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Case Study

# Environmentally Sustainable Municipal Solid Waste Management- A Case Study of Surat, Gujarat, India

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## Abstract

In this expeditiously era, strong waste management issues rose to new rights of common interest in few regions of the India because of increasing strong waste production, reducing management capacity, rusting disposal costs, and open enemies to the sitting of current management facilities. Moreover, Poor solid waste management will cause a slew of issues in terms of health, environment, and socio – economics [1]. In addition, difficulties in controlling SWM have resulted in improper waste disposal methods, such as open dumping and open burning of waste, which are adversely affect the ecology. The rising managing waste appropriately is crucial for establishing sustainable and habitable cities, though it remains a challenge for many developing nations and cities. Effective waste management is wealthy, much containing 20%-50% of domestic budgets. Running the important domestic service requires intergraded systems that are effective, sustainable and socially supported. The goal of this paper is to have sustainable solid waste management, so estimates have been made that project waste generation per capita per day in Surat in the form of bio-degradable, non-biodegradable, and recyclable wastes in the next 30 years, as well as how these wastes can be treated in the form of compost, biofuel, fuel pallets, and generating power from waste. It gives an overview of solid waste management in the world, India, and Surat, as well as how to address the problem by offering sustainable Solid Waste Management.

***Keywords:*** Solid waste; management; treatment options; sustainability; economic output; transformation of waste to value added products

## Introduction

Solid waste management is defined as the discipline that deals with the generation, storage, collection, transport or transfer, processing, and disposal of solid waste materials in a way that takes into account a variety of public health, conservation, economic, aesthetic, engineering, and other environmental factors [2]. Planning, administrative, financial, engineering, and legal tasks are all part of solid waste management. Complex inter-disciplinary relationships between subjects including public health, city and regional planning, political science, geography, sociology, economics, communication and conservation, demography, engineering, and material sciences could be used to find solutions.

Every year, an estimated 11.2 billion tonnes of solid trash are collected around the world, with organic garbage decomposition accounting for around 5% of global greenhouse gas emissions [6]. An estimated 11.2 billion tonnes of solid trash are collected each year around the world. Solid garbage generation is increasing on a daily basis [1]. Because of their higher consumption levels, developing countries produce more garbage per capita. In 2018, the United Kingdom created 222.2 million tonnes of total trash. In the 2018-2019 financial year, Australia created 75.8 million tonnes of solid trash. On a daily basis, Canadians generated 2.3 kg of municipal solid garbage Its annual trash total is predicted to be 1,325,480,289 metric tones [6]. With a population of 36.7 million people, that equates to 36.1 metric tonnes of trash per person each year. Bulgaria's yearly garbage per capita is projected to be 26.7 metric tonnes, with an annual waste total of 189,141,945 metric tonnes. Bulgaria's massive construction industry is the country's largest garbage generator, producing 172 million metric tonnes of rubbish annually. Estonia's annual garbage per capita was predicted to be 23.5 metric tonnes, with a total of 30,912,409 metric tonnes. Hazardous trash accounts for roughly a third of the country's nearly 31 million metric tonnes of garbage.

The amount of waste produced in India has been continuously increasing in recent years. In 2016, cities around the world created 2.01 billion tonnes of MSW, averaging 0.74 kg per person every day [6]. Annual trash creation is anticipated to increase by 70% from 2016 levels to 3.40 billion tonnes in 2050, [6] owing to high population expansion and urbanisation. According to a 2014 report by the Planning Commission's "Task Force on Trash to Energy," urban India will generate 2,76,342 tonnes per day (TPD) of waste by 2021, 4,50,132 TPD by 2031, and 11,95,000 TPD by 2050. The trash generation per capita is 450 grammes per day, and it is increasing at a rate of 1.3 percent each year. As of January 2020, garbage generation in 84,456 wards ranged from 32 MT to 22,080 MT per day.

| *Major Cities* | *Waste Quantity (Tonnes Per Day)* |
|---|---|
| Surat | 1000 |
| Pune | 1175 |
| Kanpur | 1100 |
| Ahmedabad | 1302 |
| Hyderabad | 2187 |
| Bangalore | 1669 |
| Chennai | 3036 |
| Delhi | 5922 |
| Mumbai | 5320 |
| Kolkata | 2653 |

