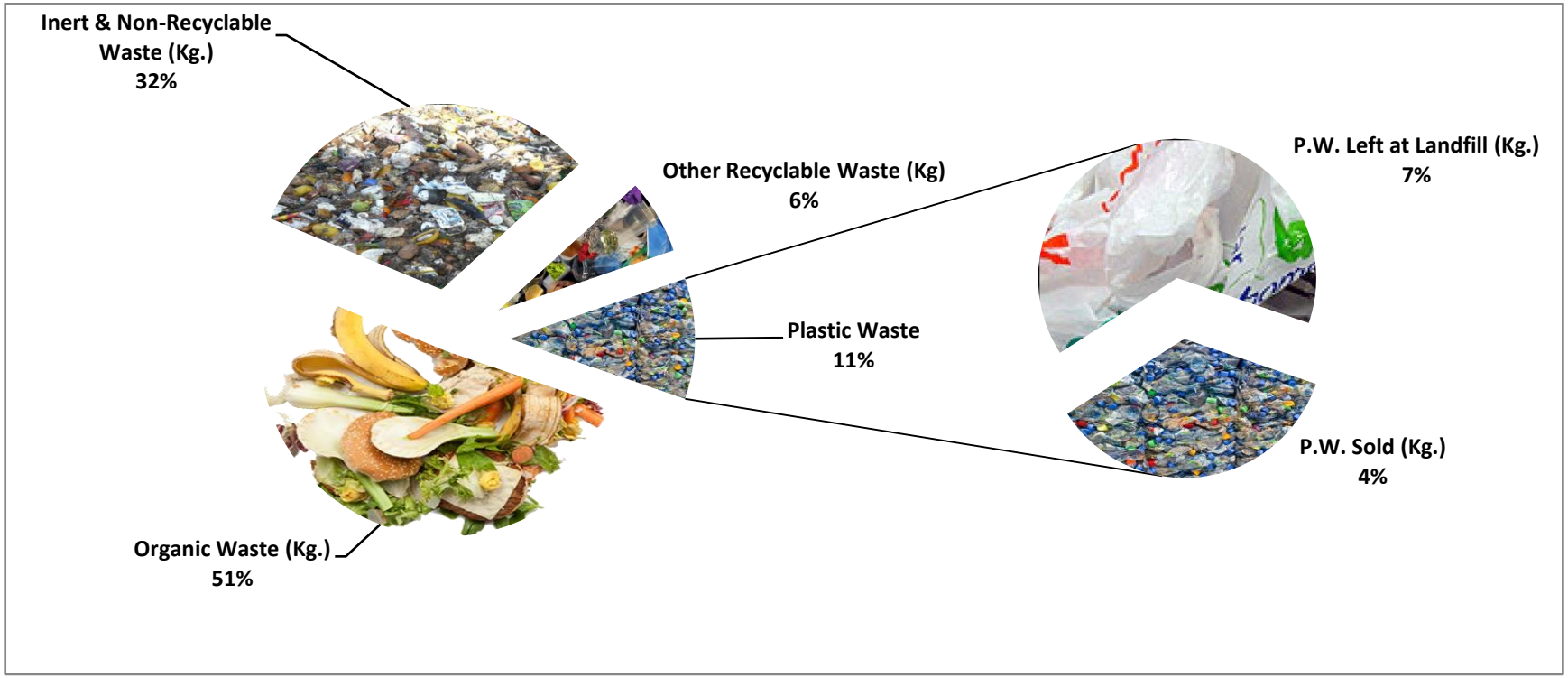


CIVIL LINES JHOKAN BAGH	
ORGANIC WASTE (KG.)	219.3
INERT & NON-RECYCLABLE WASTE (KG.)	137.6
OTHER RECYCLABLE WASTE (KG)	19.1
PLASTIC WASTE SOLD (KG.)	12
PLASTIC WASTE LEFT AT LANDFILL (KG.)	42

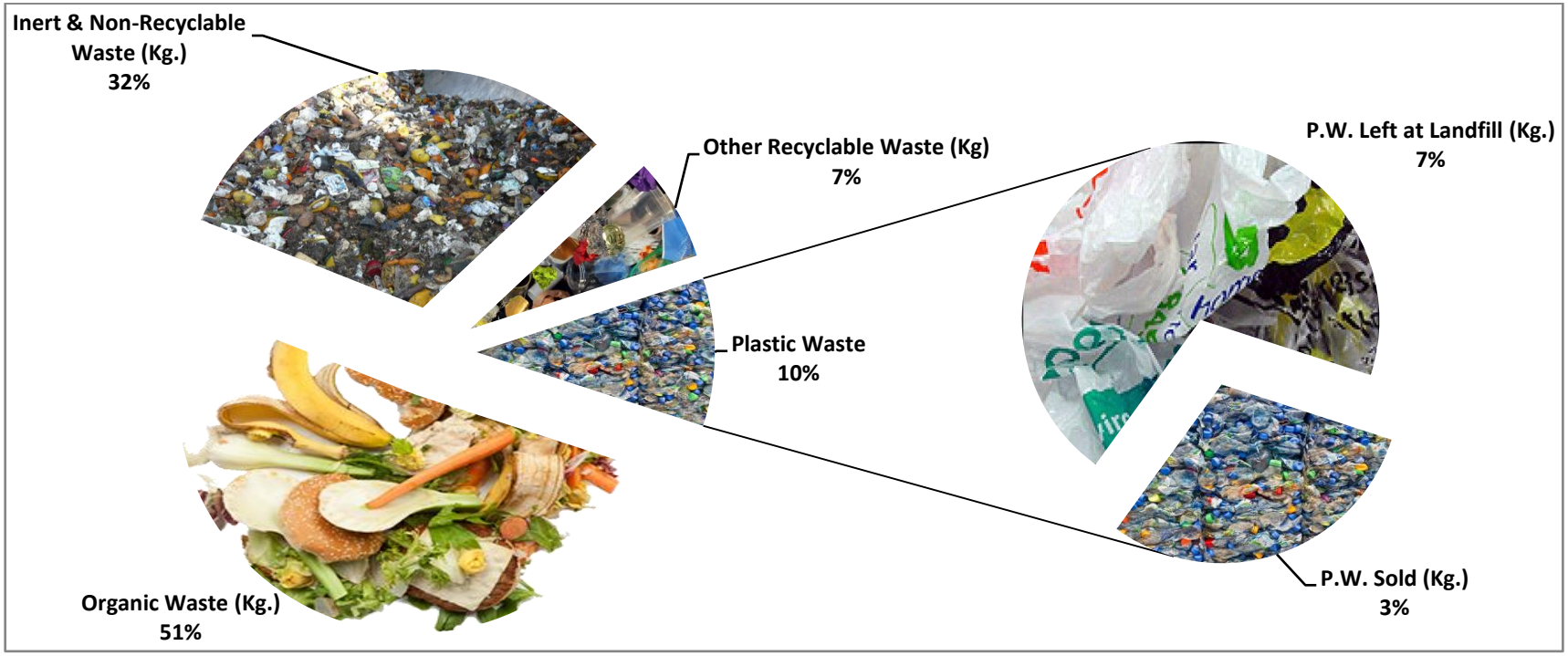


CIVIL LINES SOUTH PART-2 GONDU COMPOUND	
ORGANIC WASTE (KG.)	178.5
INERT & NON-RECYCLABLE WASTE (KG.)	112
OTHER RECYCLABLE WASTE (KG)	14.5
PLASTIC WASTE SOLD (KG.)	10
PLASTIC WASTE LEFT AT LANDFILL (KG.)	35

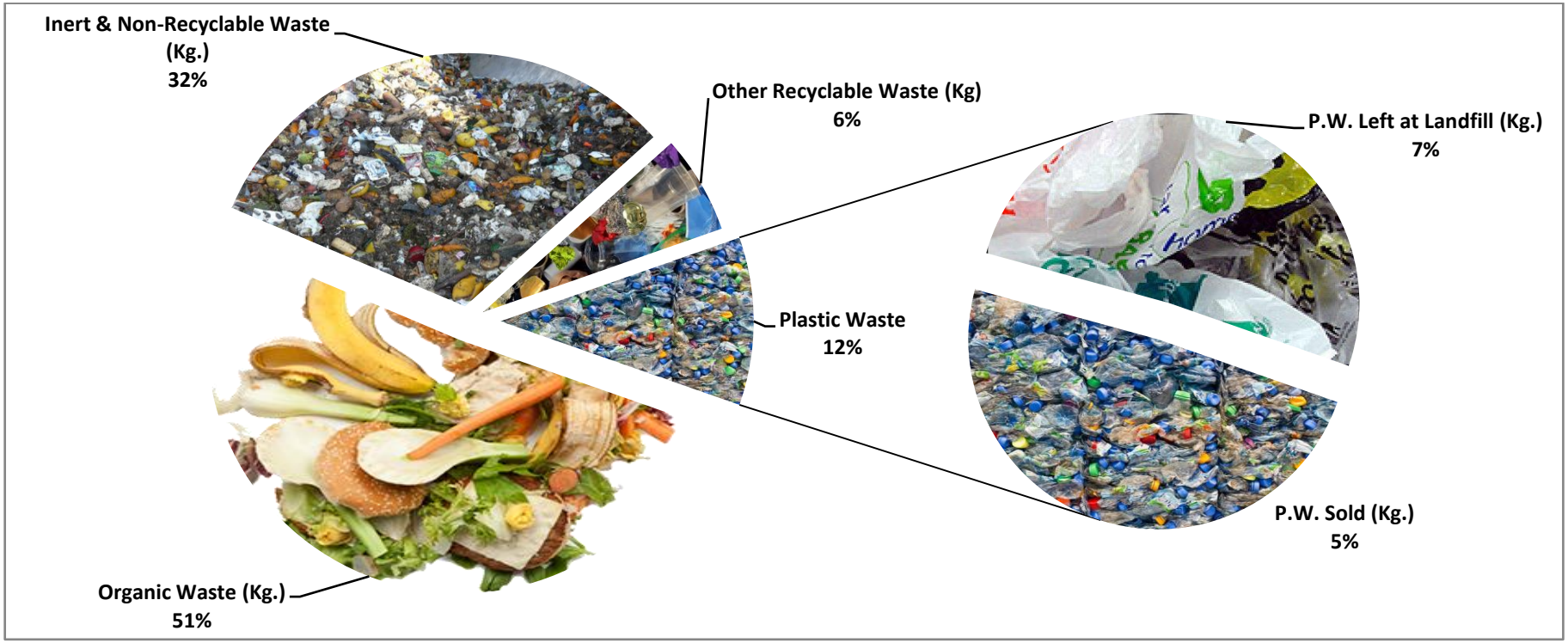
CIVIL LINES WEST REFUGEE COLONY - SATISH NAGAR	
ORGANIC WASTE (KG.)	204
INERT & NON-RECYCLABLE WASTE (KG.)	128
OTHER RECYCLABLE WASTE (KG)	26
PLASTIC WASTE SOLD (KG.)	15
PLASTIC WASTE LEFT AT LANDFILL (KG.)	27



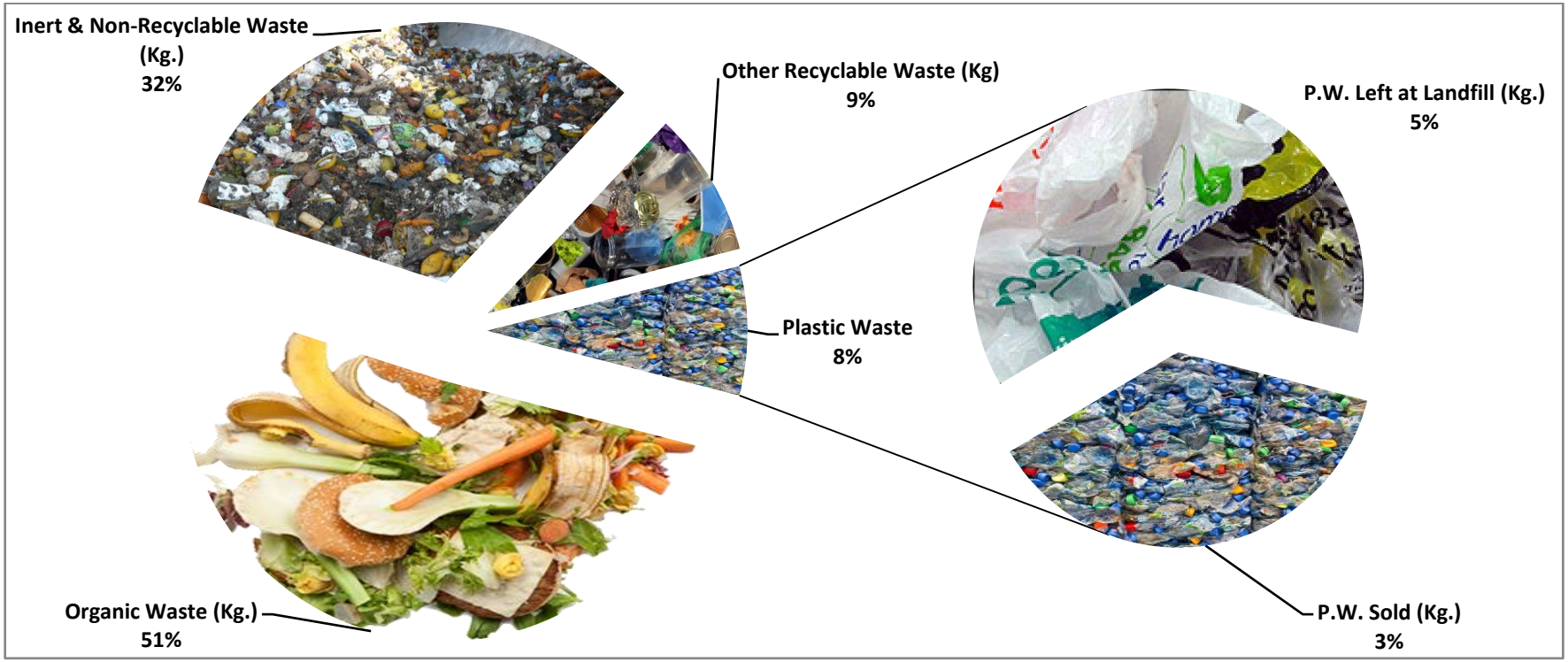
C P MISSION COMPOUND	
ORGANIC WASTE (KG.)	204
INERT & NON-RECYCLABLE WASTE (KG.)	128
OTHER RECYCLABLE WASTE (KG)	28
PLASTIC WASTE SOLD (KG.)	12
PLASTIC WASTE LEFT AT LANDFILL (KG.)	28



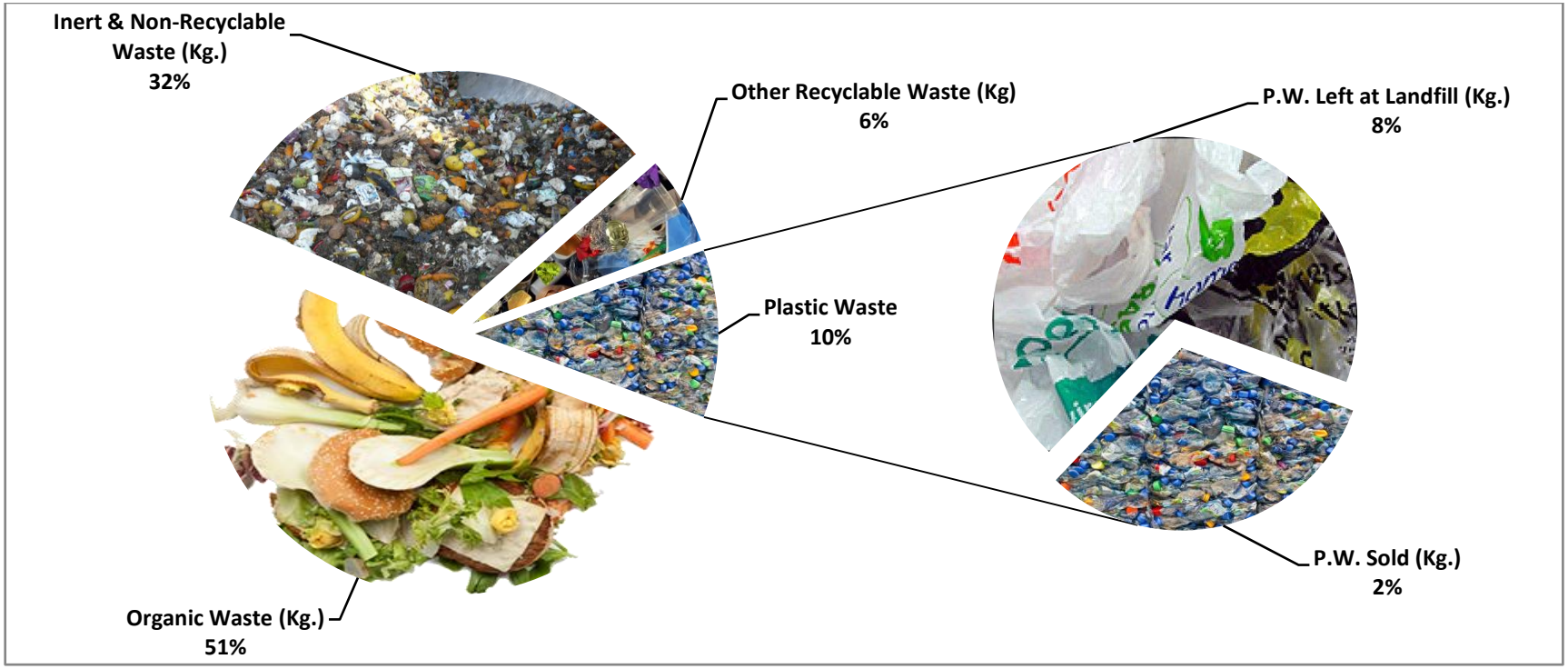
RAJIV NAGAR - NAINAGARH	
ORGANIC WASTE (KG.)	214.2
INERT & NON-RECYCLABLE WASTE (KG.)	134.4
OTHER RECYCLABLE WASTE (KG)	26.4
PLASTIC WASTE SOLD (KG.)	22
PLASTIC WASTE LEFT AT LANDFILL (KG.)	23



NAINAGARH PART-2 MANOHARPURA	
ORGANIC WASTE (KG.)	204
INERT & NON-RECYCLABLE WASTE (KG.)	128
OTHER RECYCLABLE WASTE (KG)	36
PLASTIC WASTE SOLD (KG.)	12
PLASTIC WASTE LEFT AT LANDFILL (KG.)	20



GRAND TOTAL	
ORGANIC WASTE (KG.)	1453.5
INERT & NON-RECYCLABLE WASTE (KG.)	912
OTHER RECYCLABLE WASTE (KG)	167.5
PLASTIC WASTE SOLD (KG.)	100
PLASTIC WASTE LEFT AT LANDFILL (KG.)	217



 # Figures for Mela ki Tauriya Landfill, Masihaganj, Jhansi, Uttar Pradesh.

 # Source: R.R. Collective, Jhansi – 2015

ESTIMATES IF 100% OF PW IS SENT TO PLANT					
Year	**Population**	**MSW Generation (@ .45 kg per capita)**	**Total PW Generation (@ 11.12% of MSW Generated)**	**PW Sold to Traders (@ 3.51% of Total MSW)**	**PW Sent to Plant (@7.61% of Total MSW)**
		A	**B**	**C**	**D**
2011	556107	250248.15	27827.59	-	-
2015	606588	272964.6	30353.66	9581.06	20772.61
2021	657069	295681.05	32879.73	10378.40	22501.33
2025	715118	321803.1	35784.50	11295.29	24489.22
2031	773167	347925.15	38689.28	12212.17	26477.10

