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RESEARCH ARTICLE

SOLID WASTE AUDITING AND MANAGEMENT PLAN AND POLICY IN JHARGRAM MUNICIPALITY, WEST BENGAL, INDIA

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Abstract

Waste (or waste) is useless or unusable materials or components that are discarded after principal use. Sometimes, it is a defective article and of no use. In the modern outlook, waste may be a valuable substance subject to an appropriate operation or action on the waste. In the context of waste management RRR (reduce, reuse and recycle) model may be followed appropriately.Pollution from waste is aesthetically unpleasing and results in large amounts of litter in our communities which can cause health problems. Plastic bags and discarded ropes and strings can be very dangerous to birds and other animals. This indicator addresses waste production and disposal, plastic waste, paper waste, food waste, and recycling. Solid waste can be divided into two categories: general waste and hazardous waste.Jhargram Municipality is one of the fastest developing Municipalities in West Bengalwith a population of 61,682 anda population density of 2882.33 /sq km in 2011 but at the present near about 92000. This Municipality has around 19775 houses, markets, apartments and offices, colleges, hospitals, and schools which generate 79 Metric Ton of solid waste per day. The study has been carried out to select solid waste disposal sites and to find out the suitable management strategies forthe solid waste system by using Geographical Information System techniques. Manually field observation and expert opinion have been taken for disposal site selection thematic layers are prepared using Remote Sensing and GIS technique. Finally, theGeographicalInformation System technique was applied in Arc GIS Software to identify the disposal sites. The leading problem is the open dumping of solid waste without recycling, which resulted in environmental pollution for thisjhargram Municipality. The auditor diagnoses the prevailing waste disposal policies and suggests the best way to combat the problems. It is therefore essential that any environmentally responsible institution and authority examine its waste processing practices. Keeping the objective of the audit the following study will be limited to the waste generated on the residence campus and surroundings.The study has been decided with some productive

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management strategies which may be helpful to the local people as well as municipal authority.

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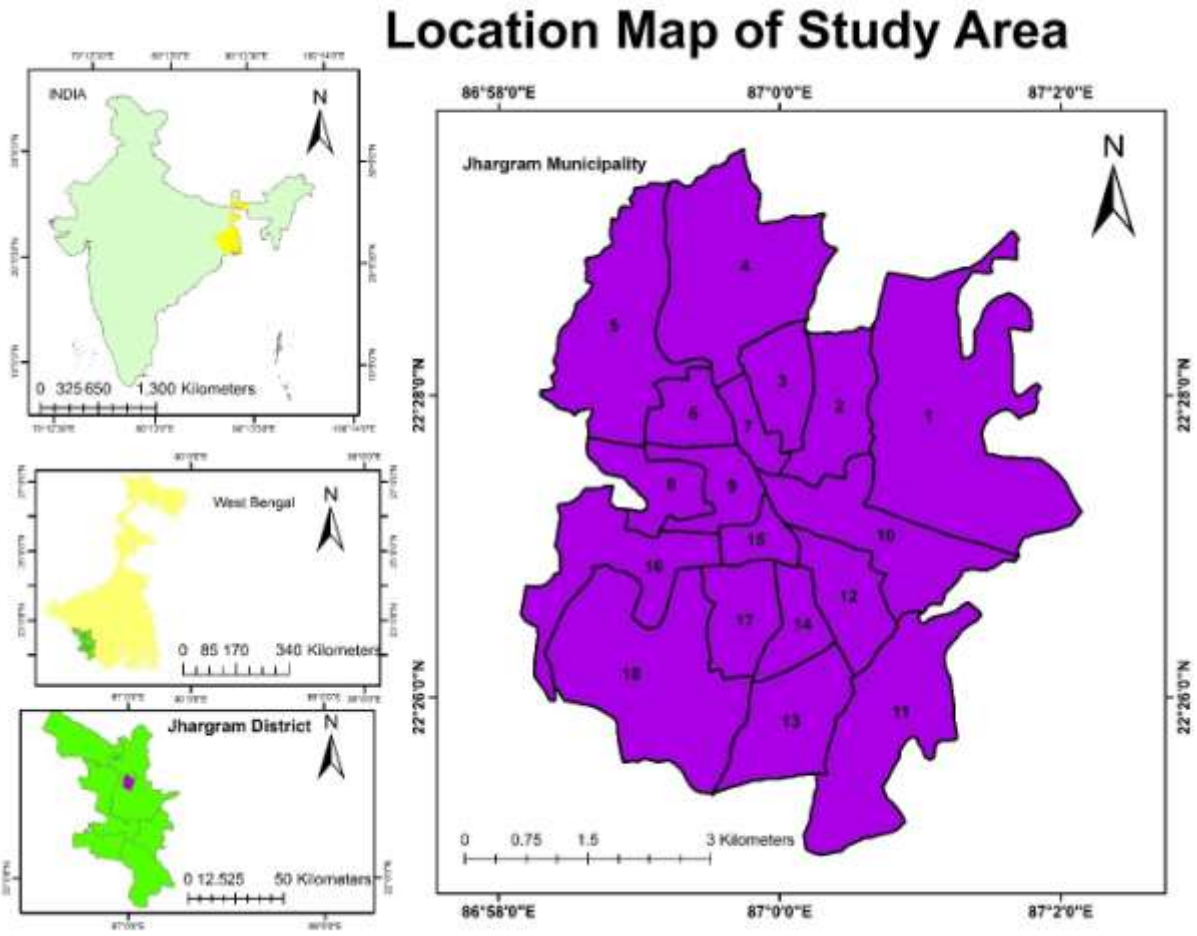
1.1 Introduction:-