Shows the amount of waste generated (tonnes per day) in various Indian cities. [7]

***Table 1:*** Waste Quantity (Tonnes per day) of Indian cities.

## Literature Review

Due to the rapid urbanization, the various Development authorities of the respective cities have started preparation in how to manage the increase solid waste generated by the population. As per data collected, ten years ago, the collective management of solid wastes across the urban cities were nearly 0.7 billion tons of wastes each year. And there is a projected growth of wastes to 2.2 billion tons by 2025 with the increase of urban population and an increase of per capita waste generation. Also, globally waste generation contribute to the greenhouse gas emission in the environment to a comparatively small amount which is around 3 to 5 percent approximately. Thus, proper and effective waste management can contribute to the mitigation of the emissions [16].

As per research it is seen that the process of door-to-door collection of solid wastes has been achieved to almost 100 percent in 329 cities in India, including Goa, Karnataka, Madhya Pradesh, Mizoram, Nagaland, Odisha, Sikkim, Tamil Nadu and Telangana. As per proposal, by 2015-16 the number of cities involved in door-to-door solid waste collection may increase to 1000. In Goa, there is active participation of self-help groups in terms solid waste collection under Margoa Municipal Council. The concept of bin less systems in terms of solid wastes disposal have been successfully implemented by the Kochi Municipal Corporation in some of the wards of the city [17].

Under, SWaCH programme the concept of door-to-door collection of municipal waste was started by Pune Municipal Corporation (PMC). In 2008, PMC did sign a memorandum of understandings for a tenure of 10 years which involved decentralization of door-to-door collection of municipal wastes from various sources of its generation to be performed by the workers of SWaCH programme. As per reports, presently wastes from approximately 4 lakh properties are being collected by 2,300 waste collectors with an overall average of 174 properties per waste collector. There is total five decentralized units of disposal across the Pune city. SWaCH programme proved to be useful for PMC of being cost effective, high resource energy recovery, labour friendly and proved to be sustainable in nature [18].

Surat introduced a PPP model for waste collection and transportation since 2004, which involved closed vehicles and vehicle tracking devices. In 2009 Shimla, the Municipal body formed a society named' Shimla Environment Heritage Conservation and Beautification'(SEHB) and it became operating at April 2010. The concept of 'Zero Waste' has been adopted by many cities as well like Pune, Ahmedabad, Namakkal and so on and so forth.In terms of solid waste disposal and collection, this model was the first to receive an ISO certification. The sustainability of this model is dependent on the segregation of wastes generated from households and commercial properties. Ahmedabad has taken the initial steps in converting the city into a 'Zero waste city' by signing a memorandum with United Nations Regional Development situated in Japan. In order to achieve the objective Ahmedabad is developing Master Plan and City Sanitation Plan along with the cooperation of Urban Management Centre (UMC) [19].

## Examples of Solid Wastes Management throughout the World

### *Reward for plastic recycling on Colombia*

Colombian municipalities create roughly 28,800 tonnes of solid trash each day, which is rewarded for plastic recycling. To address this problem, Colombia created ECOBOT, a recycling effort that promotes recycling culture throughout the country. The goal is to raise recycling awareness among citizens by rewarding citizens for each item that is recycled. ECOBOT is a type of reverse vending machine that is seen at shopping malls, institutions, and public spaces and encourages PET (Polyethylene terephthalate) bottle recycling. You will receive a coupon from affiliated companies called Eco partners every time you deposit a transparent plastic bottle (PET) or the caps. This system can handle everything from restaurant coupons to movie tickets to shopping cash. All of the plastic that is collected is transferred to recycling operations rather than landfills [3].

### *Trash can be traded in Indonesia*

Malang, a city in Indonesia, generates around 55,000 tonnes of rubbish per day. It was also a city where the majority of residents lacked health coverage. Although these two diseases appear to be unrelated, Dr.GamalaAlbinsaid, a healthcare entrepreneur and CEO of a health company, viewed this as a major societal opportunity. He came up with the concept of Waste Clinical Insurance, which

allowed people to swap garbage for medical services and medications. This programme tries to combat both poverty and waste in Indonesia, a country where more than 10% of the population lives in poverty [3]. The programme encourages low-income families to recycle their trash since it allows them to pay for health insurance. The clinic collects waste from the public and sells it to recyclers. The funds raised from recyclers are then used to provide people with basic health insurance.