Year	**PW Sent to Plant (@7.61% of Total MSW)**	**Inerts Sent to Plant. @ 4% of the Total PW**	**Sent to Bailing Machine (Estimate Percentage)**	**Sent to Shredder (Estimate Percentage)**	**Sent to Fine Shredder**
	E	**F = 4% of E**	**G=20% of E**	**H =75% of E**	**I**
2015	20772.61	830.90	4154.52	15579.45	500.00
2021	22501.33	900.05	4500.27	16876.00	500.00
2025	24489.22	979.57	4897.84	18366.91	500.00
2031	26477.10	1059.08	5295.42	19857.83	500.00

Year	**Sent to make Diesel**	**Converted for RDF for Cement Klln/ Power Generation**	**Converted for making Lumber**
	J1 = H-I	**J2=H-I**	**J3=H-I**
2015	15079.45	15079.45	15079.45
2021	16376.00	16376.00	16376.00
2025	17866.91	17866.91	17866.91
2031	19357.83	19357.83	19357.83

#1 The quantity of PW (H) which cannot be Recycled has to pass through Shredder before going in either/or

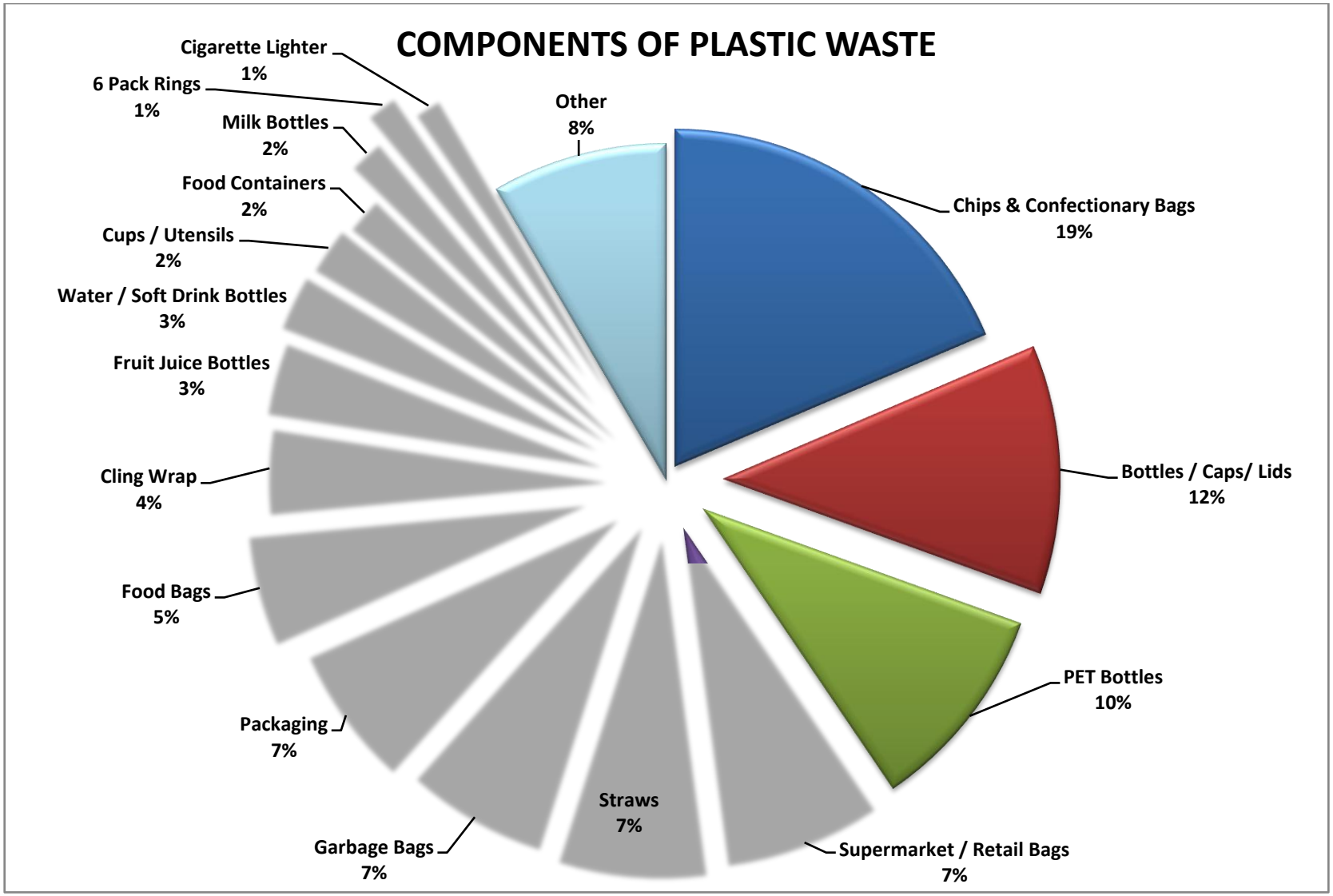
a. RDF to Cement Klin of Power Generation
b. For getting converted to fuel
c. For Lumber making

#2 If the projected PW comes to plant then the equipment which are planned to be installed in Phase-1 will not be able to meet the requirement and minimum three sets of plants have to be installed to process the PW and that too in two shifts.

#3 The plant preferable should be run on 6 Hrs shift and maximum two shifts of 6 Hrs each should be planned.

#4 As the basis of sorting is majorly manual it will be very difficult for a handler to efficently sort PW for a very long period of time.

#5 The facility has to run 7 days a week and if workers work on 6 Hrs shift then 6x7= 42 Hrs week will be there.


COMPONENTS OF PLASTIC WASTE
Cigarette Lighter 1%
6 Pack Rings 1%
Milk Bottles 2%
Food Containers 2%
Cups / Utensils 2%
Water / Soft Drink Bottles 3%
Fruit Juice Bottles 3%
Cling Wrap 4%
Food Bags 5%
Packaging 7%
Garbage Bags 7%
Straws 7%
Supermarket / Retail Bags 7%
PET Bottles 10%
Bottles / Caps/ Lids 12%
Chips & Confectionary Bags 19%
Other 8%

CHAPTER 9

FINANCIAL SCHEME AND FEASIBILITY REPORT

9. FINANCIAL SCHEME AND FEASIBILITY REPORT

Narration:

1. This business model is for the recycling plant and a small investment in waste exchange centers. This is because of backward integration for ensuring regular raw material supply to the plant. The waste exchange centers are self-sustaining models and their income and deposits are now integrated in this business model, for which the funding is planned from TFC.

2. The recycling plant is proposed to be self-sustaining model as far as its broader income and expenditure is concerned. This is as part of municipal service of plastics waste processing to the plastics waste handling community. Only on success full demonstration and on emerging data future expansion plan of plant will be determined.

3. All other expenses of project development, establishment and management, including IEC is on the cost of regular Nagar Nigams' expenses of sanitation work like waste collection, tools and machines for waste collection.

4. The Nagar Nigam will regularly be involved and meet the necessary expenses of project management fee, its office and infrastructure, routine office expenses, tools for waste collection through rag-pickers, like uniforms, I-cards, registers, safety jackets, bags, gloves and boots for recyclable waste at initial stages for every house. The data management cost, website interaction, one transport vehicle for every 50000 population, driver, fuel, helpers, maintenance of vehicles, supervisors for every 10 porta-cabins, with support staff, and other incidental expenses.

5. The aggressive IEC activity also does not form part of the project funding and will come from regular IEC work and resource management of Nagar Nigam.

6. The raw material for the plant is the plastics waste, which is not regularly recycled by the plastics industry. This is because of such waste not being cost effective. We expect that it will increase with door to door waste collection.

7. The Nagar Nigam is also planning to remediate the waste dumpsite, trenching ground to extract the plastics waste, as well as use the plastics waste collected from the Jhansi Cantonment Board, railway colony, workshop, and railway stations, The BHEL colonies, the Parichha Power plant colony, cement plant colony and Babina cantonment board for processing.

8. The regular kabadi network transports the plastics waste to nearby markets –Kanpur and Delhi at huge cost without compacting and they do manual sorting which is not perfect or cost effective. The service offered to them will be very cost effective to them and also to us to meet the revenue need.

9. The quantity utilization of individual equipment does not justify as the whole system is synchronized, irrespective of their capacities. It is to process approximately 5 tons of the plastics dry waste in a day. However based of the need and waste available, the plant will be used in two shifts and expansion plan will be determined.

10. The first priority is to have a recycling plant for plastics waste, dry waste, if we want any segregation practice to succeed. And primary it has to be established, and exist, operated by and ULB and serve the community. Children get confidence that if they segregate, it will meet a proper end.

11. To begin with we are only working for $1/6^{th}$. Of the projected waste. The separating of this stream of waste from municipal waste stream will have new data, and new parameters. A beginning is to be made is more important with minimum risk, than the projected population growth. The plastics consumption pattern, life style of the people, success of the courts and governments in prohibition of plastics bags and packaging material. Acceptance of segregation by populace, the habit change etc. are other parameters, which will affect this project greatly.

12. As of now the top priority is to start collecting the segregated waste from home, help homes to segregate, mobilize and empower the rag pickers to make a little better living by this collection from home and eliminating both rag picking and littering.

13. The financial feasibility model has 35% utilization as breakeven point and IRR is 2.88%. this means that project dose not any profit, and we know that it does great service to the community.

14. In fact, it is an essential service the ULB has to provide, to prevent its own hard ship in drain cleaning and street cleaning and biodegradable waste without plastics waste is as good as compost in a few hours to a few days.

15. The financial feasibility model has three hundred working days in a year, and figures always vary after three years of project establishment. In this project, the review period is three months- every quarter and the next growth step is planed here.

16. There for once the primary sorting system is installed, the primary collection mechanism is established and demonstration system has worked for three months; almost all its aspects will have to be reworked.

17. The working capital requirements and working capital utilization has little meaning as of now. The Nagar Nigam is well placed to meet its cost which is in conservative calculations stands as:
    - The Working capital requirement in whole project of 15 Crore investment is approximately Rs. 70 lacs.
    - On $1/5^{th}$ of investment i.e. of Rs. 3 crore investments, it is only 14 lacs per years or just 1.17 lacs per month.
    - This can come from the general operations fund of the ULB.

18. The raw material stock is holding, the finished good stock holding (we get advances) creditors and debtors payment schedules will ensure the working capital flow is not problem.

19. The whole establishment and the whole plant funding is spread over two years and this stepped growth will be evaluated at every stage very critically by funding agencies.

19. Though the Plastics waste to fuel and plastics waste to lumber are not time tested technologies they will be incorporated only when a funding agency agrees and the manufacturers will be called for the justification of operations. Till than their figure are only indicative.

20. It is assumed that the plant will work for 300 days in a year and 15 tonnes being the full capacity in 300 days will have 1500 tonnes of waste per sorting unit. Therefore the total plant capacity will be 4500 tonnes, however, making the plant work in 2 shifts or 3 shifts as well

as quantity of the waste received will determine the future course of action. As of now, the whole project investment is 3 crores and its stable operation will determine the future expansion of the recycling plant.

21. This plant is for the Plastic Waste Management for which a separate law is enacted, and there exists a very well established supply chain network. The response of this network will determine the above two factors. Therefore, changing any figure in the feasibility report may not be proper. It will be reviewed after 3 month of successful of 1 unit.

22. The proposed method by R.C.U.E.S for the project financials is for the finished goods only, while here we have raw materials processing and finished goods including debtors, creditors as well as cost of holding raw materials and finished goods. Therefore, not much of the changes are required at this stage in this feasibility report except a little addition of technical details. This has approval of Shri. Santosh Verma of R.C.U.E.S, Lucknow.

Note: After the tendering and selection of the bidders as supplier, we have found the cost quoted as L1 (Lowest 1) is Rs.3, 25,000/- for the porta-cabins (Per Unit) and Rs. 1,76,90,000/- for the integrated sorting, bailing, shredding and conveyor belts (1 Unit). This price does not include excise duty of 12.5% and central sales tax of 5.25% besides other costs.

Name of the Project: Plastic Waste Management

Area: Jhansi Nagar Nigam

Nature of Project: Plastic Waste Management by Urban Local Bodies for litter free area

PROJECT REPORT FOR WASTE RECYCLE					
COST OF PROJECT					
Fixed Assets			1430.00		
Interest During Construction Period			0.00		0.00
Working Capital Margin			69.09		
			1499.09		
MEANS OF FINANCE					
Contribution Under VGF,EPR & CSR			1150.00		76.71%
Promoter Contribution by Nagar Nigam, Jhansi			300.00		20.01%
Porta Cabins Deposit			49.09		3.27%
Total			**1499.09**		**100.00%**
ANNEXURE-I					
FIXED ASSETS					
S.No.	**Heads**	**Amount Rs. In Lacs**	**Cost**	**Prelim & IDCP Apportioned**	
1	Plant & Machinery		1100.00	0.00	1100.00
2	Building (To be Construed By Nagar Nigam)		330.00	0.00	330.00
3	Land (To Be Provided By Nagar Nigam)		0.00	0.00	0.00
Total			**1430.00**	**0.00**	**1430.00**

DETAILS OF PROPOSED PLANT, MACHINERY & EQUIPMENTS									
S.No.	**Particulars**							**Rate**	**Amount (Rs.)**
1	Plant & Machinery:	Vibrator	Air Density Separator	Conveyor Belt 20mt + 5mt + 5mt	2 Bailers	2 Shredders			
	a) Waste Segregation Plant							45000000	
	b) Diesel Generation Plant							5000000	
	c) Lumber Plant							25000000	
								(a+b+c)	75000000
2	Electricals & D.G. Set								10000000
3	Porta-cabins	Units:	30	Price Per Unit:	500000				15000000
								(1+2+3)	100000000
	Contingencies & Installation						@	10.00%	10000000
								Total	**110000000**

DETAILS OF PROPOSED BUILDING							
S.No.	**Particulars**						**Amount (Rs.)**
1	Factory Building & Sheds	Area: 35*35*10(m)	Structure: Shed & Concrete Platform	Price Per Unit:	10000000		30000000
	Contingencies & Installation					@ 10.00%	3000000
						Total	**33000000**

WORKING CAPITAL REQUIREMENT								
Raw Material	21 Days	20.25	21.60	22.96	24.31	24.31	24.31	24.31
Finished Goods	15 Days	27.80	27.63	27.68	27.91	27.28	26.80	26.56
Sundry Debtors	15 Days	29.39	31.34	33.30	35.26	35.26	35.26	40.55
Current Assets (A)		**77.44**	**80.58**	**83.93**	**87.48**	**86.85**	**86.37**	**91.42**
Provisions & Payables	7 Days	8.36	8.93	9.51	10.10	10.22	10.34	10.53
Current Liabilities(B)		**8.36**	**8.93**	**9.51**	**10.10**	**10.22**	**10.34**	**10.53**
Net Current Assets (A-B)		**69.09**	**71.65**	**74.42**	**77.38**	**76.63**	**76.02**	**80.88**
Source of Working Capital								
Own Contribution		69.09	71.65	74.42	77.38	76.63	76.02	80.88
		69.09	**71.65**	**74.42**	**77.38**	**76.63**	**76.02**	**80.88**
Current Ratio								
Current Assets								
Raw Material		20.25	21.60	22.96	24.31	24.31	24.31	24.31
Finished Goods		27.80	27.63	27.68	27.91	27.28	26.80	26.56
Sundry Debtors		29.39	31.34	33.30	35.26	35.26	35.26	40.55
Other Current Assets and Cash &		220.12	439.49	661.43	886.74	1106.96	1318.70	1589.51
Bank Balance								
Total Current Assets (A)		297.57	520.07	745.36	974.22	1193.81	1405.07	1680.92
Current Liabilities								
Provisions & Payables		8.36	8.93	9.51	10.10	10.22	10.34	10.53
Total Current Liabilities (B)		8.36	8.93	9.51	10.10	10.22	10.34	10.53
Current Ratio (A/B)		**35.61**	**58.25**	**78.37**	**96.45**	**116.84**	**135.82**	**159.59**

INTERNAL RATE OF RETURN								
	Project Cost	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
Project Cost	-1430.00							
Cash Inflow		220.12	221.93	224.71	228.26	219.48	211.14	275.66
	-1430.00	**220.12**	**221.93**	**224.71**	**228.26**	**219.48**	**211.14**	**275.66**
IRR	**2.85%**							

COST OF PRODUCTION & PROFITABILITY STATEMENT								
ANNEXURE								
		Figure Rs. In Lacs						
		Year						
S No.	**Particulars**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
	CAPACITY UTILISATION	75.00%	80.00%	85.00%	90.00%	90.00%	90.00%	90.00%
1	Cost Of Raw Material	289.35	308.64	327.93	347.22	347.22	347.22	347.22
2	Power & Fuel	9.45	10.08	10.71	11.34	11.34	11.34	11.34
3	Salary & Wages	29.94	32.93	36.23	39.85	43.84	48.22	53.04
4	Insurance and Repair & Maintenance	17.60	18.48	19.40	20.37	21.39	22.46	23.59
5	Selling & Administrative Exp.	11.75	12.54	13.32	14.10	14.10	14.10	16.22
6	Depreciation	198.00	169.95	145.94	125.39	107.78	92.70	79.77
	Total Operating Cost (a)	556.09	552.62	553.54	558.28	545.68	536.04	531.17
	Cost Of Sales (b)	556.09	552.62	553.54	558.28	545.68	536.04	531.17
7	Gross Receipts (c)	587.70	626.88	666.06	705.24	705.24	705.24	811.03
	Profit Before Tax (c-b)	31.61	74.26	112.52	146.96	159.56	169.20	279.85
8	Income Tax (d)	9.48	22.28	33.76	44.09	47.87	50.76	83.96
	Profit After Tax (c-b-d)	22.12	51.98	78.77	102.87	111.70	118.44	195.90
	Cash Accruals							
	Profit After Tax	22.12	51.98	78.77	102.87	111.70	118.44	195.90
	Add : Depreciation	198.00	169.95	145.94	125.39	107.78	92.70	79.77
		220.12	**221.93**	**224.71**	**228.26**	**219.48**	**211.14**	**275.66**

BREAK UP OF COST OF PRODUCTION & PROFITABILITY STATEMENT

1. RAW MATERIAL

It is Considered that various Raw Material used are as follows plastics waste with other dry recyclable waste.

Which could be of 50% of total estimated plastics waste in Jhansi.

2. FUEL COST

It is Considered that 70 HP connections will be required for operating the plant at 90% Load Factor and @ Rs. 7.00 per unit for 25 Days working in a month per shift.