In recent years, the urban environment has become a main subject of concern. The main environmental problems challenged by urban areas are air, water, and soil pollution and the risingcapacity of solid waste. Municipal solid waste management is one of the main problems faced by city planners across the earth. The problem is more severe in developing nations than in developed countries, as their economic growth as well as development are faster. Increased urbanization, deprived planning, and lack of suitableresources worsen the problem of municipal solid waste management in most emergingcountries (Davis and Cornwell, 1998; Obirih et al., 2002). The volume of garbage is increasing in Indian cities (Ghosh, C., & Pal, S. C. (2018). In India, rapid population growth and economic development cause a significant rise in MSW generation during the last few years (Kumar et al., 2009). Among the basic essential services, Solid waste management service is provided by local government to keep cities clean and hygienic. Municipal solid waste management (MSWM) is oneof the major environmental problems of JhargramMunicipality. To propose any suitable measures for the improvements of the city's solid waste management situation and reduce the potential problems of the city, it is very important to make a situational analysis of the current conditions. The condition of the disposal site of this municipality is not maintained scientifically and properly. Though the Municipality was established in 1982, the solid waste recycling processes have not started to date. Without segregation, solid waste is dumped on the dumping ground. Environmental degradation and pollution take place around the waste disposal site because there is no arrangement of a scientific waste disposal site in this Municipality. New communication tools and technology options such as waste-to-energy (or energy from waste) offerpossible strategies to advance. Ultimately, waste Fig. 1: Location Mapmanagement grants an opportunity, not only to avoid the detrimental impacts associated with waste but also to recuperate resources, realize environmental, economic, and social benefits, and take a step on the road to a sustainable future (Guerrero et al., 2013).Remote sensing and GIS techniques are useful for suitability analysis, site selection problems, etc. It has been successfully used to identify proper landfill sites in Mafraq city (Ansari et al., 2012), Khulna City Corporation (Rahaman et al. 2008)Davis, M. L., & Cornwell, D. A. (1998, Nabadwip Municipality (Paul, 2012), Lucknow City, Uttar Pradesh (Kumar et al., 2014). Themain objective of this present research work is to find out suitable solid waste disposal sites in the Jhargram Municipality area. Another objective is to propose a recommendation for the development of a sustainable solid waste management system for this Municipality.



Map1:-

1.2 Study Area:

Jhargram Municipality is located between $86^0$59′42″E in the west to $87^0$1′15″E in the east and 22^o25′06″ N in the South to 22^0 28′ 55″N in the north. It is set up in 1982 and comprises 18wards which distance from the capital of Kolkata is around 170 km and passes the South Eastern Railways that the Kharagpur – Tata segment in the town. Jhargram town is situated on the Howrah-Mumbai railroad line and 160Km away from Kolkata and just 20 km away from the line of Jharkhand State and 15Km away from N.H.- 6, known as AH – 46. Jhargram town achieved its municipal status in 1982 adopting 25 mouzas of jhargramPanchyetsamity. There are 18(eighteen) wards of the municipality with one councilor in each ward. This Municipality is situated in the central part of the jhargram District. Jhargram Municipality was established in the year 1982(Sahoo, P., &Mahata, S. (2021).At that time municipality covered a 21.40sq km area and the population was 61682 only. Data regarding solid waste was collected from the municipal office, and residents and Municipal Solid Waste handling workerswere also interviewed. The questions asked during the interviews were focused on the satisfactionlevel of the residents with the municipal solid waste management practice. The continuous field visits helped to monitor the present management methods adopted by the Jhargram Municipality.(Jhargram Municipality n.d.) The waste bins provided for the secondary collection throughout the study area were inspected. The interviews with the concerned officers were made to assess theirstrengths and faintness in the management of solidwaste.Secondary data and its information have beenobtained from a variety of sources, which are given in Table 1.The analyses have been started after the collection of the required datasets. Now the Jhargram Municipality consists of 18 wards, out of the 18 wards the largest and smallest ward according to the area is 1 no ward and 7no ward. There are 39 Slums and a population of slum 21395, in 5.65 sq km in the jhargram municipality. Mahata, S. (2021c).