### *Sweden*

Sweden has run out of trash and is requesting garbage from other countries in order to keep its recycling plants operational. Less than 1% of Sweden's domestic garbage is disposed of in landfills; the remainder is recycled in various ways [3]. Today, Sweden's 32 waste treatment plants provide heat to 810,000 families and power to around 250,000 private homes. Sweden has implemented a recycling scheme that directs all waste-burning energy into the national heating network. This is a cost-effective technique to heat homes in the cold.

### *A trash amusement park in Uganda*

Ruganzu Bruno, an artist and environmentalist, has developed an amusement park for children living in Kampala's slums. It's made completely of trash. Bruno first collected all of the villagers' trash, then refashioned it into swings and life-size board games with their assistance. The artist's ambition is to build more than 100 identical amusement parks across Uganda [3].

## Technological Options for Transforming Waste into Usable Products

Various technologies for solid waste transformation into resource are given in Table 2.

| ***S.NO*** | ***Technology***[10] | ***Details*** |
|---|---|---|
| 1 | Windrow composting | Windrow composting is preferred in an area where higher ambient temperature is available. Organic matter (Wetwaste) is converted into compost by aerobic decomposition. The aerobic microorganism oxidizes the wet waste into carbon dioxide and oxides of nitrogen. Carbon is used as an energy source and nitrogen is been recycled. Temperature of mass rises due to exothermic reaction. In this method, refused wet waste is delivered on the open land in about 20 windrows. The time required for windrow composting is approximately 4-8 weeks [11] |
| 2 | Vermicomposting | Vermicomposting is a process of converting organic matter into Bio-fertilizer using earth worms. These<br>worms give out an excreta material in the form of 'vermicasts' when feed on the organic waste. This excreta material is rich in Nitrates, phosphorous, magnesium, calcium and potassium. This is used as fertilizer and can be used to enhance the soil quality. [12] |
| 3 | Bio methanation | Bio methanation is a process in which microorganism converts organic matter into biogas. It is a complex process leading to generation of methane and carbon dioxide. Bio methanation involves the process of Hydrolysis, acidogenesis, acetogenesis and methanogenesis. [13] |
| 4 | RDF | RDF is a fuel derived from dry or non-biodegradable waste. It can be used to produce electricity or steam. Waste which has higher calorific value can be used to produce RDF. Dry solid waste with Caloric value 1500 Kcal/kg or more can be accepted in RDF plant. Process of conversion of dry waste into RDF include Screening, Coarse Shredding, bag splitting, shredding, Magnetic Separation and Refining Separation [14] |

| | | |
|---|---|---|
| 5 | Incineration | Incineration involves burning of dry waste with energy recovery. But it will only disappear the solid waste problem and can leads air pollution. This is the most common method of waste to energy (WTE) around the world. It can reduce the volume of waste by 95-96%. Incineration process depends on composition and degree of recovery of material such as metals from ash for recycling. [15] |
| 6 | Integrated system (Composting + RDF) | The aim of Integrated System is to achieve zero discharge. It could include composting of wet waste. Dry waste can be processed as RDF. Sanitary landfill can be included for refused waste coming out from Composting and RDF.[20] |
| 7 | Sanitary landfill | Sanitary landfill includes disposal of solid waste on land scientifically. The solid waste is either buried in underground or in large piles. The ground or base can be guarded with a thick plastic and a layer of clay which should be impervious. A collection system is there in the sanitary landfill to collect the leachate and gases coming-out from the filled waste of sanitary landfill. [20] |

## Case Study of Surat City

Surat is a city in Gujarat, a western Indian state. It used to be a significant seaport at the mouth of the Tapti River. It is currently the commercial and economic heart of South Gujarat, as well as one of Western India's main urban centres. It is Gujarat's second-largest city after Ahmedabad, as well as India's eighth-largest city by population and ninth-largest urban agglomeration. Surat District has a total area of 4,418 km2 and a population density of 1,376 people per km2 according to the 2011 Census. The region has the state's greatest population density, followed by Ahmedabad. It is India's 12th most populous district (out of 640) and Gujarat's second most populous district (out of 33) after Ahmadabad as of 2011. According to a study conducted by Economic Times, Surat would be the world's fastest expanding metropolis from 2019 to 2035. According to the SwachhSurvekshan 2020 on August 20, Surat is the second cleanest city in India as of August 21, 2020.