Say Monthly per shift	**105000**
No. of Shift	**1**
Hence Annually	**1260000**

3. SALARY

S.No.	Particulars	No.	Monthly salary (Rs.)	Annual Amount
1	Manager/Supervisor	2	15000	360000
2	Accountant	1	15000	180000
3	Labor	15	7500	1350000
4	Staff	2	10000	240000
5	Operator	6	12000	864000
			Annual Salary & Wages	**2994000**

an increase of 10% p.a. is considered

4. INSURANCE AND REPAIR & MAINTENANCE

It is Considered that annually 2% of the Building will be incurred in repair & Maintenance

It is Considered that annually 1% of the Plant will be incurred on Insurance

For 1st Year

Building	6.60
Plant & Machinery	11.00
	17.60

it is envisaged that an increase of 5% from 2nd year every year

5. SELLING & ADMINISTRATIVE EXPENSES

It is considered that Selling & Administrative Expenses will be 2% of the Receipt Amount

6. DEPRECIATION

Considered

Building Cost Including Furnishing	33000000
Add : Interest During Construction Period	0
10% on Building of	33000000

Considered

Plant & Machinery Cost	110000000
Add : Interest During Construction Period	0
15% on Plant & Machinery of	110000000

Year	Building (Rs.)	Plant & Machinery (Rs.)	Amount (Rs.)
1	3300000	16500000	19800000
2	2970000	14025000	16995000
3	2673000	11921250	14594250
4	2405700	10133063	12538763
5	2165130	8613103	10778233
6	1948617	7321138	9269755
7	1753755	6222967	7976722
	17216202.3	**74736520**	**91952723**

7. INCOME TAX

It has been calculated at the current rates

8. REVENUE AT 100% OCCUPANCY					
1. Sales Receipts					
1. Receipts (At 100% Capacity)					
For Single Shift					
S. No.		**Qty**		**Rate**	**Value**
1	Recycle Plastic Waste Receipts	4500	Ton	10000	45000000
2	Diesel Generation Plant Receipt	48000	Litres	45	2160000
3	Lumber Plant Generation Receipt	600	Ton	50000	30000000
4	Advertisement Income From Portacabins	30 Units		@ 2000/	600000
5	Profit Sharing Income From Portacabins	30 Units		@ 2000/	600000
				Total Revenue in a year:	**78360000**

CASH FLOW STATEMENT									
ANNEXURE									
			Figure Rs. In Lacs						
			Year						
S No.	**Particulars**		**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
A)	INFLOW								
1	Voluntary Contribution Under CSR		1150.00						
2	Porta Cabins Deposit		49.09						
3	Promoter Contribution by Nagar Nigam		300.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Cash Accruals		220.12	221.93	224.71	228.26	219.48	211.14	275.66
		Total	**1719.21**	**221.93**	**224.71**	**228.26**	**219.48**	**211.14**	**275.66**
B)	OUTFLOW								
1	Capital Outlays		1430.00						
2	Working Capital Req./		69.09	2.56	2.77	2.96	-0.75	-0.61	4.86
	Incr. in requirement								
3	Capital Distribution		0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Total	**1499.09**	**2.56**	**2.77**	**2.96**	**-0.75**	**-0.61**	**4.86**
A)	Opening Balance		0.00	220.12	439.49	661.43	886.74	1106.96	1318.70
B)	Surplus		220.12	219.37	221.94	225.31	220.22	211.74	270.81
C)	Closing Balance		220.12	439.49	661.43	886.74	1106.96	1318.70	1589.51

BREAK EVEN POINT AT 90% CAPACITY				
		Figure Rs. In Lacs		
S.No.	**Particulars**	**Fixed Overheads**	**Variable Overheads**	**Amount (Rs.)**
1	Cost Of Raw Material	0.00	347.22	347.22
2	Power & Fuel	0.00	11.34	11.34
3	Salary & Wages (Fixed 40: Variable 60)	21.22	31.82	53.04
4	Repair & Maintenance Cost (Variable Cost)	0.00	22.46	22.46
5	Selling & Admin Exp.(Fixed 40: Variable 60)	9.73	6.49	16.22
6	Depreciation	79.77	0.00	79.77
	Total	**110.72**	**419.34**	**530.05**
Sales				705.24
Contribution (Sales - Variable Cost)				285.90
BEP			(Fixed Cost / Contribution)*90%	
				34.85%

Current Liabilities							
Provisions & Sundry Creditors	8.36	8.93	9.51	10.10	10.22	10.34	10.53
	-	-	-	-	-	-	-
	8.36	8.93	9.51	10.10	10.22	10.34	10.53
Net Current Assets	**289.21**	**511.14**	**735.85**	**964.12**	**1183.59**	**1394.73**	**1670.39**
	-						
	1521.21	**1573.19**	**1651.96**	**1754.84**	**1866.53**	**1984.97**	**2180.86**
	-						
	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PROJECTED BALANCE SHEET							
	Year						
	2015-16	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
Capital							
Opening	0.00	1472.12	1524.11	1602.87	1705.75	1817.44	1935.88
Add Profits Of The Year	22.12	51.98	78.77	102.87	111.70	118.44	195.90
Add Promoter Contribution by Nagar Nigam	300.00	0.00	0.00	0.00	0.00	0.00	0.00
Voluntary Contribution Under CSR	1150.00	0.00	0.00	0.00	0.00	0.00	0.00
	-	-	-	-	-	-	-
	1472.12	1524.11	1602.87	1705.75	1817.44	1935.88	2131.78
Less Withdrawals	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-	-	-	-	-	-	-
	1472.12	**1524.11**	**1602.87**	**1705.75**	**1817.44**	**1935.88**	**2131.78**
Porta Cabin Deposits	**49.09**	**49.09**	**49.09**	**49.09**	**49.09**	**49.09**	**49.09**
	-						
	1521.21	1573.19	1651.96	1754.84	1866.53	1984.97	2180.86
	-						
Net Fixed Assets	**1232.00**	**1062.05**	**916.11**	**790.72**	**682.94**	**590.24**	**510.47**
Net Current Assets							
Current Assets							
Raw Material	20.25	21.60	22.96	24.31	24.31	24.31	24.31
Finished Goods	27.80	27.63	27.68	27.91	27.28	26.80	26.56
Sundry Debtors	29.39	31.34	33.30	35.26	35.26	35.26	40.55
Other Current Assets and Cash &	220.12	439.49	661.43	886.74	1106.96	1318.70	1589.51
Bank	-	-	-	-	-	-	-
	297.57	520.07	745.36	974.22	1193.81	1405.07	1680.92

ANNEXURE "A"
COST OF PROJECT :

The Cost of the Project has been estimated at Rs.15.00 Crores. The details of the project are as follows:

Sl.No.	P A R T I C U L A R S		Amount (Rs.)
Fixed Assets			
1	**Plant & Machinery**		
	Sorting & Shredding System including Vibrator (3 Units, Per unit costs Rs. 15,000,000/-	45,000,000	
	Fuel Making Machine	5,000,000	
	Lumber Making Machine	25,000,000	
	Electrical and Generator	10,000,000	
	Factory, Building and Shed	33,000,000	118,000,000
2	Porta Cabins(30 Units, Per Unit costs Rs. 500000/-	15,000,000	15,000,000
3	Contigencies & Installation	10,000,000	10,000,000
		10,000,000	**143,000,000**
			7,000,000
		Total project cost	**150,000,000**

Working Capital for one year							
	Raw Material						
			In Kgs		**Rate /kg.**	**Amount**	
	Plastic Waste	5000	125,000		5	625,000	7,500,000
	finished goods	4850	121,250		10	1,212,500	14,550,000
	Estimated approx.gross profit					**587,500**	**7,050,000**
Expenses	**Labour**						
	2 Managers & Supervisors (@15,000/- per Month)					30,000	360,000
	1 Acoountant (@15,000/- per month)					15,000	180,000
	2 Staff (@10,000/- per month)					20,000	240,000
	6 Operator (@ 12,000/- per month)					72,000	864,000
	15 Labour (@ 7500/- per month)					112,500	1,350,000
						249,500	**2,994,000**
	Other Overheads						
	Repair, maintainance & insurance of building, plant & machinery					146,667	1,760,000
	Electricity @ Rs. 7 at 90 % load factor for 25 working day in a month					105,000	1,260,000
						251,667	**3,020,000**
					Total	**501,167**	**6,014,000**
					Estimated approx. gross profit	**86,333**	**1,036,000**

MEANS OF FINANCE:	
The Cost of the project is proposed to be financed as follows:	
P A R T I C U L A R S	**Amount (Rs.)**
1. Promoter Contribution by Nagar Nigam, Jhansi	30,000,000
2. Contribution Under VGF,EPR & CSR	118,800,000
3. Porta Cabins Deposit and advertisement revenue	1,200,000
Total	**150,000,000**

JHANSI NAGAR NIGAM JHANSI				
INCOME & EXPENDITURE SUMMARY IN LACKS Rs				
MONTH MARCH, 2015				
DETAILS (1)	BUDGET AMOUNT (2)	CURRENT YEAR UP TO LAST MONTH (3)	CURRENT MONTH (4)	TOTAL (3+4)
OPENING BALANCE	0	3080.12	3255.32	3080.12
INCOME				
(1) INCOME REVENUE	3599.95	679.41	868.4	1547.81
(2) INCOME CAPITAL	12876	7411.38	647.64	8059.03
(3) INCOME SUSPENSE	25.1	0.64	4.09	4.74
GRAND TOTAL OF INCOME WITHOUT OPENING BALANCE	16501.05	8091.43	1520.14	9611.57
GRAND TOTAL OF INCOME WITH OPENING BALANCE (A)	16501.05	11171.55	4775.45	12691.69
EXPENDITURE				
(1) REVENUE EXPENDITURE	5458.75	3882.29	667.81	4550.09
(2) CAPITAL EXPENDITURE	10885.00	3927.61	1146.35	5073.95
(3) SUSPENSE EXPENDITURE	7.20	0.00	0.00	0.00
(4) SUSPENSE ACCOUNT EXPENDITURE	0.00	118.20	0.00	118.20
GRAND TOTAL OF EXPENDITURE (B)	16350.95	7928.09	1814.15	9742.25
GRAND TOTAL OF EXPENSES PAYABLE (C)	0.00	-11.85	15.43	3.57
GRAND TOTAL OF NET EXPENDITURE (D=(B-C)	16350.95	7916.24	1829.58	9745.82
CLOSING BALANCE (A-D)	150.1	3255.32	2945.87	2945.87
GRAND TOTAL	16501.05	11171.55	4775.45	12691.69

Prepared By:	Prem Prakash & Associates Chartered Accountants
Place :	JHANSI, UTTAR PRADESH
Prepared For:	R.R. Collective (Project Management Agency) & Jhansi Nagar Nigam.

This project is for achieving service level bench mark, taking cue of PWM rules, and does not have connotation of profit motive of investment. The promoters fund will ensure capability and commitment to seek VGF, or EPR or CSR. The status of all the waste to wealth projects is well known and this project offers a viable solution but needs very hard work in system implementation with right spirit.

CHAPTER 10

ALTERNATE SYSTEMS ASSESSED

10. ALTERNATE SYSTEMS ASSESSED

1. OPTICAL SORTING EQUIPMENT

The operating principle of optical sorting units (Optical Sorter) is quite simple: materials on a conveyor belt travel at high speed under a powerful light source. Part of the light's wavelengths is absorbed by the materials while the other is reflected and captured by lenses.

These lenses transmit the signal to a spectrometer and/or camera, which associates each reading with a specific curve since each material has its own signature. Different types of materials, such as plastics (PET, HDPE, PVC, PP, PS, and others) and fibres can be detected. Different sorts of fibres can also be recognized, as with pressed wood and melamine.

When the desired material passes under the lenses, according to the library selected by the computer, a command is sent to the corresponding shutter valves that blow the material into the correct chute. This is how an automated optical sorting unit can replace the manual sorting of a dozen employees. The sorted materials only require a simple quality control. (1)

Image: Optical Sorting Equipment
Image Source: CP Manufacturing (http://www.cpmfg.com)

2. HYDROPULPEUR

The first phase occurs inside the hydropulper. The residues' organic fraction is diluted in water when mechanically stirred. This operation disintegrates the organic fraction and disperses it in the water solution. In addition, a separation by gravity occurs thanks to the difference in density of the products in the hydropulper. Thus, the heavier materials (those whose density is greater than water) are separated through sedimentation.

The diluted organic fraction and the light fraction (mainly plastics floating on the surface) are sent to a multi-separator, the second phase of the process. In this separator, the light fraction floating on the surface is mechanically removed thanks to screws. The residue fraction in suspension passes through a series of screens and is removed by a screw conveyor. The diluted organic fraction in the water settles with gravity and is then removed.

This process is ideal for creating rich organic fraction for various re-use applications. (2)

Image: Hydropulpeur
Image Source: OEM Sherbrooke (http://www.sherbrooke-oem.com)

3. BAG SPLITTER

A conveyor on the bottom of the bunker moves the materials in the direction of the ripper head where bagged and light materials are forced into a series of retractable ripper tines. The ripper head (rotor) holding the tines is rotating in the opposite direction to the flow of material and is adjusted to provide sufficient space below the rotor to allow the smaller, heavier and flatter materials to be dragged along the conveyor and under the rotor without compromise. However, most of the bagged material and plastic film is caught by the retractable tines which in turn lift the material up to the top of the rotor and into the ripper comb. The comb acts as a tearing device which pulls the plastic bags apart and as the tines pass between the comb elements the contents are freed and dropped onto the belt on the downstream side of the rotor. Here they are combined with the materials that have passed under the rotor untouched. The hydraulic comb lifter above the rotor is constructed in sections to allow passage of dense and stiffer materials that cannot be ripped open. The distance between the ripper comb elements and the ripping tines is measured in such a way that the bags are pulled through a constriction. In this manner the bags are opened but the materials inside are not compressed or shredded. Oversized, bulky materials such as lawn chairs, pails stuck into each other, styrofoam parts, unwieldy packaging or similar items are reduced to a manageable size. The tines in the rotor retract once they pass through the ripper comb at the top of the cycle to release any plastic material that may have become attached before another extended cycle begins at the lowest point of rotation and just above the bunker conveyor floor. (3)

Image: Bag Splitter
Image Source: OEM Sherbrooke (http://www.sherbrooke-oem.com)

References:

1. OEM Sherbrooke (http://www.sherbrooke-oem.com/optical-sorter)
2. OEM Sherbrooke (http://www.sherbrooke-oem.com/hydropulpeur-en)
3. OEM Sherbrooke (http://www.sherbrooke-oem.com/bag-opener)

CHAPTER 11

INFORMATION, EDUCATION AND COMMUNICATION

11. INFORMATION EDUCATION AND COMMUNICATION ACTIVITIES & CAPACITY BUILDING

Information sharing & Communication Planning is an integral part of planning for sustained development. The development of human society has largely been due to its ability to communicate information and ideas with each other and to use such information and ideas for progress. This project being implemented by the Jhansi Nagar Nigam aims at making Jhansi, a plastic-litter free city. The success of this project is heavily dependent on the participation of the people, in the implementation process. To enable people to participate in the development process, it is necessary that people have adequate knowledge about the nature and content of these projects. Information Education and Communication, therefore, assumes added significance in the context of this project.

The feedback received on the implementation of such projects in the field indicate that these projects are critically dependent on the awareness level about them, transparency in the implementation process at the field level, participation of the people in the development process and accountability of different groups of stakeholders with different stakes e.g. Municipal Corporations, beneficiaries, contractors etc.

In this context it is proposed to adopt a 4-pronged strategy of creating Awareness about the project, ensuring Transparency in the implementation, encouraging People's Participation in the development process and promoting the concept of Social Audit for ensuring Accountability. All the four elements of the above strategy are complementary to each other and appropriate IEC activities are an essential part of actualizing this strategy.

Information, Education and Communication plays a pivotal role in creating awareness, mobilizing people and making development participatory through advocacy and by transferring knowledge, skills and techniques to the people. It is also critical for bringing about transparency in implementation of the project at the field level and for promoting the concept of accountability and social audit.

It is proposed to formulate appropriate IEC strategy in tune with the communication needs of this project. The IEC activities are to be undertaken through the available & effective modes of communication in order to inform the people with messages and details on Plastic Waste Management Project. Dissemination of information has to be sustained over a period of time and also that in order to make communication effective, it has to be in the language and idiom of the target groups.

Accordingly, efforts are required to be made through Electronic Media and Print Media to disseminate information in regional languages and dialects, besides Hindi and English. In addition, the Action Plan also envisages IEC activities through other modes of communication, outdoor publicity and other conventional and non-conventional modes of communication for reaching out to the people in project areas.

11.1 PRINT MEDIA

The power of the press arises from its ability of appealing to the minds of the people and being capable of moving their hearts. Despite the fast growth of the electronic media, the printed word continues to play a crucial role in disseminating information and mobilizing people. It is required to ensure that the Project is portrayed in proper perspective; several steps need to be taken to sensitize the media about social, economical and environmental issues. During the implementation period, it was proposed to organize press conferences, press tours and workshops, so as to sensitize press persons about these issues. It was also proposed to issue advertisements at regular intervals in State and Regional Press. It was also proposed to publish booklets, leaflets providing information about the project & need for proper management of waste in Hindi and Regional languages. The other possible means for publicity could be printing & distribution of wall calendars, desk calendars.

11.2 ELECTRONIC MEDIA

An intensive IEC campaign over the Electronic Media (Radio and TV) is also required for optimum dissemination of information on these issues. In order to meet the area and region specific communication needs of this project, audio and video programmes of suitable time period shall be produced and broadcast/telecast over local and primary stations of All India Radio, Regional Kendras of Doordarshan along with local TV and Radio channels. In addition short duration spots on different themes relating to plastic waste and its hazards shall need to produced in different languages and broadcast over AIR, Doordarshan and any other electronic media of the city. Synergies between different media can be exploited to great advantage.

11.3 CAPACITY BUILDING

Capacity building often refers to assistance which is provided to entities, usually lacking in resources to achieve required objectives, which have a need to develop a certain skill or competence, or for general upgrading of performance ability.

UNDP defined 'capacity building' as the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation (of women in particular), human resources development and strengthening of managerial systems, adding that, UNDP recognizes that capacity building is a long-term, continuing process, in which all stakeholders participate (ministries, local authorities, non-governmental organizations and user groups, professional associations, academics and others).

Capacity Building is much more than training and includes the following:

- Human resource development, the process of equipping individuals with the understanding, skills and access to information, knowledge and training that enables them to perform effectively.

- Organizational development, the elaboration of management structures, processes and procedures, not only within organizations but also the management of relationships between the different organizations and sectors (public, private and community).
- Institutional and legal framework development, making legal and regulatory changes to enable organizations, institutions and agencies at all levels and in all sectors to enhance their capacities

The capacity building measures proposed under this project are summarized below:

Human Resource Development

Human resources development is very essential for internal capacity building for any organization. Training, motivation, incentives for outstanding service and disincentives for those who fail to perform are essential for human resources development. This includes:

Training

Management of plastic waste system is a new responsibility with Municipal Corporations. Integrated & comprehensive systems have to be developed to operate & maintain the system effectively. Knowledge of new technology and methods coupled with training at all levels is necessary. Short and medium term courses should, therefore, be designed for the field workers, rag-pickers, scrap dealers, scrap traders and supervisory staff. Special training and refresher courses may also be conducted as under:-

- Special Training to Unqualified Staff Refresher Courses for All Levels of Staff.
- Roles & Responsibilities
- Jurisdiction
- Training on use of new equipment o Safe way to work
- Exposure to Municipal Commissioner/ Chief Executives
- Exposure to Elected Members

Data acquisition & retrieval

The following tools were used to ease the collection, analysis and retrieval of all system data in timely & economical manner.

- Computers
- Printers
- Plotter
- Operating System Software
- Office Software
- CAD Software
- Geographical Information System (GIS)

- Tools Required: A toll free and automated response phone number (along with an phone application that can run on all platform) goes a long way in facilitating transmittal of advance requirement for collection of plastic waste, ease of access to get the waste collected once it reaches certain weight as which may be useful in reducing response time.
- Involvement of Voluntary organization/ NGO/ Private Sector Participation

Efforts to increase the efficiency by Human Resource Development and institutional strengthening will, to some extent improve the performance but that may not be enough. It is proposed to involve Voluntary Organisations/NGO/Private sector participation in Plastic Waste Management.

COMMUNITY PARTICIPATION UNITS

For successful implementation of project and its consequent efficient & uninterrupted operations, the active participation of all the stakeholders is of utmost importance which includes the actual users. The primary task is to educate, inform and enlighten the public for dos and don'ts for effective utilization of plastic waste management system. To achieve these objectives, it is proposed to setup a community participation unit which will perform following activities:

- Devise & implement a Communication Plan
- Implement a Media Plan for dissemination of information
- Catalyze formation of user groups, resident welfare association for effective involvement of users.