Table 1:-

The general profile of the Jhargram Municipality	
Total Municipal Area	21.40 Sq. Km.
Population (As per census 2011)	61,682 (about 92,000 at present)
Male	30,945(46,156 persons)
30,945	30,737((45844 persons)
Density of Population	2882.33 per Sq.Km.(at present -4299) persons
Number of Slum	39
Slum Population	21,395(at present -31,906) persons
Area of Slum as per RAY slum survey	5.65 Sq.Km.
No. of Ward	18
Number of Councilors	18
Metalled Road	72 Km.
Day Population	About 22000 – 25000 Persons / Day
Metalled P.W.D Road	9 Km.
Unmetalled Road	150 Km.
Drainage System	
>Pucca	18.6 Km.
>Katcha	275 Km.
Daily Water Supply	1,22,277 Lac Gallon/Day
Overhead Reservoir	02
Deep Tube Well	21
Park	09
Guest House	01
Schools, Colleges & Technical Institutions	
Primary School	23
G.S.F. Primary	02
SSK (ShishuSiksha Kendra)	10
N.C.L.P. Jhargram	01
Junior High School	03
High School	08
Colleges	02 (Gen.),04(Training college)
Technical Institute	01
Others	
MusafirKhana (Night Shelter)	01
Super Market	02
Pay & Use Toilet	07
Bus Stand	01
Burning Ghat (Wooden Chulli)	05 Electric Chulli 1
Burial Ground	03
Market& Market complex	11
Festival Ground and area	05
Maternity Home (PVT)	06
No. of Holdings	19775
Health Post	05
Sub Health Post	27

Number of Slum	39
Slum Population	21,395(at present -31,906
Area of Slum as per RAY slum survey	5.65 Sq.Km.

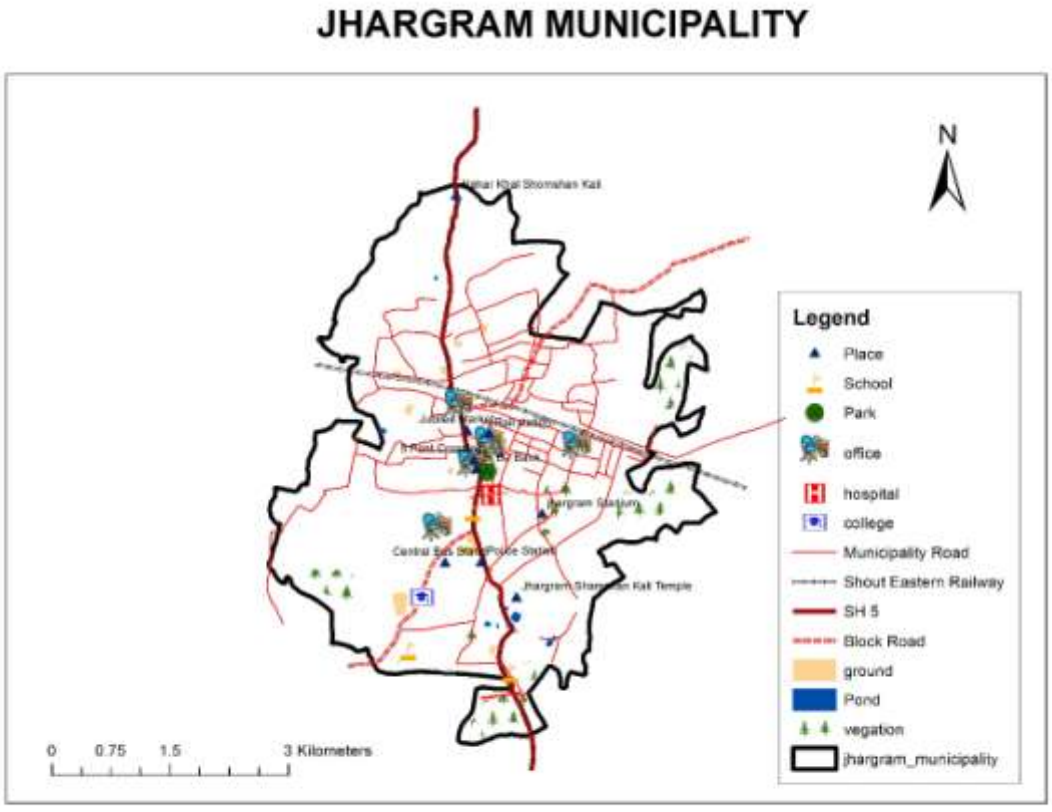
Source: Jhargram Municipality and Field Survey