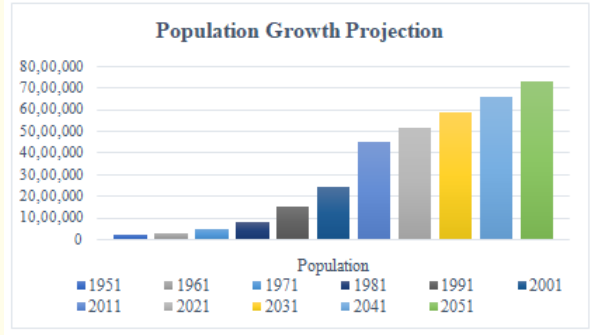
### *Population projection*

Surat's population has exploded in the previous 20 years. The city had many barren regions, green spaces (agricultural lands), and water bodies, albeit as the year progressed, the city continued to grow, diminishing natural drainage lines and lakes. The population of the city is growing rapidly per year as people migrate to the city in quest of work. Surat's population is forecasted for 2021, 2031, 2041, and 2051 using the Arithmetic Projection method. As the population of the area increases as a result of new initiatives, the physical and social infrastructure will benefit even more. Surat's population is predicted to grow dramatically in the next 5 years, as it becomes a hub for employment, resulting in a rapid increase in garbage creation. In order to accommodate the growing population, additional land will be required to provide shelter and meet their needs. The population trends and predictions are shown in table 3 and graph presented in figure 1.

| *Year* | *Projected Population by AP* | *Projected Population by GP* | *Projected Population by Incremental Method* | *Average projected Population* |
|---|---|---|---|---|
| 2011 | - | - | - | 4,466,826 (existing) |
| 2021 | 51,74,100 | 66,59,246 | 55,67,729 | 58,00,358 |
| 2031 | 58,81,374 | 99,27,756 | 70,62,262 | 76,23,797 |
| 2041 | 65,88,648 | 1,48,00,524 | 89,50,424 | 1,01,13,199 |
| 2051 | 72,95,922 | 2,20,64,958 | 1,12,32,216 | 1,35,31,032 |

Showing the decadal population projections from 2021 – 2051 by Arithmetic Progression, Geometric Progression, Incremental method and finally the average of it, depending on the existing population of 2011 (Source – Author).

***Table 3:*** Population Projection.




The Graph shows the decadal population trends and projections.

***Graph 1:*** Showing graph of population trends andpredictions.

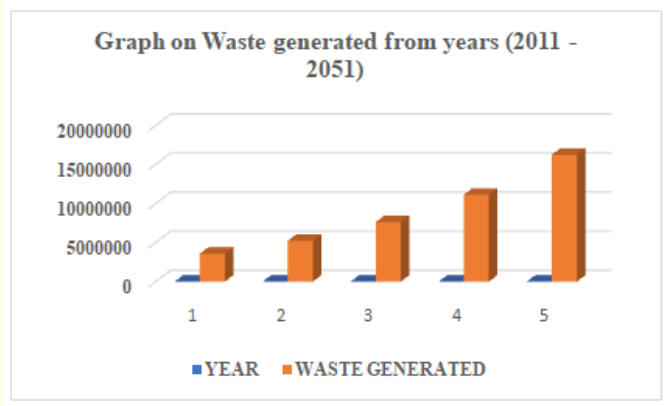
### *Estimation of Solid waste in different decades*