The various components for these activities shall be as follows:

S.no	Activity	Remark
1	Engagement of Public relation consultants	To gb be done with Specific objective
2	Social Survey	For Ascertaining level of awareness and willingness to pay for improved service.
3	Advertisement in TV, Radio, Newspapers in vernacular	For enhancing Awareness & Sensitization of all stakeholders
4	Publication & Distribution of Booklets, Pamphlets etc in vernacular	-do-
5	Engagement of NGOs for Street Plays, Kathputli shows, Flash Mob, Local Cultural communication techniques	-do-

CHAPTER 12

CONCLUSIONS AND RECOMMENDATIONS

12. CONCLUSIONS AND RECOMMENDATIONS

There are no independent management mechanisms or systems protocols for management of plastic waste in spite of the law being there for four years now. They come under the larger purview of solid waste management with Municipal Corporation's being the key organization responsible for it.

Management of solid waste is in a dismal state in Jhansi as is all over the country after a decade of experimentation. This is due to lack of proper collection systems, lack of understanding of environmental responsibility and vested interests. The plastics are littered at public places leading to all the negativities described as in above. Lack of segregation of waste at source or at collection points is one of the main problems for management of waste.

The innovative modalities of integrating the formal sector, take up work to open waste exchange centers, and working professionally in this rivers supply chain network will take us long way to address plastics litter problem.

To support any recycling initiative, collection and storage of plastic waste will be a problem due to its high volume but less density. However, if there is a system in place for segregation at source and again at WECs, the problem may be addressed. To pick up the littered waste is additional work, for which the system should work for. There are technologies available for compacting the waste for easy and economical storage and transportation without compromising the quality of plastic.

The major legislations governing solid plastic waste management are:

- Municipal Solid Waste (Management and Handing) Rules, 2000
- Recycled Plastic Manufacture and Usage (Amendment) Rules, 2003
- Plastic Waste (Management and Handling) Rules, 2011

The major reference documents governing plastic waste management are:

- Report of the Task Force on Waste to Energy (Volume I and Volume II) –Planning Commission, Government of India (May 12, 2014)
- The manual On Solid Waste Management - MOUD
- The Draft Rules on BMW, MSW, E-Waste, and Plastics Waste.

The MSW/PWM rules lays down strict norms and timelines for municipal corporations for management of municipal waste/Plastics waste. Lack of awareness and capacities to fulfill the tasks have come up as major shortcomings. Hence, capacity building and awareness

generation of municipal officials on issues of plastics waste management is an essential need.

Informal sector is an important player in management of waste especially recyclable wastes like plastic, paper and glass, etc., providing livelihoods to thousands in a city. There is a need to integrate this sector with the formal waste collection systems to ensure efficient waste management as is modeled here. Beside that there are also some recommendations of CPCB's such as;

- The technology needs to be established for demonstrating use of postconsumer plastics to reduce menace of plastics waste disposal along with municipal solid waste

- Use of PVC waste should be avoided and in case it is used, it should be converted into hydrochloric acid and no emissions be let out.

- Environmental consciousness is certainly of paramount importance. This is where well designed and continued public awareness campaigns and education is useful. People must be educated on the need to protect and preserve the environment.

- We have to refer Plastics Waste Management rules 2011, for the EPR contributions. The VGF guidelines are in the Planning commission report on Waste to Energy - May 14, 2014. The CSR contributions for this kind of projects are yet to be defined. However other plastic centric waste management rules, like biomedical waste, municipal solid waste, Industrial hazardous waste and electronics waste rules also referred and integrated to achieve optimum plastics waste to the plant as part of control scientific recycling.

- It is also pertinent to mention hear that zero waste concepts can be implemented with a sound national recycling program (NRP), where it is not the waste stream, but ultimate objective determines the methodology and technology to be used. There are guidelines in one of the planning commission documents, as in next chapter. However it is not part of implementation plan of this report.

Further taking a cue from recommendation of planning commission:

EXCERPTS:

National Recycling Program (NRP): The NRP will be an overarching framework to create and mainstream the organized waste management and recycling industry. Under the NRP structured frameworks and guidelines for recycling industry will be developed to integrate it

with the existing waste management rules & guidelines. Industry and sector specific recycling standards will be developed under the NRP.

Public - Private Partnerships: Public Private Partnerships to establish facilities for reuse, recycling and reprocessing of wastes from various sectors should be encouraged by providing incentives and ensuring the process for setting up PPP facilities is conducive for widespread implementation

Dumpsites: Development / rehabilitation of dumpsites should be based on scientific assessment of contamination of soil and groundwater and projected future impact based on expected modeling scenarios.

Polluter Pays Principle: A polluter pays principle should be enforced to industries that are non-complying to hazardous waste and chemicals regulations

Research and Development: R&D plays an important role in waste management to identify recycling opportunities and scientific method of waste management. The government should allocate fund for promoting R&D activities in identifying new technologies for waste management & recycling and for scaling up of developed technologies in an industrial context.

Institutional Upgrade: Local institutional bodies must have their capacity built on recycling and waste management, with regards to increase the awareness of practices and technical capacity of recycling and waste management technologies.

Reduced Material Waste Generation: Reduced waste generation should be targeted in a twofold manner of:

- Developing and implementing strategies for their recycle, reuse, and final environmentally benign disposal.

- Promoting biodegradable recyclable substitutes for non-biodegradable materials

Sector Specific Recommendations

Alternate Fuels: At present, annually 50,000 tons (approx) of wastes are used as alternate fuel, which is less than 0.1% of total thermal energy consumption in cements industries in India. The scope to increase this use is extremely high. The usage of high-calorific values wastes (hazardous / non-hazardous) as alternate fuel in cement industries should be promoted and encouraged

Utilization of Non-Hazardous Waste: Non-hazardous wastes, namely fly ash, bottom ash and red mud should be utilized for the manufacture of cement and construction materials.

Stakeholder Engagement

The responsibilities of the various stakeholders for instituting an Organized Waste Management and Recycling Industry are listed below:

Stakeholder Responsibility

 Develop structured framework and guidelines for recycling industry

 Develop standards to support recycling & recovery of products

 Emphasize the need for strengthening the capacities of local bodies

 Promote waste to energy, co-Processing and waste exchange activities

 Promote organized recyclers' associations

 Encourage R& D in recycling & recovery of material

Government

 Increase consumers awareness on 4R (reduce, reuse,recover, recycle) concept

 Practice extended producers' responsibility (EPR)

 Invest in developing recovery technologies

 Practice co-processing, waste exchange activities

 Practice 4R concept – reduce, reuse, recover & recycle

Industry

 Making India's unique recycling workforce organized

 Waste management at community level

Consumers

 Opt for recycled / recyclable / bio-degradable products

 Participate in extended producers responsibility programs

APPENDIX 1

Plastic Waste (Management and Handling) Rules

2011

Appendix-1

Ministry of Environment and Forests Notification
New Delhi, the 4th February 2011.
(As amended up to 2.7.2011)

(Amendment carried out vide notification no. S.O. 1527 (E) dated 2.07.2011 have been shown in bold letters)

S.O. 249 (E).- Whereas the draft rules, namely, the Plastics (Manufacture, Usage and Waste Management) Rules, 2009 were published by the Government of India in the Ministry of Environment and Forest vide number S.O. 2400(E), dated the 17th September 2009 in the Gazette of India, extraordinary of the same date inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of a period of sixty days from the date on which copies of the Gazette containing the said notification were made available to the public;

AND WHEREAS copies of the said Gazette were made available to the public on the 17th day of September, 2009;

AND WHEREAS the objections and suggestions received within the said period from the public in respect of the said draft rules have been duly considered by the Central Government.

NOW, THEREFORE, in exercise of the powers conferred by sections 3,6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), and in supersession of the Recycled Plastics Manufacture and Usage Rules 1999, except as respects things done or omitted to be done before such supersession, the Central Government hereby makes the following Rules, namely:-

1. Short title and commencement:
(1) These rules may be called the Plastic Waste (Management and Handling) Rules, 2011.
(2) They shall come into force on the date of their publication in the Official Gazette.

2. Application:-

2(1) The provisions of rules 5 and 8 shall not apply to the manufacture of carry bags exclusively for export purposes, against an order for export, received by the owner or occupier of the concerned manufacturing unit.

2(2) This exemption does not apply to any surplus or rejects, left over and the like.

3. Definitions.- In these rules, unless the context otherwise requires.-

(a) "Act" means the Environment (Protection) Act, 1986 (29 of 1986);

(b) "Carry Bags" mean bags made from any plastic material used for the purpose of carrying or dispensing commodities but do not include bags that constitute or form an

integral part of the packaging in which goods are sealed prior to use;
(c) "Commodities" mean articles; including but not limited to vegetables, fruits, pharmaceuticals, foods gains and the like;

(d) "Compostable plastics" means plastic that undergoes degradation by biological processes during composting to yield CO2 , water , inorganic compounds and biomass at a rate consistent with other known compostable materials and does not leave visible, distinguishable or toxic residue;

(e) "Consent" means the consent to establish and operate from the concerned State Pollution Control Board or Pollution Committee granted under the Water (Prevention and Control of Pollution) Act 1974 (6 of 1974) and the Air (Prevention and Control of Pollution) Act 1981 (14 of 1981);

(f) "Disintegration" means the physical breakdown of a material into very small fragments;

(g) "Extended producer's responsibility (EPR)" means the responsibility of a manufacturer of plastic carry bags, and multilayered plastic pouches and sachets and the brand owners using such carry bags and multilayered plastic pouches and sachets for the environmentally sound management of the product until the end of its life;

(h) "Food stuffs" means ready to eat food product, fast food, processed or cooked food in liquid, powder, solid or semi solid form;

(i) "Manufacturer" means any person who manufactures plastic carry bags or multilayered plastic pouches or sachets or like;

(j) "Municipal authority" means Municipal Corporation, Municipality, Nagar Palika, Nagar Nigam, Nagar Panchayat, Municipal Council including notified area committee (NAC) or any other local body constituted under the relevant statutes and, where the management and handling of municipal solid waste is entrusted to such agency;

(k) "Multilayered plastic pouch or sachet" means a pouch or sachet having at least one layer of plastic in combination with one or more layers of packaging material such as paper, paper board, metalised layers or aluminum foil, either in the form of a laminate or co-extruded structure;

(l) "Plastic" means material which contains as an essential ingredient a high polymer and which at some stage in its processing into finished products can be shaped by flow;

(m)"Plastic waste" means any plastic product such as carry bags, pouches or multilayered plastic pouch or sachets etc., which have been discarded after use or after their intended life is over;

(n) "Registration" means registration with the State Pollution Control Board or Pollution Control Committee concerned, as the case may be, of units manufacturing plastic carry bags, multilayered plastic pouch or sachet or recycling of plastic waste;

(o) "Virgin Plastic" means plastic material which has not been subjected to use earlier and

has also not been blended with scrap or waste;

(p) “Waste management” means the scientific reduction, re-use, recovery, recycling, composting or disposal of plastic waste;

(q) “Waste pickers” mean individuals or groups of individuals engaged in the collection of plastic waste.

4. Prescribed Authority

The prescribed Authority means the Authority-

(a) for enforcement of the provisions of these rules related to registration, manufacturer and recycling shall be the State Pollution Control Board and in respect of a Union territory shall be the Pollution Control Committee;

(b) for enforcement of the provisions of these rules relating to the use, collection, segregation, transportation and disposal of the plastic waste, the prescribed authority shall be the municipal authority concerned.

5. Conditions:- During the course of manufacture, stocking, distribution, sale and use of carry bags and sachets, the following conditions shall be fulfilled, namely:-

(a) carry bags shall either be in natural shade (Colourless) which is without any added pigments or made using only those pigments and colourants which are in conformity with Indian standard: IS : 9833: 1981 titled as List of pigments and colourants for use in plastics in contact with foodstuffs, pharmaceuticals and drinking water, as amended from time to time.

(b) no person shall use carry bags made of recycled plastics or compostable plastics for storing, carrying, dispensing or packaging food stuffs;

(c) no person shall manufacture, stock, distribute or sell any carry bag made of virgin or recycled or compostable plastic, which is less than 40 microns in thickness.

(d) sachets using plastic material shall not be used for storing, packing or selling gutkha, tobacco and pan masala;

(e) recycled carry bags shall conform to the Indian standard IS 14534:1998 titled as Guidelines for Recycling of Plastic, as amended from time to time;

(f) carry bags made from compostable plastics shall conform to the Indian Standard : IS/ISO 17088:2008 titled as specifications for Compostable plastics, as amended from time to time;

(g) plastic material, in any form, shall not be used in any package for packing gutkha, pan masala and tobacco in all forms.

6. Plastic Waste Management:

The plastic waste management shall be as under :-

(a) recycling, recovery or disposal of plastic waste shall be carried out as per the rules, regulations and standards stipulated by the Central Government from time to time;

(b) recycling of plastics shall be carried our in accordance with the Indian Standard IS 14534: 1998 titled as Guidelines for Recycling of Plastics, as amended from time to time;

(c) the municipal authority shall be responsible for setting up, operationalisation and co-ordination of the waste management system and for performing the associated function, namely:- (i) to ensure safe collection , storage, segregation, transportation, processing and disposal of plastic waste; (ii) to ensure that no damage is caused to the environment during this process; (iii) to ensure setting up of collection centres for plastic waste involving manufactures; (iv) to ensure its chanelisation to recycles; (v) to create awareness among all stakeholders about their responsibilities; (vi) to engage agencies or groups working in waste management including waste pickers, and
(vii) to ensure that open burning of plastic waste is not permitted;

(d) (i) the responsibility for setting up collection systems for plastic waste shall be of the municipal authority concerned and the said municipal authority may, for this purpose, seek the assistance of manufacturers of plastic carry bags, multilayered plastic pouches or sachets or of brand owners using such products;

(ii) the municipal authority may work out the modalities of a mechanism based on Extended Producer's Responsibility involving such manufacturers, registered within it's jurisdiction and brand owners with registered offices within it's jurisdiction either individually or collectively, as feasible or setup such collection systems through its own agencies;

(e) recycler shall ensure that recycling facilities are in accordance with the Indian Standard: IS 14534: 1998 titled as Guidelines for Recycling of Plastics and in compliance with the rules under the Environment (Protection) Act, 1986 as amended from time to time;

(f) the concerned municipal authority shall ensure that the residues generated from recycling processes are disposed of in compliance with Schedule II (Management of Municipal Solid Waste) and Schedule III (Specification for Land fill Sites) of the Municipal Solid Wastes (Management and Handling) Rules , 2000 made under the Environment (Protection) Act, 1986 as amended from time to time;

(g) the municipal authority shall incorporate the said rules in the Municipal bye laws of all the Urban Local Bodies;

(h) the municipal authority shall encourage the use of plastic waste by adopting suitable technology such as in road construction, co-incineration etc. The municipal authority or the operator intending to use such
technology shall ensure the compliance with the prescribed standard including pollution control norms prescribed by the competent authority in this regard.

7. Protocols for Compostable Plastic Materials-Determination of the degree of degradability

and degree of disintegration of plastic material shall be as per the protocols of the Indian Standards listed in the Annexure to these rules.

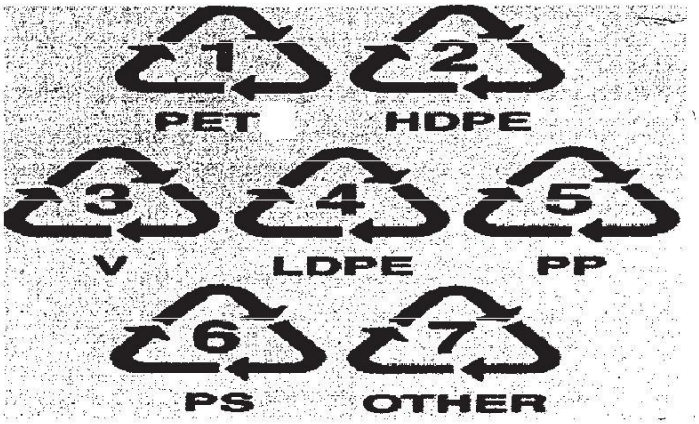
8 Marking or Labelling:

(a) each plastic carry bag and multilayered plastic pouch or sachet shall have the following information printed in English or in local language, namely:-

(i) name, registration number of manufacturer and thickness in case of carry bag.

(ii) name and registration number of the manufacturer in case of **multilayered plastic pouch or sachet.**

(b) each recycled carry bag shall bear a label or a mark " recycled" as shown below and shall conform to the Indian Standard : IS 14534: 1998 titled as Guidelines for Recycling of Plastics , as amended from time to time;



NOTE: PET-Polyethylene terephthalate, HDPE-High density polyethylene, V-Vinyl (PVC), LDPE- Low density polyethylene, PP-Polypropylene, PS-Polystyrene and Other means all other resins and multi-materials like ABS (Acrylonitrile butadiene styrene), PPO (Polyphenylene oxide), PC (Polycarbonate), PBT (Polybutylene terephalate) etc.

(c) each carry bag made from compostable plastics shall bear a label " compostable" and shall conform to the Indian Standard : IS/ISO 17088: 2008 titled as Specifications for Compostable Plastics;

(d) retailers shall ensure that plastic carry bags and **multilayered plastic pouch or sachet** sold by them are properly labelled as per stipulations under these rules.

9. Registration of Manufacturers and Recyclers:

(a) any person manufacturing or proposing to manufacture **plastic carry bags, multilayered plastic pouch or sachet** shall apply to the State Pollution Control Board (SPCB) or Pollution Control Committee (PCC) of the Union territory concerned for the grant of registration or for the renewal of registration for the manufacturing unit using Form I appended to these rules;

(b) any person recycling or proposing to recycle carry bags or **multilayered plastic pouch or sachet** or any plastic waste shall apply to the SPCB or PCC for grant of registration or

renewal of registration for the recycling unit using Form 2 appended to these rules;

(c) no person shall manufacture plastic carry bags, multilayered plastic pouch or sachet or recycle plastic carry bags or multilayered plastic pouch or sachet or any plastic waste without obtaining registration certificate from the State Pollution Control Board or Pollution Control Committee, as the case may be, prior to the commencement of its production;

(d) the SPCB and PCC shall not issue or renew a registration for manufacturing or recycling units unless the unit possesses a valid consent under the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) and certificate of registration issued by the District Industries Centre or any other government agency authorized in this regard.

(e) (i) every State Pollution Control Board or Pollution Control Committee, as the case may be, shall take a decision on the grant of registration within a period of ninety days of receipt of an application which shall be complete in all respects;

Provided that the registration may be deemed to have been granted in case no final decision is communicated to the applicant by the State Pollution Control Board or Pollution Control Committee within a period of ninety days from the date of an application complete in all respects;

(ii) the manufacturer who has already registered for manufacturing under the Recycled Plastics Manufacture and Usage (Amendment) Rules, 2003 shall not be required to register under these rules and whereas others shall have to register within the period of ninety days from the date of coming into force of these rules.

(f) the registration granted under this rule shall be valid for a period of three years, unless revoked, suspended or cancelled; and registration shall not be revoked, suspended or cancelled without providing the manufacturer an opportunity for a hearing;

(g) every application for renewal of registration shall be made at least ninety days before the expiry of the validity of the registration certificate.

10 Explicit pricing of carry bags:-

No carry bags shall be made available free of cost by retailers to consumers. The concerned municipal authority may by notification determine the minimum price for carry bags depending upon their quality and size which covers their material and waste management costs in order to encourage their re-use so as to minimize plastic waste generation.

11. State level Advisory Body:

(1) There shall be a State Level Advisory Body to monitor the implementation of these Rules.