The study estimates different issues of solid waste management amount in various decades. Solid trash created by residential, commercial, and industrial operations is frequently disposed of in an indiscriminate manner. Unscientific waste management has significant environmental consequences. Diseases such as typhoid, cholera, dysentery, yellow fever, plague, and others have a high danger of spreading. In our research, we calculated the amount of solid garbage generated in Gurgaon. Over the previous few decades, the amount of garbage produced has increased dramatically. According to MOHUA (Ministry of Housing and Urban Affairs), solid waste created per inhabitant per day ranges between 0.5 and 0.9 metric tonnes, with 147,613 metric tonnes generated each day. By 2021, the Planning Commission estimates that urban India would create 2, 76,342 tonnes of garbage per day. As a result of our research, we've chosen 0.9 as the mean figure for solid waste creation per capita per day in Gurgaon, which is rising at a pace of 1.3 percent each year. Then we divided the solid waste generation into three categories: biodegradable trash, non-biodegradable waste, and recycle garbage, which accounted for 52 percent, 32 percent, and 17 percent of total solid waste created in Gurgaon during the next five decades, respectively. Then there's the production of solid trash (70%).

| *Year* | *Waste Generated* | *Unit* |
|---|---|---|
| 2011 | 4,466,826 x 0.8 = 35,73,460.8 | Kg/Capita/Day |
| 2021 | 58,00,358 x 0.9 = 52,20,322.2 | Kg/Capita/Day |
| 2031 | 76,23,797 x 1 = 76,23,797 | Kg/Capita/Day |
| 2041 | 1,01,13,199 x 1.1 = 1,11,24,518.9 | Kg/Capita/Day |
| 2051 | 1,35,31,032x 1.2 = 1,62,37,238.4 | Kg/Capita/Day |

Gives the total solid waste generated by the projected population from the year 2021 – 51 and of existing 2011 as well.(Source – Author).

***Table 4:*** Solid Wastes Generation.




The Graph shows Solid waste to be generated from 2021 – 2051 including that of 2011.

***Graph 2:*** Solid Waste Generated.

### *Wastes-to-Usable-Products Transformation*

The waste management issue in India has significant consequences for the country's environment, economy, and public health [5]. We are primarily interested in developing technology and solutions that reduce trash creation and turn all garbage into usable goods. This comprises efforts to create a circular economy in industries by maximising resource recovery and recycling for landfill-free communities, as well as attempts to promote a circular economy through resource efficient and cleaner manufacturing in industries [5]. Increased creation of solid wastes in both urban and rural regions of the city stem from population growth along with better people's lifestyles. Rural solid waste is more biodegradable, whereas urban solid waste contains more non-biodegradable components such as plastics and packaging [5]. However, both sectors share a repulsive attitude toward solid waste and its management. The universally accepted practise is to keep rubbish out of sight. Solid waste management, which typically entails appropriate segregation and scientific recycling of all components, is the best approach to deal with solid waste. The application of techniques to ensure an orderly execution of the various functions of collection, transport, processing, treatment, and disposal of solid waste is known as solid waste management (SWM) (Robinson, 1986).

Solid Municipal Wastes generated can be majorly subdivided into two types – Degradable and Non degradable Wastes. Out of the total solid wastes generated 15% comprises of Non degradable wastes and 85% percent comprises of Degradable wastes. Thus, after disposal, segregation and transportation of municipal wastes generated as a part of the solid waste management, the process of reduce, reuse and recycle (3R's) play a very vital role in this process. And the end results after the process of 3R's can be subdivided into four parts which proves to be an alternative source of energy. Nondegradable Wastes can be managed to produce Power (electricity). Biodegradable Wastes can be managed properly to produce Compost, Fuel Pallets and Bio Fuel [21].

### *Power*

When municipal solid waste (MSW) and other wastes are burned, corrosive flue gases are released, which damage boiler components such as super heater tubes. The typical way for converting waste energy into electricity is to use a boiler to produce steam, followed by a turbine/generator combination [21].

### *Compost*

Composting is a biological process in which the organic element of garbage is allowed to decay under carefully controlled conditions as another technique of handling municipal solid waste. The organic waste material is metabolised by microbes, which reduces its volume by up to 50% [21].

### *Fuel pellets*

Pelletization of municipal solid waste entails sorting, crushing, mixing high and low heat value organic waste material, and solidifying it to generate fuel pellets or briquettes, also known as Refuse Derived Fuel (RDF), Process Engineered Fuel (PEF), or Solid Recovered Fuel (SRF) (SRF) [21].