(2) The State Level Advisory Body shall consist of the Following persons, namely:-

(a) the Secretary, Department of Urban Development - Chairman

(b) one expert from State Department of Environment - Member
(c) one expert from State Pollution Control Board or

Pollution Control Committee -Member
(d) one expert from Urban Local Body - Member
(e) one expert from Non-Governmental Organization -
Member
(f) one expert from field of Industry - Member
(g) one expert from the field of academic institution - Member

(3) The State Level Advisory Body shall meet at least once in a year and may invite experts, if it considers necessary.

(12) Annual Reports:-

(1) each State Pollution Control Board or Pollution Control Committee shall prepare and submit the annual report to the Central Pollution Control Board on the implementation of these rules by the 30th day of September of each year;

(2) the Central Pollution Control Board shall prepare a consolidated annual report on the use and management of plastic waste and forward it to the central government along with its recommendations before the 30th day of December each year.

[F.No.17-2/2001-HSMD] RAJEEV GAUBA, Jt.Secy.

ANNEXURE
(See rule 7)

1.	IS/ ISO 14851: 1999 Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium-Method by measuring the oxygen demand in a closed Respirometer
2	IS/ ISO 14852: 1999 Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium-Method by analysis of evolved carbon dioxide
3	IS/ ISO 14853:2005 Plastics -Determination of the ultimate anaerobic biodegradation of plastic materials in an aqueous system-Method by measurement of biogas production .
4.	IS/ ISO 14855-1: 2005 Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions-Method by analysis of evolved carbon dioxide (Part I General method)
5.	IS/ ISO 14855-2: 2007 Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions-Methods by analysis of evolved carbon dioxide (Part-2 : Gravimetric measurement of carbon dioxide evolved in a laboratory-scale test)
6.	IS/ ISO 15985:2004 Plastics- Determination of the ultimate anaerobic biodegradation and disintegration under high-solids anaerobic digestion conditions-Methods by analysis of released biogas
7.	IS/ ISO 16929:2002 Plastics-Determination of degree of disintegration of plastic materials under defined composting conditions in a pilot-scale test
8.	IS/ ISO 17556-2003 Plastics-Determination of ultimate aerobic biodegradability in soil by measuring the oxygen demand in a Respirometer or the amount of carbon dioxide evolved
9.	IS/ ISO 20200:2004 Plastics-Determination of degree of disintegration of plastic materials under simulated composting conditions in a laboratory-scale test

FORM-1 (See rules 9)

APPLICATION FOR REGISTRATION OF A UNIT FOR THE MANUFACTRUING OF PLASTIC CARRY BAGS, MULTIAYERED PLASTIC POUCH OR SACHET

From……
…….. (Name and full address of the occupier)

To
The Member Secretary
……..Pollution Control Board / Pollution Control Committee
…….
Sir,
I/ We hereby apply for registration under rule 9 of the Plastic Waste (Management and Handling) Rules ,2011.

Part –A GENERAL		
1. (a)	Name and location of the unit	
(b)	Address of the unit	
(c)	Registration required for manufacturing of:	
	(i) Carry bags	
	(ii) Multilayered plastic pouch or sachet	
(d)	Manufacturing capacity	
(e)	In case of renewal, previous registration number and date of registration	
2	Is the unit registered with the District Industries Centre (DIC)/ Development Commissioner, Small Scale Industries (DCSSI) of the State Government / Union territory? If yes, attach a copy.	
3(a)	Total capital invested on the project	
(b)	Year of commencement of production	
4 (a)	List and quantum of products and by products	
(b)	List and quantum of raw materials used	
5	List and quantum of raw materials used Furnish a flow diagram of manufacturing process showing input and output in terms of products and waste generated including for captive power generation and water.	
6.	Thickness of carry bags to be manufactured	
7	Status of compliance with these rules	

.

	Part -B **PERTAINING TO LIQUID EFFLUENT AND GASEOUS EMISSIONS**	
8	**(a) Does the unit have a valid consent under the Water (Prevention and Control of Pollution) Act 1974 (6 of 1974)? If yes, attach a copy**	
	(b)Does the unit have a valid consent under the Air (Prevention and Control of Pollution) Act 1981 (14 of 1981) ? **(c) If yes, attach a copy**	
	Part -C **PERTAINING TO WASTE**	
9	**Solid Wastes** **(a) Total quantum of waste generated** **(b) Mode of storage within the plant** **(c) Provision made for disposal of wastes**	
		Name and Signature Designation
Date: Place:		

Note: The principle rules were published in the Gazette of India, Extraordinary vide notification no SO 249 (E) dated the 4th February , 2011

[F.No.17-2/2001-HSMD] RAJEEV GAUBA, Jt.Secy.

FORM - 2 (See rule 9)

APPLICATION FROM FOR REGISTRATION OF FACILITES POSEESSING ENVIRONMENTALLY SOUND MANAGEMENT PRACTICES FOR RECYCLING PLASTIC WASTE

1	Name and Address of the unit			
2	Contract Person with designation , Tel. /Fax / email			
3	Date Commissioned			
4	No. of workers (including contract labour)			
5	Consents Validity	a. Water (Prevention & Control of Pollution) Act 1974; Valid upto……. b. Air (Prevention & Control of Pollution) Act, 1981; valid upto……..		
6	Authorization validity			
7	Manufacturing Process	Please attach a flow diagram of the manufacturing process flow diagram for each product.		
8	Products and installed capacity of production (MTA)	Products		Installed capacity
9	Products manufactured during the Last three years (as applicable)	Year	Product	Quantity
10	Raw Material consumed during the Last three years (as applicable)	Year	Product	Quantity
11	Water consumption	Industrial ……m³ / day Domestic …… m³ / day		
	Date until which water cess has been paid (if applicable)			
	Waste Water generation as per consent ……m³ / day	Actual waste water generated (average of last 3 months) Industrial ……m³ / day Domestic …… m³ / day		
	Waste Water treatment (provide flow diagram of the treatment scheme)	Industrial Domestic		

	Waste water discharge	Quantity……. m³ / day Location……. Analysis of treated waste water for pH, BOD, COD, SS, O& G, any other parameter stipulated by SPCB/ PCC (attach details)			
12	Air Pollution Control				
	a Provide a flow diagram for emission control system(s) installed for each processing unit, utilities etc.				
	b Details for facilities provided for control of fugitive emission due to material handling, process, utilities etc				
	c. Fuel consumption	Fuel		Qty per day/ month	
		(i)			
		(ii)			
	d. Stack emission monitoring	Stack attached to		Emission (SPM, SO2 , NOX, etc.) mg/ Nm³	
		(i)			
		(ii)			
	e. Ambient air quality	Location Results µg/ m³		Parameters (SPM, SO2 , NOX, etc.) µg/ m³	
		(i)			
		(ii)			
13	Waste Management	S. No.	Type	Category	Qty.
	a. Waste generation in processing plastic-waste	(i)			
		(ii)			
		(iii)			
	b. Waste Collection and transportation (attach details)				
	c. Waste Disposal details	S. No.	Type	Category	Qty
		(i)			
		(ii)			
	d. Provide details of the disposal				

	facility, whether the facility is authorized by SPCB/ SPCC	
	e. Please attach analysis report of Characterization of waste generated (Including leachate test if applicable)	
14	Details of plastic waste proposed to be acquired through sale, auction, contract or import, as the case may be, for use as raw material	(i) Name (ii) Quantity required / year
15	Occupational safety and health aspects	Please provide details of facilities
16	Remarks:	
	Whether the unit s has adequate pollution Control systems / equipment to meet the standards of emission / effluent	If yes, please furnish details
	Whether unit is in compliance with conditions laid down in the said rules.	Yes/ No
	Whether conditions exist or are likely to exist of the material being handled / processed posing adverse immediate or delayed impacts on the environment.	Yes/ No
	Whether conditions exist (or are likely to exist) of the material being handled / processed by any means capable of yielding another material (e.g. leachate) which may possess eco-toxicity.	Yes/ No
17	Any other relevant information	
18	List of enclosures as per rule	

Name and Signature
Designation
Date:
Place:

APPENDIX 2

WASTE EXCHANGE CENTER'S GPS LOCATION

Appendix -2

WARD WISE DETAIL OF 33 WASTE EXCHANGE CENTERS (WEC) OF JHANSI NAGAR NIGAM.

We propose to put one Waste Exchange Center for every 5000 houses in every ward in the city of Jhansi. In the initial phase and also due to lack of available space in some of the wards, majority of the WEC's have been assigned to more than one ward currently.

For the initial phase of the project, we have earmarked 33 positions scattered strategically across the city to serve as waste exchange centers. Mentioned below are the GPS locations along with the colonies that will be served by the WEC's. The locations in the map have been marked with a red balloon.

WEC Number	Ward No.	Ward Names	Colonies in Wards	WEC Location	GPS
1	1,2	1 Hansari Gird 1, 2 Hansari Gird 2	1.Kumhar Toli 2.Gwal Toli. 3.Hansari Gird 4.Khara Kua 5.Azad Nagar 6.Ganesh Nagar 7.Jyoti Nagar 8.Vijay Nagar 9.Main Road 1.Roadways Workshop 2.Harizan Colony 3.Sarandha Nagar Residensial Colony 4.Govind Nagar 5.Hansari Gird	Near Hansari Bus Depot - Drain.	25.417455 78.567395
2	3	3 Bahar Sainyer Gate	1.Bahar Saiyer Gate 2.Markaji Masjid 3.Fort Bazar 4.Rajhans Petrol Pump 5.Balmiki Mandir	Christian Hospital	25.447219 78.578032

3	4, 23	4 Bhattagaon 23 Simraha	1.Talpura 2.Bhatta Gaon 3.Khirakpatti 1.Simraha Srinagar Aarakchit Van Chetra 2.Bhagwant Pura 3.Singarara 4.Mathura Pura 5.Pardesi 6.Simraha 7.Shrinagar	At Taxi Stand Bhattagaon under Banyan Tree.	25.427182 78.598432
4	5, 53	5 Masihaganj 53 Azad Ganj	1.Hansari GIRD East Part Central BANK 2.Masihaganj (Aansik) 3.Bodh Nagar 4.St. Marry High School 5.Mirza Compound 1.Ajad Ganj 2.Mashisha Ganj(Ansik) 3.Subhash Market(Sipri) 4.Pila Girza Ghar 5.Best Compound 6.Chari Ganj	Masiha Ganj, Shyam Kunj	25.456207 78.546508
5	6, 21, 25, 28	6. Nainagarh 21. Nainagarh South First 25 Heerapura 28 Nainagarh South Second	1.Nainagarh (Aansik) 2.Police Chowki 1.Naina Garh South Part (Ansik) 2.Rajiv Nagar 3.Mahaviran 1.Ganesh Pura 2.Kailash Mandir 3.Ratan Pura 4.Gurudwara 5.Pratap Pura 6.Heera Pura 1.Nainagarh South 2.Hata Pyarelal 3.JIvar Pura 4.Manohar Pura	Near Lord Shankar' Temple (Shankar Ji Ka Mandir Nagra).	25.422835 78.537649

6	7, 13, 16, 22	7. Schoolpura 13. Gadhiya gaon 16. Isaee tola second 22. Isayee tola first	1.Chamaryana 2.Villeshwar 3.Maharajpura 4.Shekhwara 5.Tola Badluram 6.Schoolpura 7.Silvertganj 8.Imambara 9.Gudripura 10.Islam Ganj 1.Gariya Gaon 2.Krishna Nagar Colony 3.Ambedkar Colony 4.Kheraa 5.Ajad Nagar 1. Isai Tola 2. Purviya Tola 3. Khati Baba 4. NIrmala Convent 5. Panday Farm 6. Anwar Farm 7. Sherwood School 8. Khodan Isai Tola 1. Isai Tola 2. Bihari Pura 3. Sumer Nager 4. Shastri Nagar 5. Kamal Singh's Farm 6. Kabristan 7. Noor Nagar	1. Near Prem Nagar Bus Stop	25.433669 78.541734

7	8, 12	8. Taalpura First 12. Taalpura second	1.Abbot Market 2.D C Primary School 3.Kambal Mill 4.Kalimaee Talpura 5.Nadan 6.Ravidas Mandir 7.Taalpura 1.Ambedkar Nagar 2.Harijan Chatravas 3.Naya Bus Stand 4.Krishi Mandi Samiti 5. R.T.O. 6. Jai Mahakali Transport 7. Taalpura	Near Vishal Mega Mart Transformer	25.445381 78.589098
8	9, 14	9. Khushi Pura First 14. Khushipura second	1.Khushipura 2.Rajkiya Zila Pustkalya 3.Shikcha Bhawan 4.Vipin Vihari Inter College 5.Chrischan Hospital 6.Madia 7.Karyalya Zila Panchayat 1.Khusipura(Aansik) 2.Virangna Jhalkari Bai Junior HIgh School 3. Vansi Nagar 4. Nagariya Colony 5. Masjid	Near B.I.C Overhead Water Tank	25.448726 78.580456
9	10	10. Simardha	1.Simradha 2.Karari 3.Budha 4.Jhansi Khas Nagariya Kuan 5.Mary 6.PAL colony 7.Meri 8.Om Sai Puram 9.Nagariya Kuan	Near Krisshi Vanik Anusandhan Kendra Grass Land	25.511527 78.531714

10	11, 19	11. Nayi Basti First 19. Nayi Basti Second	1.Nayi Basti (Aansik) 2.Mahila Bhagini Mandal 3.Khajoor Baag 4.Idgaah 5.Mehdibaag 6.Indrapuri Colony 8.Patla Ke Hanuman 9.J. D. Colony 1.Nai Basti Second 2.Sharda Hills Colony 4.Ansik Chauraha 5.Siya Masjid 6.Katera Wali Haweli 7. Khai Mohalla 8. Atiya Tal Road 9. Atiya Talab to Gwalior road 10. Atiya talab - Khanderao Gate 11. B.K.D Chauraha - Gwalior road 12. Chand Darwaza 13. Gwalior Road 14. Indrapuri Colony 15. Khajur Bagh 16. Mehndi Bagh 17. Sood Colony	Near Hathi Khana	25.462293 78.569352
11	15	15. Bijauli	1.Bijauli 2.Rajgarh 3.PAC Colony 4.U.P.S.I.D.C. 5.Industrial Growth Center 6.Dau Baba 7.Panch Bihar 8.Veeru Nagar 9.Rajjak Nagar 10.Khati Baba 11.Anjani Nagar 12.Vikash Nagar	Bijauli Industrial Area Cut, Road Side, Main Road - Opp. Petrol Pump	25.383147 78.552523

12	17, 27	17. Kachiyana puliya no 9 27. Bagicha puliya no 9	1.Kachiyana 2.Kabristan 3.Choti Masjid 4.Tapriyan Ka Ansik Bhag 5.Tanki Ka Ansik Bhag 6.Pulia No.9 1.Idgaah 2.Bada Kuan 3.Tikonia 4.Allhabadi 5.Badi Masjid 6.Rail Ganj 7.Bagicha 8.Mahobiya 9.Naya Pura 10 Suranyana 11. Dadaniya 12. Khichri Pura 13. Thakuryana	Puliya No. 9 Opposite Railway Line, Near Taxi Stand	25.424015 78.550589
13	18, 20, 58	18. Gudri 20. Bangla Ghat 58. Daroo Bhondela	1.Gudri 2.Suje Khan Khidki 3.Ander Bada Gaon Gate 4.Shankar Singh Ka Bagicha 1.Daru Bhondela 2.Ganesh Madia 3.Najhai Bazar 4.Vashudeo 5.Chadharyana 6.Parwaran 7.Panna Lal 1. Bangla Ghat 2. Hajaryana 3. Andar Laxmi Gate 4. Chaturyana	Bada Gaon Gate	25.463894 78.586588

14	24, 31	24. Lahargird first 31. Lahar gird second	1.Lahar Gird (Ansik) 2.Ras Bahar Colony 3.Naal Ganj 4.Atri Ka Bagicha 5.State Bank Colony 6.Krishna Inclave 7.Khodan 8.Saryu Bihar 9.Vasudev Bihar 10.Pench Mohalla 11.Murari Nagar 12.Vardan Vihar 13.OmShanti Green 1.Lahargird(Ansik) 2.Hari Kishan Degree College 3.Braham Nagar Colony 4.ITI Colony 5.Naya Gaon 6.Sooti Mill 7.Dadri 8.Siddeswar Nagar 9.Khodan(Lahar Girad) 10.Gwalior Balaji Road 11.Mahendra Puri 12.Ayodhya Puri 13.Sudama Puri Colony 14.Basant Bihar Colony 15.Ansal Colony	Near Khalsa Inter College - next to Ashok scrapdealer	25.466673 78.550731
15	26	26. Koncha bhawar	1.Koncha Bhanwar 2.Imlipura 3.Toriya 4.Kumar Ka Kunwa 5.Similiya	Front End Corner of B.U.Engineering College	25.466110 78.639515

16	29	29. Pichhor	1.B.U.Medical College 2.Pichor Gramin(Gumnawara) 3.Kargua 4.Bajrang Colony 5.Gumnawara 6.J.D.A. 7.Kaimasan Nagar 8.Rajpoot Nagar 9.Maharana Pratap Nagar 10.Ansal Colony 11.Main Road Kanpur	Near Gate No. 3 Medical College Opposite Shankar Hospital	25.459924 78.616738
17	30, 38	30. Sagar Gate 38. Chaniyapura	1.Sagar Gate 2.Tilyani Bajriya 3.Bhadhraaj 4.Jugyana 1.Chaniyapura 2.Andar Orcha Gate 3.Subhash Ganj	1. Near Kuldeep Intercollege,Chandan Khateek's Godown	Approval Pending
18	32, 34, 39	32. Nandanpura second 34. Nandanpura first 39. Nandanpura third	1.Nandanpura 2.Avash Vikash Colony Block- 1 3.Surya Puram 4.Kundpatha 1.Nandanpura(Ansik) 2.Deendyal Nagar 3.Taaj Compound 4.Balaji Puram 1.Sangam Vihar Colony 2.K.K. Puri 3.Priya Puri 4.Bankers Colony 5.Avash Vikash Colony Block- B 6.Haji Petrol Pump Nadi Khoran 7.Indane Gas Colony 8.Raaj Ghat Colony 9.Krishna Bihar Colony 10.Amreek Vihar 11.Pahuz Bihar 12.Saiyad Nagar	Near Prathmik Vidhyalya Nandanpura	25.456003 78.536225

19	33, 35	33. Bahar orcha gate second 35. Bahar orcha gate first	1.Bahar Orcha Gate 2.Kasai Mandi 3.Kabristan 4.Ajay Inclave 5.Kailash Residency 6.Kumariya Pulia 7.Kuresh Nagar Mandi 1.Bahar Orcha Gate 2.Mohini Baba 3.Makad Khana	Kasai Mandi, Near Khurshid'd Office (Parshad)	25.452807 78.584719
20	36, 44, 50, 57	36. Aligole second 44. Bahar datiya gate first 50. Bahar datiya gate second 57. Mukaryana	1.Aligol 2.Bhairo Khidki 3.Sarai 4.Madhiya 1.Home Guard Training Center 2.Pathoriya 3.Idgaah 4.Water Institute And Filter 5.Imlipura 6.Bahar Datia Gate Ansik 7.Nakta Chaupra 8.Kabristan 9.Daroga ka Bagh 10.Datia Cungi Road 11.Datia Cungi Road Towards Filter 12.GIC Road 13.Inside Bagicha 14.Main Road GIC 15.Near Puliya Nala 16.Sharda Ka Bagh 17.Thapak Bagh 18.Bahar Datia Gate 1.Bahar Datia Gate(Ansik) 2.Bansal Colony 3.DAV Colony 4.Datia Gate To Idgaah Marg Ka South Part 5.Swami Puram 1.Mukaryana 2.Rai Ka Tajiya 3.Bisaat Khana 4.Darigraan	Near Transformer (Fish Market)	Approval Pending