### *Bio-fuel*

A dilute-acid technique was used to convert MSW to bio fuel in the first stage. The major goal of this procedure was to hydrolyse starch and produce a glucose-containing hydrolysate [21].

| *Year* | *Non degradable Waste* | *Unit* | *Power Generated* | *Unit* |
|---|---|---|---|---|
| 2011 | 536.02 | Ton/Capita/Day | 5.3602 | Megawatt |
| 2021 | 783.05 | Ton /Capita/Day | 7.8305 | Megawatt |
| 2031 | 1143.57 | Ton /Capita/Day | 11.4357 | Megawatt |
| 2041 | 1668.68 | Ton /Capita/Day | 16.6868 | Megawatt |
| 2051 | 2435.59 | Ton /Capita/Day | 24.3559 | Megawatt |

Gives the amount of Non degradable waste that is generated out of the total solid wastes of 2021 – 51 and of existing 2011 as well and the power generated out of the non degradable wastes.

*Note- (Power generated = Non degradable waste generated / 100)(Source – Author)

***Table 5:*** Non-Degradable Wastes and Power generation.

| *Year* | *Degradable Waste* | *Unit* | *Biofuel Generated* | *Unit* |
|---|---|---|---|---|
| 2011 | 3037.44 | Ton/Capita/Day | 65092.37 | Litres |
| 2021 | 4437.27 | Ton /Capita/Day | 95090.78 | Litres |
| 2031 | 6480.23 | Ton /Capita/Day | 138871.27 | Litres |
| 2041 | 9455.84 | Ton /Capita/Day | 202638.67 | Litres |
| 2051 | 13801.65 | Ton /Capita/Day | 295769.42 | Litres |

Gives the amount of Degradable waste that is generated out of the total solid wastes of 2021 – 51 and of existing 2011 as well and the Biofuel generated out of the Degradable wastes.

*Note- (Biofuel generated = Degradable waste generated*21.43)(Source – Author)

***Table 6:*** Degradable Wastes and Bio fuel generation.

| *Year* | *Degradable Waste* | *Unit* | *Compost Generated* | *Unit* |
|---|---|---|---|---|
| 2011 | 3037.44 | Ton/Capita/Day | 252107.66 | Tons |
| 2021 | 4437.27 | Ton /Capita/Day | 368293.73 | Tons |
| 2031 | 6480.23 | Ton /Capita/Day | 537858.88 | Tons |
| 2041 | 9455.84 | Ton /Capita/Day | 784834.81 | Tons |
| 2051 | 13801.65 | Ton /Capita/Day | 1145537.17 | Tons |

Gives the amount of Degradable waste that is generated out of the total solid wastes of 2021 – 51 and of existing 2011 as well and the Compost generated out of the Degradable wastes.

*Note- (Compost generated = Degradable waste generated*83)(Source – Author)

***Table 7:*** Degradable Wastes and Compost generation.

| *Year* | *Degradable Waste* | *Unit* | *Fuel pellets Generated* | *Unit* |
|---|---|---|---|---|
| 2011 | 3037441.68 | Kg/Capita/Day | 1139.04 | Tons |
| 2021 | 4437273.87 | Kg/Capita/Day | 1663.98 | Tons |
| 2031 | 6480227.45 | Kg/Capita/Day | 2430.08 | Tons |
| 2041 | 9455841.06 | Kg/Capita/Day | 3545.94 | Tons |
| 2051 | 13801652.64 | Kg/Capita/Day | 5175.62 | Tons |

Gives the amount of Degradable waste that is generated out of the total solid wastes of 2021 – 51 and of existing 2011 as well and the Fuel Pellets generated out of the Degradable wastes.

*Note- (Fuel pellets generated (in Tons) = (Degradable waste generated (in Kg)*0.375)/1000)(Source – Author)

***Table 8:*** Degradable Wastes and Fuel Pellets generation.

As a result of this research, we hope to present a long-term solid waste management strategy, based on the principle that "the higher the economic value, the longer the sustainability." All of the methods that have been mentioned and elaborated on here have had their economic value calculated:

| *Year* | *Cost From Power (Per Year)(In Rupees)* | *Cost From Biofuel (Per Year) (In Rupees)* | *Cost From Compost (Per Year) (In Rupees)* | *Cost From Fuel Pellets (Per Year)(In Rupees)* |
|---|---|---|---|---|
| 2011 | 7825879.15 | 712761508.5 | 460096478.5 | 10393745.75 |
| 2021 | 11432505.62 | 1561866046 | 1344272119 | 21257315.13 |
| 2031 | 16696115.43 | 3041280906 | 2944777359 | 39914150.95 |
| 2041 | 24362696.39 | 5547233701 | 5729294101 | 71184753.52 |
| 2051 | 35559552.1 | 9716025318 | 10453026668 | 122791578.3 |