21	37	37. Unnao Gate Bahar	1.Bahar Unnao Gate 2.Panchwati 3.Shamshan Ghat 4.Bhanderi Gate 5.Bhairo Khidki Bahar 6.Nalanda Om Garden 7.Pitambra Nagar Avasiya Yojna	Near Puliya	25.472970 78.579663
22	40	40. Talaiya	1.Talaiya 2.Andar Saiyer Gate 3.Jharna Gate 4.Kustyana 5.Ninawa Takiz 6.Kali Bari	1. Near State Bank of India, Manik Chowk.	Approval Pending
23	41, 45	41. Dadiyapura first 45. Dadiyapura second	1.Bada Gaon Gate Bahar 2.Suje Khan Khidki 3. Shamshan Ghat 4.Master Colony 5.Madrasi Colony 6.Gopal Ka Bagicha 7.Mahakaleshwar Mandir 8.Anjani Ke Hanuman 9.Dariya Pura 1.Laxmi Gate Bahar 2.Dadiyapura 3.Kaliji Ka Mandir 4.Gangadhar Rao Ka Samadhi 5.Shivaji Nagar 6.Avas Vikas 7.Laxmi Gate To Mandi Chauraha 8.Main Road 9.Main Road Laxmi Gate 10.Narayan Bagh Road 11.Laxmi Gate Bahar Main Road 12.Om Shanti Nagar	Near Fish - Chicken market	25.45028878.592335

24	42	42. Civil Lines South Part - 1	1.Suraj Prasad Inter College Ke Pradhan 2.Daakghar 3.Jail Chauraha 4.Collectrate 5.Chrischian Inter College 6.Jhokan Baag 7.Narayan Dharmshala 8.State Bank Main Branch 9.Nandani Cinema 10.Danik Jagran And Behind Part 11.Civil Lines	Narayan Dharmshala Road - Near Santosh Scrapdealer	25.448225 78.572099
25	43	43.Civil Lines South Part - 2	1.Behind Zila Jail 2.Crist The King Primary School 3.Gudindo Compound 4.Edilji Voice Compound 5.Forest Dept Office 6.Business Tax Office 7.Dharaiya Line Police Aawas 8.Rani Laxmi Bai Eye Hospital 9.SSP Office 10.Thana Nababad Police Line 11.Allahabad Bank To DIG Office 12.Jain Nurshing Home To Vijay Kankane Home 13.Chatai Ke Hanuman 14.Christ The King College To Dr.Rathor Home 15.Civil Lines	Opposite of Jail	25.44121678.575326

26	46, 60	46. Mewati pura 60. Laxmanganj	1.Andar Unnao Gate 2.Mewatipura 3.Andar Bhanderi Gate 4.Itwari Ganj 1.Sarai 2.Laxman Ganj 3.Purani Najhai 4.Purani Pasrath 5.Gopal Nikhra 6.Itwari Ganj 7.Sarafa	Near Gulab Chand's Havelli (Tentative)	Approval Pending
27	47	47. Bahar Khanderao Gate	1.Bahar Khanderao Gate 2.Civil Line Ansik 3.Tahsil Jhansi 4.Laxmi Bai Park 5.S.P.I. College 6.Kunj Bihari Mandir 7.Antiya Taalab	Near Bhagni Mandal Antiya Talab	25.459388 78.566937
28	48, 49	48. Premganj First 49. Premganj Second	1.Premganj(Ansik) 2.Rajkiya Pulled Housing Colony 3.Jarmeny Hospital 4.Adarsh Nagar 5.Naal Ganj 1.Premganj(Ansik) 2.Raiganj 3.Singlapura 4.Thana Sipri Bazar 5.Khalsa School 6.Tandon Garden	Near Kali Badi Association (At T-point) - Sulabh Complex	25.45970678.549473
29	51	51. Civil Lines (West Part)	1.Civil Lines (Ansik) 2.Central Hotel 3.Ministrial Housing Colony 4.Rishab Hotel 5.Officers Colony 6.Gondu Compound 7.Refuji colony 8.Satish Nagar 9.Kamal Kachi KaHata	Near Dhyanchan Stadium - opposite SBI	25.453145 78.556660

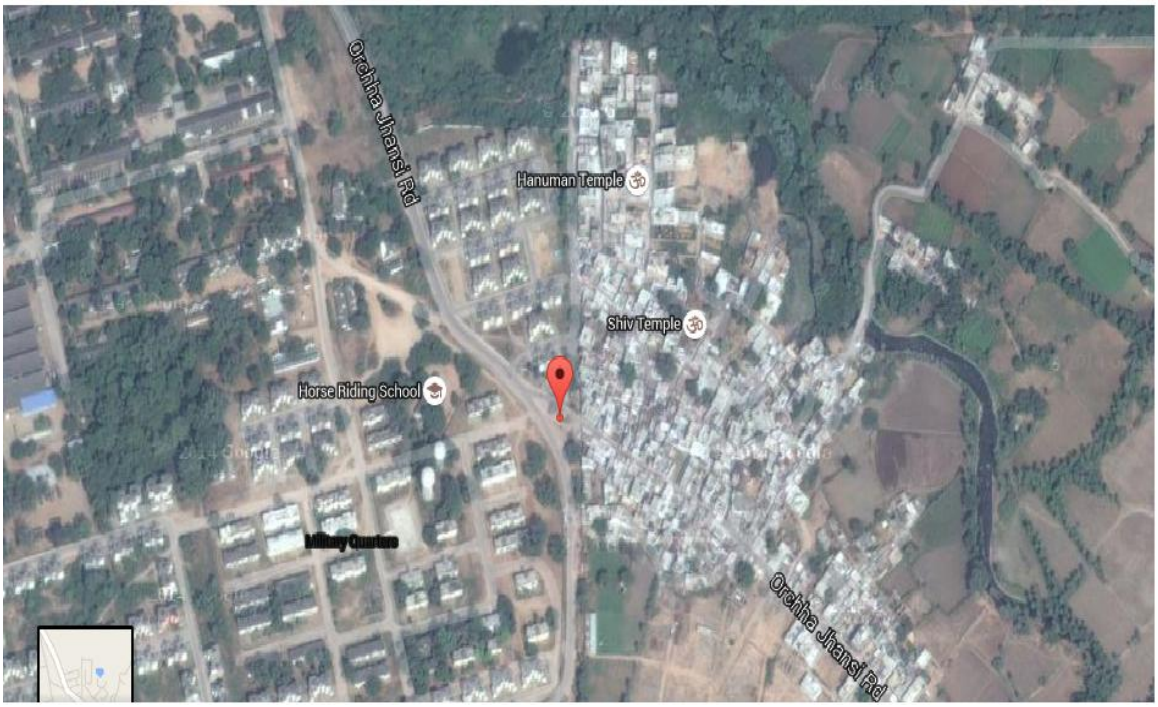
30	52	52. Civil Lines (North Part)	1.Civil Lines(Ansik) 2.Behind Chitra Cinema 3.Sevaram Oil Mill 4.Circuit House Area 5.B.K.D. College 6.Hydil And Water Board Colony 7.Nagar Palika Compound 8.Prakash Hotel 9. Income Tax Office To Behind Elite 10.Srinath Hotel 11.Prakash Hotel 12.B.K.D. To Chitra Road 13. Behind Central Hotel 14.Ebert Compound Near Chitra 15.Elite Sipri Road Samrat Hotel 16.Gondu Compound 17. Near Central Hotel 18. Officers Colony	Opposite Kunj Bihari mandir, BKD	25.455326 78.566054
31	54	54.C.P.Mission Compound	1.Commisioner Office 2.C.P. Mission Compound 3.H.M. Memorial School 4.Ayurved College 5.G.I.C. 6.Jaar Pahaar 7.M.P. Roadways Service Center 8.Munna Lal Power House 9.Sood Colony 10.Gawal Toli 11.Civil Lines 12.Sarv Nagar	Mission Compound Gate	25.45964178.563048
32	55	55. Nanak Ganj	1.Chaman Ganj 2.Nanak Ganj 3.Arya Kanya 4.Tandan Road	Behind Arya Kanya College	25.456202 78.548925

33	56, 59	56. Toriya Narsingh Rao, 59. Gunsaipura	1.Panchkuya 2.Toriya Narsingh Rao 3.Andar Datia Gate 5.Pani Wali Dharmshala 6.Jharkhadiya 7.Hingan Katra 1.Chandra Shekhar Azad 2.Gadhighar Ka Tapra 3.Taksal 4.Gusaipura 5.Jawahar Chowk 6.Khatrayana 7.Rani Mahal 8.Civil Hospital Kotwali	Near Panchkuiyan Temple	25.460603 78.573631

WEC No. 1, Near Hansari Bus Depot 25.417455, 78.567395,

WEC No.2, Christian Hospital, 25447219, 78.578032

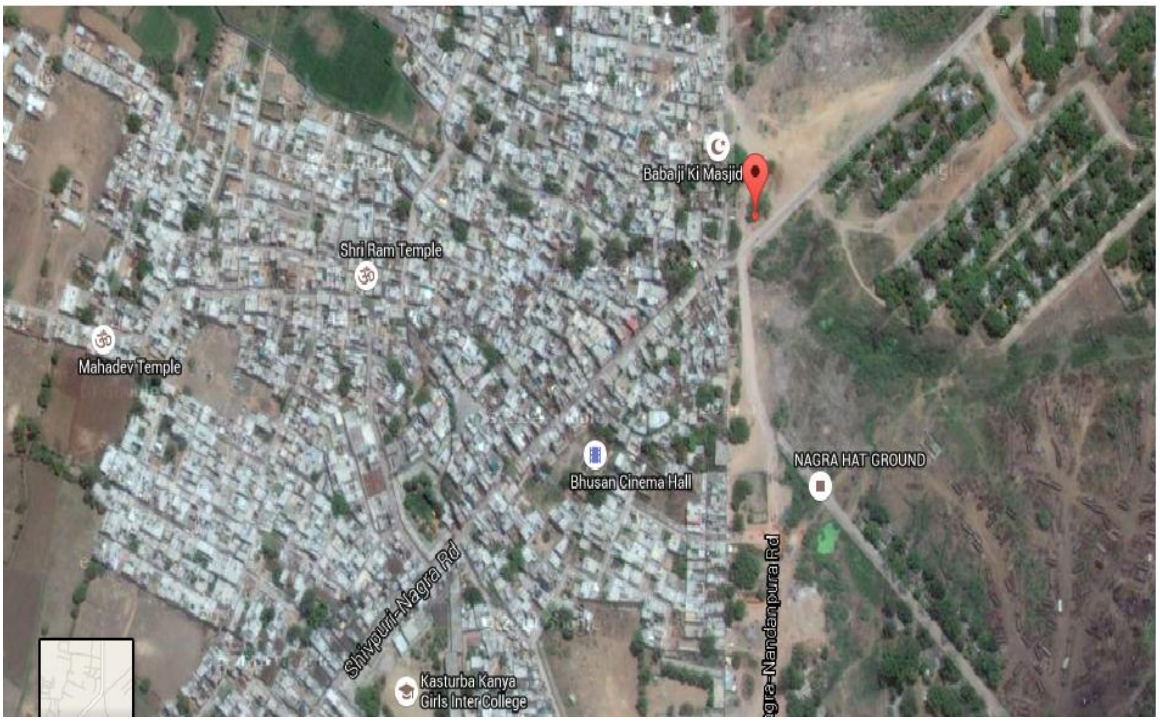
WEC No.3, Bhattagaon Bargad Ke Ped Ke Neeche, 25.427282, 78.598432



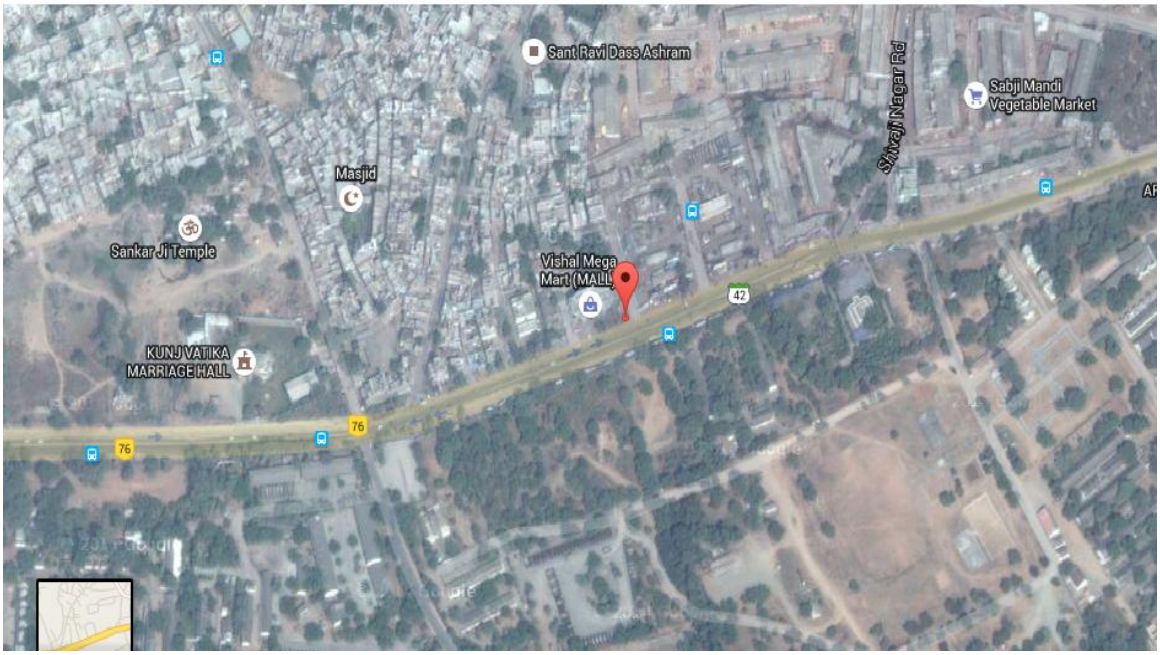
WEC No.4, Masiha Ganj, Shyam Kunj, 25.456207, 78.546508

WEC No. 5, Near Lord Shankar's Temple, 25.422835, 78.537649

WEC No. 6, Near Prem Nagar Bus Stop, 25.433669, 78.54174

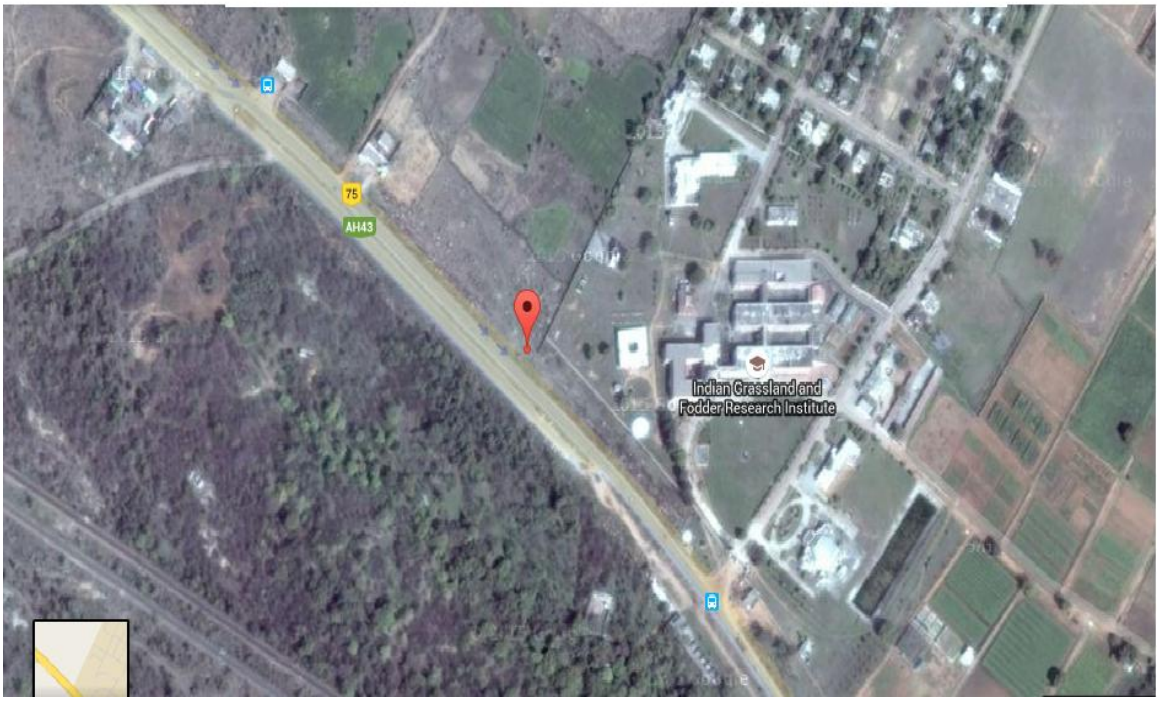


WEC No. 7, Near Vishal Mega Mart transformer, 25.445381, 78.589098



WEC No. 8, Near BIC, Overhead water tank, 25.448726, 78.580456

WEC No. 9, Near Krishi Anusandhan Kendra, Grassland. 25.511527, 78.531714

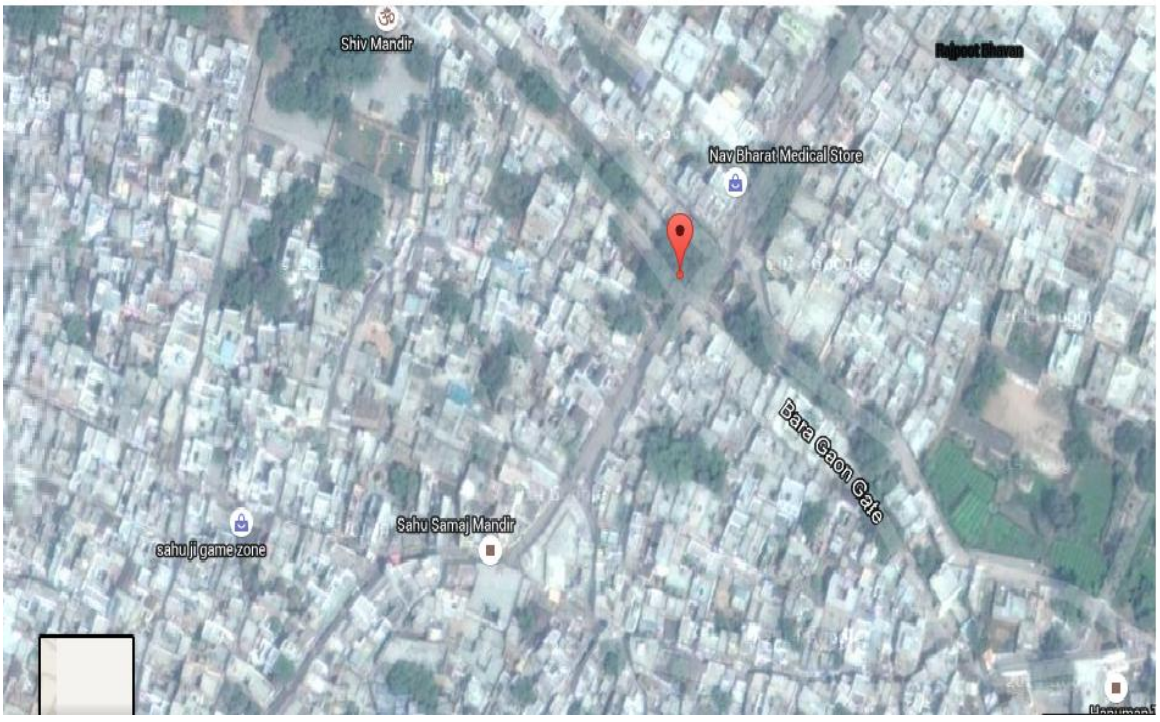


WEC No. 10. Near Hathi Khana, 25.462293, 78.569352

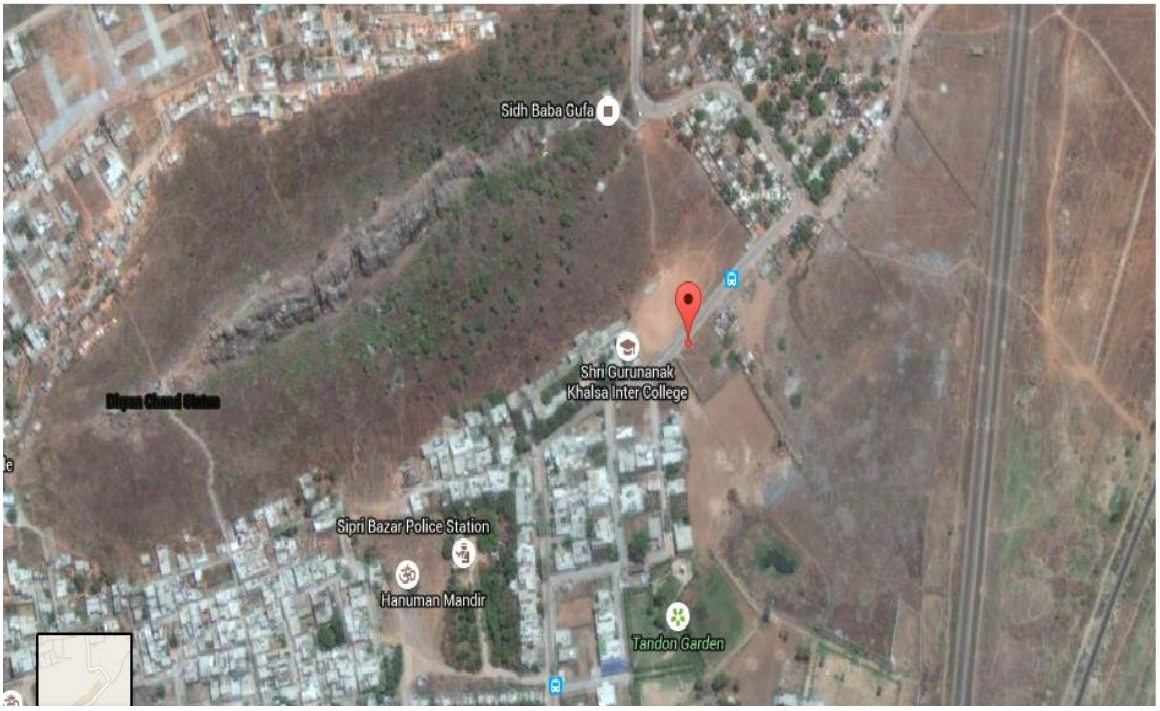
WEC No. 11, Bijauli Industrial Area, Main Road, Opp. Petrol Pump 25.383147, 78.552532

WEC No. 12, Puliya No.9 Taxi Stand, Opp. Railway Line, 25.424015, 78.550589

WEC No. 13. Bada Gaon Gate, 25.463894, 78.586588

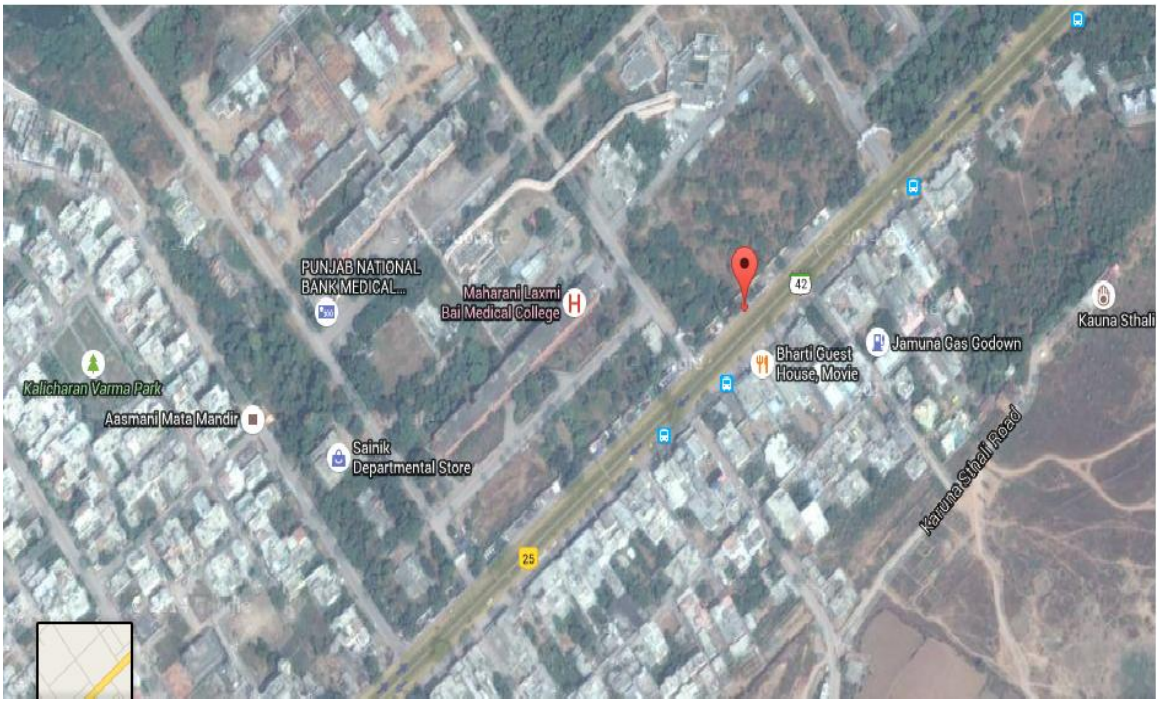


WEC NO. 14. Khalsa Inter College, Near Ashok Kabadi 25.466673, 78550731



WEC No. 15, Front End Corner BU Engineering College, 25.466110, 78639515

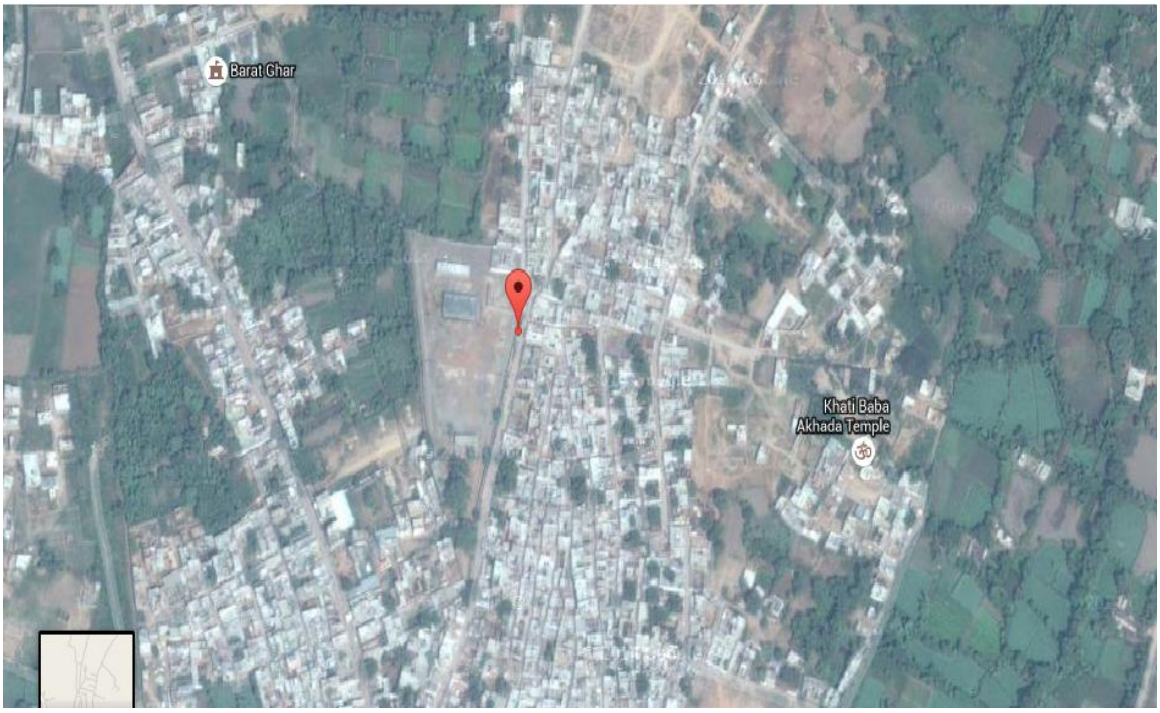
WEC No. 16, Gate No. 3 Medical College, Opp. Shankar Hospital. 25.459924, 78616738



WEC No. 18, Near Prathmik Vidhyalya, Nandanpura Tiraha, 25.456003, 78.536225

WEC No. 19. Kasai Mandi, Near Khurshid Parshad's Office. 25.452807, 78584719

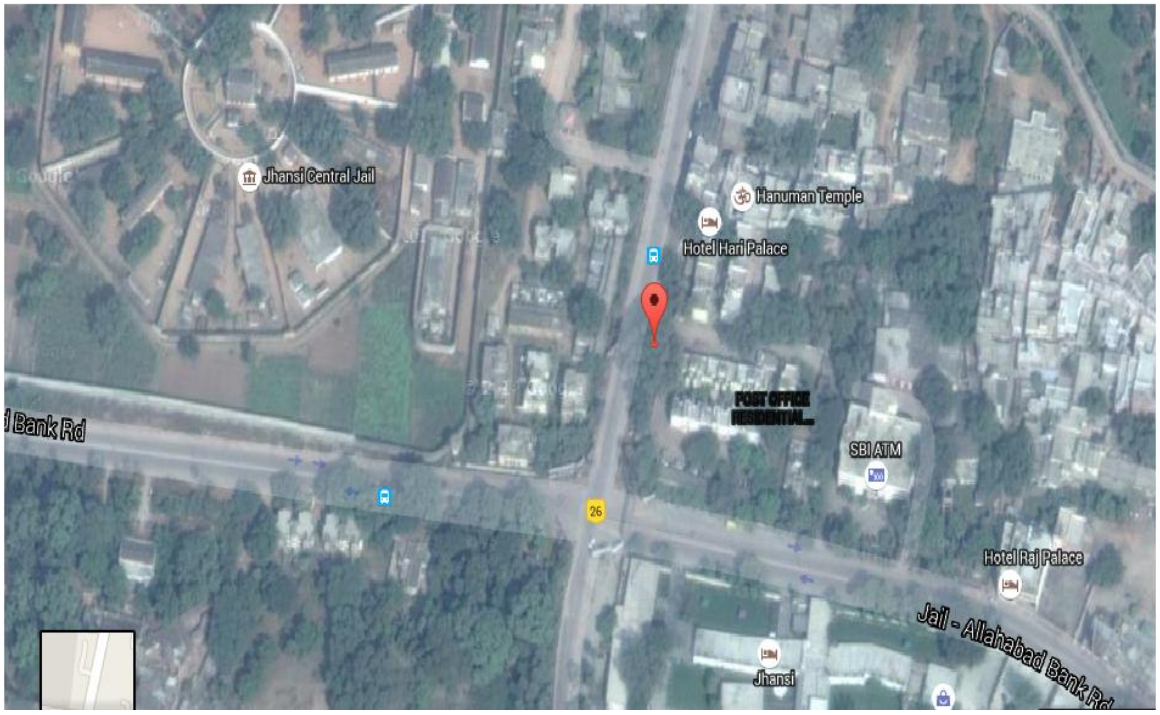
WEC No. 21, Outside Unnao Gate, Near Puliya, 25.472970, 78.579663



WEC No. 23, Near Fish-Chicken Market, 25450288, 78.592335

WEC No. 24, Near Santosh Kabadi, Elite - Narayan Dharamshal Road, 25.448225, 78.572099

WEC No. 25, Opp. Jhansi Central Jail. 25.441216, 78.575326



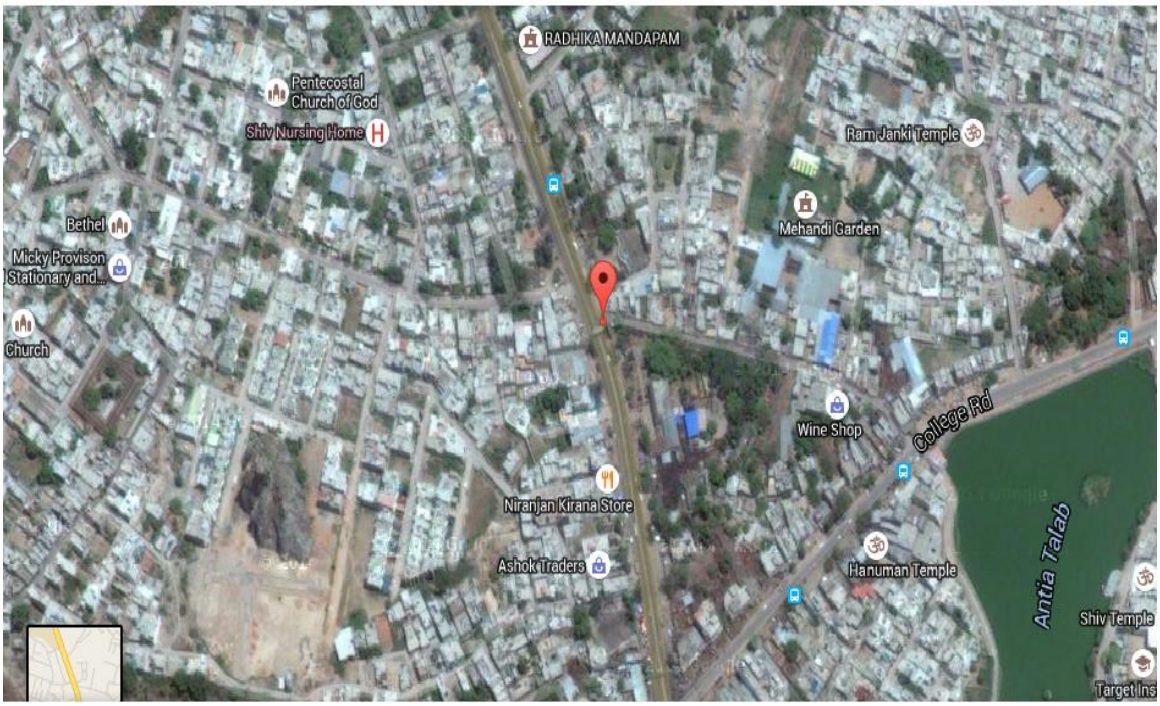
WEC No. 27, Near Bhagini Mandal, Antiya Talab, 25.459388, 78.566937

WEC No. 28, Near Kali Badi Association, 25.495706, 78.549473

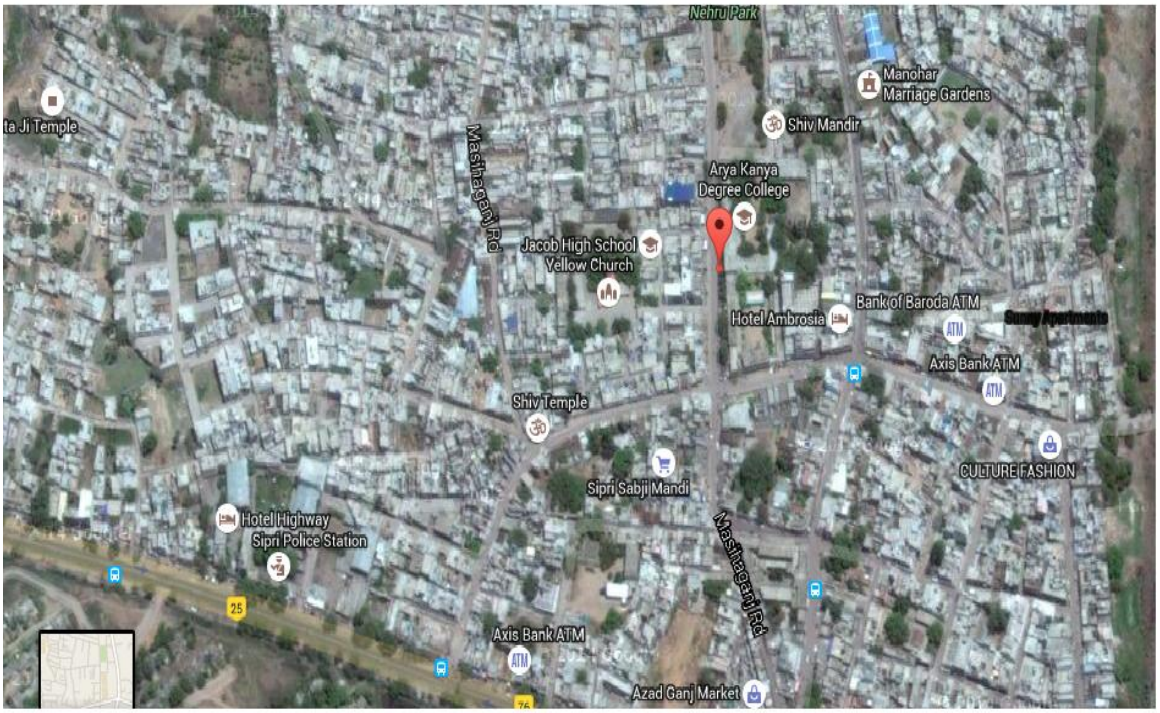
WEC No. 29, Near Major Dhayanchad Stadium, Opp SBI. 25.453145, 78.556660

WEC No. 30. Opp. Kunj Bihari Mandir, 25.455326, 78.566054

WEC No. 31, Opp. C.P. Mission Gate. 25.459641, 78.563048



WEC No. 32. Behind Arya Kanya College. 25.456202, 78.548925



WEC No. 33. Near Panchkuiyan Temple. 25.460603, 78.573631

APPENDIX 3

Agreement b/w

Jhansi Nagar Nigam

&

The Project Management Agency

Appendix-3

AGREEMENT BETWEEN PROJECT MANAGEMENT AGENCY AND THE JHANSI NAGAR NIGAM

AGREEMENT

This has reference to the bids against Expression of Interest (EOI) dated January 2, 2015, and bid submissions on January 20, 2015, and subsequent negotiations with successful bidder, for Appointment of Project Management Agency (PMA) for establishment of Plastic Waste Management System at Jhansi for the Jhansi Municipal Corporation.

This agreement is made with the successful bidder M/s. R.R. Collective after the techno-commercial evaluation of all the bids received, through its Chief Executive Officer/Proprietor Mr. Rakesh Solanki and Jhansi Nagar Nigam, through its Authorised Representative Commissioner, Nagar Nigam Jhansi, Shri Arun Prakash Ji.

1. ARTICLES OF AGREEMENT

This deed of agreement is made in the form of agreement on this __ Day of February 2015, by and between;

THE COMMISSIONER OF THE MUNICIPAL CORPORATION, JHANSI and applied to all his successors and any deemed authority for the same responsibility (**hereinafter referred to as the 'First Party'**)

AND

M/s. R. R. COLLECTIVE (RRC) having its office J-22, Jangpura Extension, New Delhi 110014, and an office in Office of Municipal Corporation Jhansi, through its Chief Executive Officer/Proprietor Mr. Rakesh Solanki, and applies to his successors or legal heirs for the period of this contract (**hereinafter referred to as the Second Party**), to carry out the Project Management Services for design, develop, implement commission of Plastic Waste Management System at Jhansi and managing it for ten years on the terms and conditions as are given in this agreement as **Project Management Agency** (**PMA**).