Gives the revenue which can be generated when non degradable waste is converted into energy in the form of power per year as well as degradable waste is converted into energy in the form of Biofuel, compost and Fuel pellets(expressed in Rupees)(Source – Author)

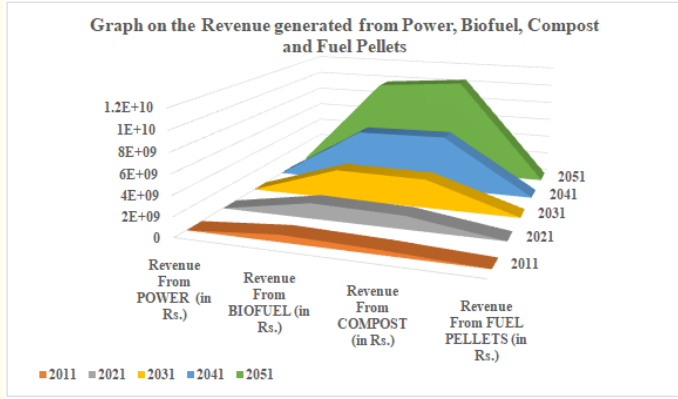
*Note- (Cost generated from Power per year = (Non degradable waste generated*4000)*365)

*Note- (Cost generated from Compost per year = (Degradable waste generated*N)*365), where, N = n, (n+5), (n+10), (n+15), (n+20) respectively. Let n be considered to be 5 for the base year (2011).

*Note- (Cost generated from Biofuel per year = (Degradable waste generated*N)*365), where, N = n, (n+15), (n+30), (n+45) respectively. Let n be considered to be 45 for the first projected decadal population (2021) and N= (n-15) for the base year (2011).

*Note- (Cost generated from Fuel pellets per year = (Degradable waste generated*N)*365), where, N = n, (n+10), (n+20), (n+30) respectively. Let n be considered to be 35 for the first projected decadal population (2021) and N= (n-10) for the base year (2011).

***Table 9:*** Revenue Generation from Waste to Energy conversion.




The above graph gives an idea of the result of converting waste to products which can be very useful sources of energy and the revenue collected from it if we add up the economic value of the recycled products.

***Graph 3:*** Revenue generated from Waste to Energy conversion.

## Conclusion

By generating, using, and wasting natural resources, human lifestyles have put strain on the ecosystem and generated ecological imbalances. Because natural resources are depleted and waste and pollution are produced, most countries have significant environmental impacts as a result of SW creation with economic development. As a result, concern over solid waste management as a critical component of long-term development has grown. The absence of public garbage bins and efficient waste collection methods has had a substantial impact on illegal rubbish dumping. Because the council could not enforce these practises, the lack of practical application of regulations and rules has been recognised as a barrier to homeowners engaging in proper waste management processes including recycling and trash separation. It has been determined that there is a dearth of knowledge, awareness, and cooperation. Improper waste management procedures clearly have a negative influence on the natural environment and long-term development in the studied area. As a result, public knowledge of the influence of SWM on sound environmental development or/and sustainable development appears to be minimal. As a result, it is critical that the SWM be designed from the ground up. The most common methods of waste management are waste storage and primary disposal. As a result, it has created considerable difficulties in the research field. As a result, in the research region, waste separation at the household level, better storage, more effective trash collection systems, and sustainable recovery and disposal procedures have been identified as necessary activities. Trash reduction, reuse, recycling, and composting techniques would be more appropriate in handling the challenge given the kind and components of waste generated by families and businesses. These management approaches should be incorporated into a long-term strategy. Monitoring processes should be given due consideration. Incorporating public education and well-planned waste management programmes into the current waste management system is also necessary. In order to raise information about the necessity of SWM for sound environmental development in the area, awareness programmes must be implemented. Nonetheless, more scientific research into the SWM process and its influence on the environment and sustainable development is required.

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