2. PLASTIC WASTE MANAGEMENT

This work order and the agreement are made for compliance of the key components of the Plastics Waste Management and Handling Rules 2011, by the Ministry of Environment and Forest. The Plastic Waste Management and Handling Rules promulgated on Feb 14, 2011 and amended in July 2, 2011 envisages as per clause 6 as reproduced below: (Copies enclosed)

(I) Plastic Waste Management - The plastic management shall be as under:-

(a) Recycling, recovery or disposal of plastic waste shall be carried out as per the rules, regulations and standards stipulated by the Central Government from time to time;

(b) Recycling of plastics shall be carried out in accordance with the Indian Standard: IS 14534:1998 titled as Guidelines for Recycling of Plastics, as amended from time to time;

(c) The municipal authority shall be responsible for setting up, operationalization and coordination of the waste management system and for performing the associated functions, namely:-

(i) To ensure safe collection, storage, segregation, transportation, processing and disposal of plastic waste;

(ii) To ensure that no damage is caused to the environment during this process;

(iii) To ensure setting up of collection centers for plastic waste involving manufacturers;

(iv) To ensure its channelization to recyclers;

(v) To create awareness among all stakeholders about their responsibilities;

(vi) To engage agencies or groups working in waste management including waste pickers, and

(vii) To ensure that open burning of plastic waste is not permitted.

(d) For setting up plastic waste collection centers, the municipal authority may ask the manufacturers, either collectively or individually in line with the principle of Extended Producer's Responsibility (EPR) to provide the support to establish such collection centers;

(e) Recyclers shall ensure that recycling facilities are in accordance with the Indian Standard: IS 14534:1998 titled as Guidelines for Recycling of Plastics and in compliance with the rules under the Environment (Protection) Act, 1986, as amended from time to time;

(f) The concerned municipal authority shall ensure that the residues generated from recycling processes are disposed of in compliance with Schedule II (Management of Municipal Solid Wastes) and Schedule III (Specifications for Landfill Sites) of the Municipal Solid Wastes (Management and Handling) Rules, 2000 made under the Environment (Protection) Act, 1986, as amended from time to time;

(g) The municipal authority shall incorporate the said rules in the Municipal bye laws of all the Urban Local Bodies;

(h) The municipal authority shall encourage the use of plastic waste by adopting suitable technology such as in road construction, co-incineration etc. The

municipal authority or the operator intending to use such technology shall ensure the compliance with the prescribed standards including pollution norms prescribed by the competent authority in this regard.

3. SCOPE OF WORK OF THE SECOND PARTY - (PMA)

A. Design and development of Plastics waste management system with Indicative Project report, for sequential implementation:

a. Work Plan with time lines to implement it.

b. GPS mapping of Municipal Corporation Jhansi area and determining Waste Exchange Center (WEC) location and estimation of Plastic Waste and number of residences to be served with each Waste Exchange Center (WEC).

c. Prepare a draft of execution plan of waste processing plant with equipment, plants and machinery.

B. Source, Selection, Procurement, Installation, Commission, Monitoring, Management, Execution and Operations of the project from the resources made available by the First Party and verification/inspection of all systems, designs, quality, passing of bills as PMA.

4. PROJECT MANAGEMENT

(I) Components for survey and time frame:

The Second Party will work with Municipal Corporation to identify the potential placement space of the waste collection centers "Portacabins", determine their sizes and estimate the localities to be serviced with each one of them. The standard operating protocols of these Waste collection centers will also be developed. Each of the places for the waste collection center will be GPS mapped and their location – latitude and longitude will be determined. This exercise will be done in whole of the municipal area and will take approximately two months.

(II) Manpower deployment and tools:

A team of 15 persons for survey and study will be deployed by The Second Party, with the job responsibilities as follows:

1. **7** of the team members will be interacting with all the RWA's, doing surveys of whole of Municipal area for potential waste collection center deployment, places for Portacabins and their GPS locations.

2. **5** of the team members will be working on tabulations and report writing work

3. **3** of the team members will be administering the different functions.

4. The operational ownership and management of the assets so procured will be in the charge of the PMA on behalf of the First party and the first party will ensure the safety and security measures as required by the Second party.

5. The Second Party will be provided an office space with 4 laptops, 3 GPS devices, high speed internet connection (Wi-Fi) besides, printers, photocopiers, office furniture, and a few other equipment as found necessary and approved by both parties.

(III) Deliverables outlines – Internal project report, implementation and operational process management:

1. The Second Party will have basic work plan and team organized in a week's time after the award of the contract.

2. The Second Party will organize GPS mapping of Municipal Corporation, Jhansi area and determining waste collection point location and Estimation of Plastic Waste and number of residence to be served with each collection points.

3. The Second Party will prepare and deliver internal project report, and manage process with implementation for a period of 10 years from the date of commencement of the project: June 1, 2015.

(IV) Completion time

The works of survey and mapping – as defined in the internal project report and basic operational modalities should be completed in Four Months from the date of this Agreement, (A margin of 15 days will be adjusted,) if not earlier. In exceptional circumstances, the time period stated in this clause may be extended in writing by mutual consent of both the parties.

PENALTY: In case of a delay for unexplained and unjustifiable reasons by the Second Party and without the permission from the First Party, a penalty of Rs.500/- per day will be imposed by the First Party.

(V) Term

The project management period is of Ten (10) years and the monthly project management fee will be paid on First day of every month by the First Party. The Second Party will be required to submit its weekly report of project performance in terms of accountability of plastics waste collection and processing every Saturday. On the revenue collection of the project, the Second Party will raise a bill of thirty percent of the value (realized revenue by MCJ from the projects) by first week of every month for the past month and the payment will be made by the Second Party within one week of the receipt of the bill.

All the payment made to the Second Party will include the statutory taxes as applicable and the second party will then be responsible for the payment of this tax to the taxation authorities. In case the tax is kept with the First Party, the First Party will be responsible for the payment of tax and follow the regulatory norms.

PENALTY: In case of a default without the consent of the other party, of more than an extra week by any party for the above clauses, the defaulting party will be liable for a penalty of Rs.1000/- per week.

5. COST OF THE CONTRACT

A. Payments under its contract:

Payments to The Second Party for consultancy services for Establishment of Plastic Waste Management System at Jhansi will be released by the first party in the following manner:-

S.No.	Scope of work in brief	Payment Terms As per RFP/ Deviation if any	Consultancy Fees		After Discount (15%)	
			Amount in (Words)	Amount in (Figures)	Amount in (Words)	Amount in (Figures)
1.	(A) Mobilization advance with order	**With order**				
	(B) Work plan and date of commencing with the team organized	**Within 15 days after work order**				
	(C) GPS mapping of Municipal Corporation, Jhansi area and determining waste collection point location and Estimation of Plastic Waste and number of residence to be served with each collection points.	**Approximately 30 days**				
2.	Preparation of Interim Report including finalization of plant machinery	**Approximately 30 days**				
3.	Preparations for Monitoring the execution of the project, verification of all drawings designs, quality, passing of bills etc.	**1 months after project in place**				
4.	**Total Project establishment consultancy cost**	**Tentatively 4 or 4.5 months,**		-		
Note: Statutory tax, if any are Extra.						
5.	**Monitoring and management of the project, verification of all drawings designs, quality, production, recovery passing of bills etc. every month**	**1 month after operations start or 4th month after the order every month for ten years.** ***15% increase every year.***			*-same-*	

B. The PMA will work for revenue collection for Municipal Corporation from this project. As the PMA is offering a 15% discount in its fee structure, it will be paid an incentive of 30% on all the revenue received from the project or for the project. This will include for its work for receipt of grants and aids as EPR, CSR, or any other grants for this project and will not include for any money spend by municipal corporation or any deposits received from vendors.

C. The salary of the laborers, workers and the contractors associated with the project will be borne by The First Party, except for the team hired by and as the PMA as mentioned in clause 4 (II) of this agreement. All the expense bills of electricity, water or any other will be paid by the first party.

D. The selection, sourcing, purchasing, installation and commission of the equipment's required for the Plastics Waste Management Plant will be done by The Second party, on behalf of the First Party. The funds and resources needed for the same can be provided to the Second Party against a Bank Guarantee for the defined amount or on the terms agreed upon. The said Bank Guarantee will subsequently be released once the equipment's have been purchased under the name of Jhansi Municipal Corporation.

E. As per the official letter, dated 29/1/2015 from Samapatti Vibhag the following land in Mauaja Bijauli, Araji number 069, admeasuring 0.453 hectare has been allotted for the Plastic Waste Management Project. Copy is hereby enclosed.

Other Terms and conditions:

1. Except the mobilization advance with the work order, all the payments will be made against the bill along with the work details and approved by the concerned authority.
2. All the bills should include statutory tax and payments will be made to the Second Party inclusive of the tax or as is advised by regulatory authority.
3. In case of a price hike or levies from the Central Government or the State Government on Statutory taxes in the future, an appropriate change in the monthly billing amount that will be mutually agreed on by both parties, too shall be applied.
4. The PMA is a part of Municipal services extension and all the infrastructure including a proper office with all the office equipment will be provided to them in the office of the Municipal Corporation Jhansi.
5. The Second Party will coordinate activities with First Party regularly and submit weekly performance reports as per the reporting format designed.
6. This detailed agreement should be considered the basic binding document for relationship for the parties and the spirit of it will be so maintained.
7. A work plan will be submitted by the Second Party within 15 days of the issuance of work order.
8. An increase of the scope of work can be done with mutual consent and mutually agreed terms and fee, and the additional terms will be part of this agreement.

6. ARBITRATION

6.1 Arbitration Procedure

If the efforts, to resolve all or any of the disputes through conciliation fail, then such a dispute shall be referred within 7 days to a Sole Arbitrator, who would be nominated by Commissioner, MCJ, and should be acceptable, by the second party. The venue of such

arbitration shall be at Jhansi. The award of the sole Arbitrator shall be binding on all parties. The cost of the Arbitration shall be borne by the respective parties. There will be no objections if the sole arbitrator nominated or appointed is an employee of MCJ.

6.2 Place of Arbitration

The place of Arbitration shall be Jhansi, Uttar Pradesh.

6.3 English Language

The request for arbitration, the answer to the request, the terms of reference, any written submissions, any order and awards shall be in English or Hindi and, if oral hearing takes place, English shall be the language to be used in all hearings. The award shall be made in writing

6.4. Enforcement of Award

Any decision or award resulting from arbitration shall subject to the provision of the Arbitration & Conciliation Act 1996 is final and binding upon the Parties. The Parties hereto agree that the arbitral award may be enforced against the Parties to the arbitration proceedings or their assets wherever they may be fond and that a judgment upon the arbitral may be ordered in any court having jurisdiction thereof.

6.5. Fees and Expenses

The fees and expenses of the arbitrators and all other expenses of the arbitration shall be initially borne and paid by respective Parties subject to determination by the prevailing Party of its cost and expenses in bringing or defending the arbitration claim, including legal fees and expenses incurred by a Party.

6.6 Performance during Arbitration

Pending the submission of and/or decision on a dispute, difference or claim until the arbitral award is pronounced, the Parties shall continue to perform all of their legal obligations under this Agreement without prejudice to a final adjustment in accordance with such award.

7. COMPLIANCE WITH LAWS

Each party shall comply in all respects with all applicable legal requirements governing the duties, obligations, and business practices of that party and shall obtain any permits or licenses necessary for its operations. Neither party shall take any action in violation of any applicable legal requirement that could result in liability being imposed on the other party.

8. CONFLICTS

The terms of this Agreement shall control over any conflicting terms in any referenced agreement or document.

9. CUMULATIVE RIGHTS

Any specific right or remedy provided in this agreement will not be exclusive, but will be cumulative of all other rights and remedies.

10. DISORDERLY CONDUCT

The second party shall at all-time take responsible precaution to prevent any unlawful, riotous or disorderly conduct by or amongst his employees and for the preservation of peace and protection of persons and property in the neighborhood of the works against the same. ("Disorderly conduct: shall include but not be limited to harvesting or natural resources such as firewood or fish by the labor when this is done to the detriment of pre-existing local interest.)

11. FAIR WAGES

11.1 The second party shall pay not less than fare wage/minimum wages to laborers engages by him on the work as revised from time to time on behalf of first party ,by the Government of Uttar Pradesh, but the Government shall not be liable to pay anything extra.

(Explanation: "Fair Wage" means minimum wages for time or piece work, fixed or revised, as established by the State Government under the Minimum Wages Act, 1948)

11.2 The regulations, aforesaid, shall be deemed to be part of this Contract and any breach thereof, shall be deemed to be breach of Contract.

12. FORCE MAJEURE

Neither party shall be held responsible for any delay or failure in performance of any part of this agreement to the extent such delay or failure is caused by fire, flood, explosion, war, embargo, government requirement, civil or military authority, act of God, or other similar causes beyond its control and without the fault or negligence of the delayed or non-performing party. The affected party will notify the other party in writing within Ten (10) days after the beginning of any such cause that would affect its performance. Notwithstanding, if a party's performance is delayed for a period exceeding thirty (30) days from the date the other party receives notice under this paragraph, the non-affected party will have the right, without any liability to the other party, to terminate this agreement.

13. GOVERNING LAW

This Agreement shall be governed by and construed in accordance with the laws of the Republic of India and be any initiation of legal proceedings shall be subject to the Courts of the city of Jhansi, Uttar Pradesh.

14. INDEMNITY

Each party shall indemnify, defend, and hold the other party harmless from and against any and all claims, actions, suits, demands, assessments, or judgments asserted, and any and all losses, liabilities, damages, costs, and expenses (including, without limitation, attorney's fees, accounting fees, and investigation costs to the extent permitted by law) alleged or incurred arising out of or relating to any operations, acts, or omissions of the indemnifying party or

any of its employees, agents, and invitees in the exercise of the indemnifying party's rights or the performance or observance of the indemnifying party's obligations under this agreement. Prompt notice must be given of any claim, and the party who is providing the indemnification will have control of any defense or settlement.

15. INSURANCE

In case of a casualty or accident of a worker/employee of The Second Party, The First Party has to compensate for the loss of life/work for the said person. Same applies for the Property and assets of the First party.

In case the working of the plant is stalled or hampered in anyways, due to no fault of the either of the parties (unforeseen circumstances like Force Majeure, damage, electrical faults, e.t.c.), the Second Party should still get the monthly dues as mentioned in clause 5.(A).5 of this Agreement.

16. INTEGRATION PROVISION OR ENTIRE AGREEMENT

This agreement sets forth and constitutes the entire agreement and understanding of the parties with respect to the subject matter hereof. This agreement supersedes any and all prior agreements, negotiations, correspondence, undertakings, promises, covenants, arrangements, communications, representations, and warranties, whether oral or written, of any party to this agreement.

17. LIMIT OF LIABILITY

In no event shall either party be liable to the other or any third party in contract, tort or otherwise for incidental or consequential damages of any kind, including, without limitation, punitive or economic damages or lost profits, regardless of whether either party shall be advised, shall have other reason to know or in fact shall know of the possibility.

18. LOCK-IN PERIOD

This Agreement has a lock-in period of 10 years and cannot be terminated by either party. In case the First Party terminates the said Agreement before the expiry of the above mentioned lock-in period, compensation to the tune of 70% of the monthly charges for the balance number of months shall be paid by the First Party to the Second Party. This is because of the intellectual investment in the systems designing and management by the First Party.

19. NOTICES

All notices shall be in writing and shall be delivered personally, by Indian Post certified or registered mail, postage prepaid, return receipt requested, or by a recognized overnight delivery service. Any notice must be delivered to the parties at their respective addresses set forth below their signatures or to such other address as shall be specified in writing by either party according to the requirements of this section. The date that notice shall be deemed to have been made shall be the date of delivery, when delivered personally; on written verification of receipt if delivered by overnight delivery; or the date set forth on the return receipt if sent by certified or registered mail.

20. RECORDS OF LABOR AND ACCIDENTS

The Second party shall maintain working hours and fee and wages of systems associates safety, health and welfare of person's accidents, and damages to the property and make such reports on these matters to the first party as he may prescribe from time to time.

21. REPRESENTATIONS AND WARRANTIES

Mutual Representations and Warranties

Each Party represents and warrants to the other party that:-

- **a.** It is duly organized, validly existing and in good standing under the laws of the jurisdiction of its incorporation/establishment.
- **b.** It has full power and authority to execute, deliver and perform its obligations under this Agreement.
- **c.** It has taken all necessary actions to authorize the execution, delivery and performance of this Agreement.
- **d.** This Agreement constitutes the legal valid and binding obligation of it, enforceable against it in accordance of terms thereof.
- **e.** There are no actions, suits or proceedings pending to the best of its knowledge, threatened against or affecting it before any court, administrative body or arbitral tribunal which might materially and adversely affect its ability to meet and perform any of its obligations under this Agreement.

22. SEPARABILITY

If for any reasons whatsoever any provision(s) or any part(s) of this Agreement is held or shall be declared void or illegal or invalid under present of future laws or regulations effective and applicable during the period of implementation of the Project and during the period of agreement as contained herein, by any competent arbitral tribunal or court, such provisions shall be fully separable and this Agreement shall be construed as if such provision(s) or such part(s) of this Agreement never comprised part of this Agreement and the remaining provisions of this Agreement shall remain in full force and shall not be affected by such void or illegal or invalid provision or by its severance from this Agreement.

23. SUCCESSORS AND ASSIGNS

This agreement shall be binding on and inure to the benefit of the parties hereto and their respective heirs, legal or personal representatives, successors, and assigns.

24. SURVIVAL

All provisions that logically ought to survive termination of this agreement, shall survive.

25. WAIVER

Failure of either party to insist on strict compliance with any of the terms, covenants, and conditions of this agreement shall not be deemed a waiver of such terms, covenants, and conditions, or of any similar right or power hereunder at any subsequent time.

26. <u>WRITTEN MODIFICATION/AMMENDMENTS</u>

This agreement may be amended or modified only by a writing executed by both parties.

THE PARTIES BELOW EXECUTE THIS AGREEMENT, WHICH SHALL BECOME EFFECTIVE ON _____

Commissioner,
Jhansi Municipal Corporation,
Jhansi,
Uttar Pradesh.
(Party of the First Part)

Authorized signatory of
M/s. R.R. Collective
J-22, Jangpura Extension
New Delhi – 110014
(Party of the Second Part)

WITNESS

WITNESS

Justification of Monthly Expenses of R.R. Collective - Project Management Agency				
Our expenses outline is as below, however, to manage these expenses in our fees of Rs.4,80,000/-, we will need an extra support system to carry out all activities as per the scope of work of your work order like liasoning for VGF, CSR & EPR and relative expenses.				
S.No.	**Numbers**	**Expense**	**Individual (Average)**	**Total**
1	**5**	**Experts**	**50000**	**250000**
2	**3**	**Supervisor**	**15000**	**45000**
3	**2**	**Computer Operators**	**10000**	**20000**
4	**1**	**Fourth Class Staff**	**8000**	**8000**
5	**10**	**Vehicle Allowance for Each Officer (Average)**	**2500**	**25000**
6	**1**	**Phones + Wi-fi**	**10000**	**10000**
7	**1**	**Chai Pani**	**20000**	**20000**
8	**1**	**Cleaning + tools**	**4000**	**4000**
9	**1**	**Income Tax @ 10%**	**48000**	**48000**
10	**1**	**Chartered Accountant Fees**	**10000**	**10000**
11	**2**	**Other Miscellanious Expense (Travelling - New Delhi, Ahemadabad, Lucknow & Other Metropolitan Cities for PWM + Boarding & Lodging)**	**20000**	**40000**
Total: (In words: Four Lakh and Eighty Thousand Only)				**480000**