2. Database and Methodology:-

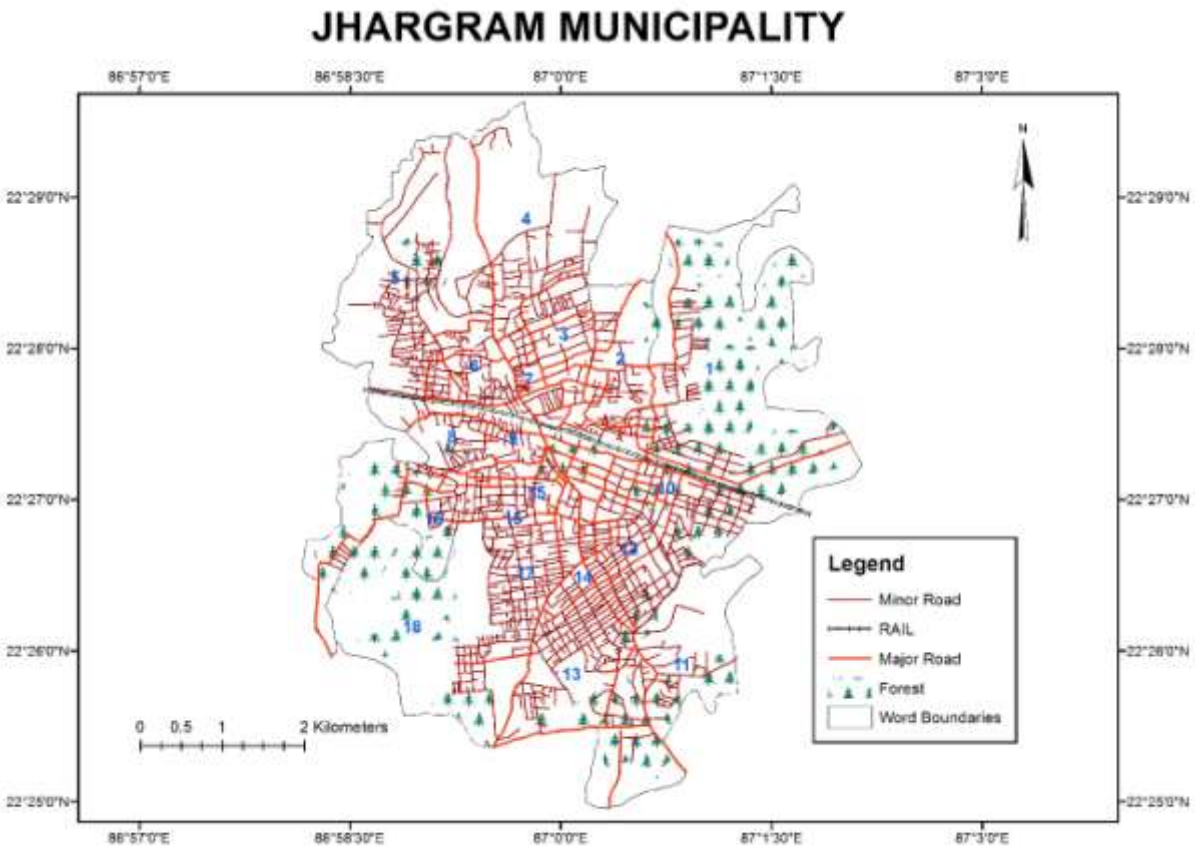
A visit was paid to the open dumping site which is situated outside the municipality area beside 2022 in the raster calculator extension of ArcGIS 10.3.1 Software and using GIS Methodologythis technique reduces the chance of biases in decision making by checking the consistency of the given priorities. It is a very simple and flexible tool because it is guided to identify the sites for solid waste disposal.

Table 2:-

Secondary data	Source
Demographic details from Primary Census Abstracts 2011.	Directorate of census operations, Census of India
All Secondary data related to Solid Waste Management	Jhargram Municipality
Ward maps and Administrative Boundary	Jhargram Municipality
Secondary Data	Google Earth
Primary Deta (Databas from)	Field Survey (Household, hospital, market, office, apartment, and small industry.



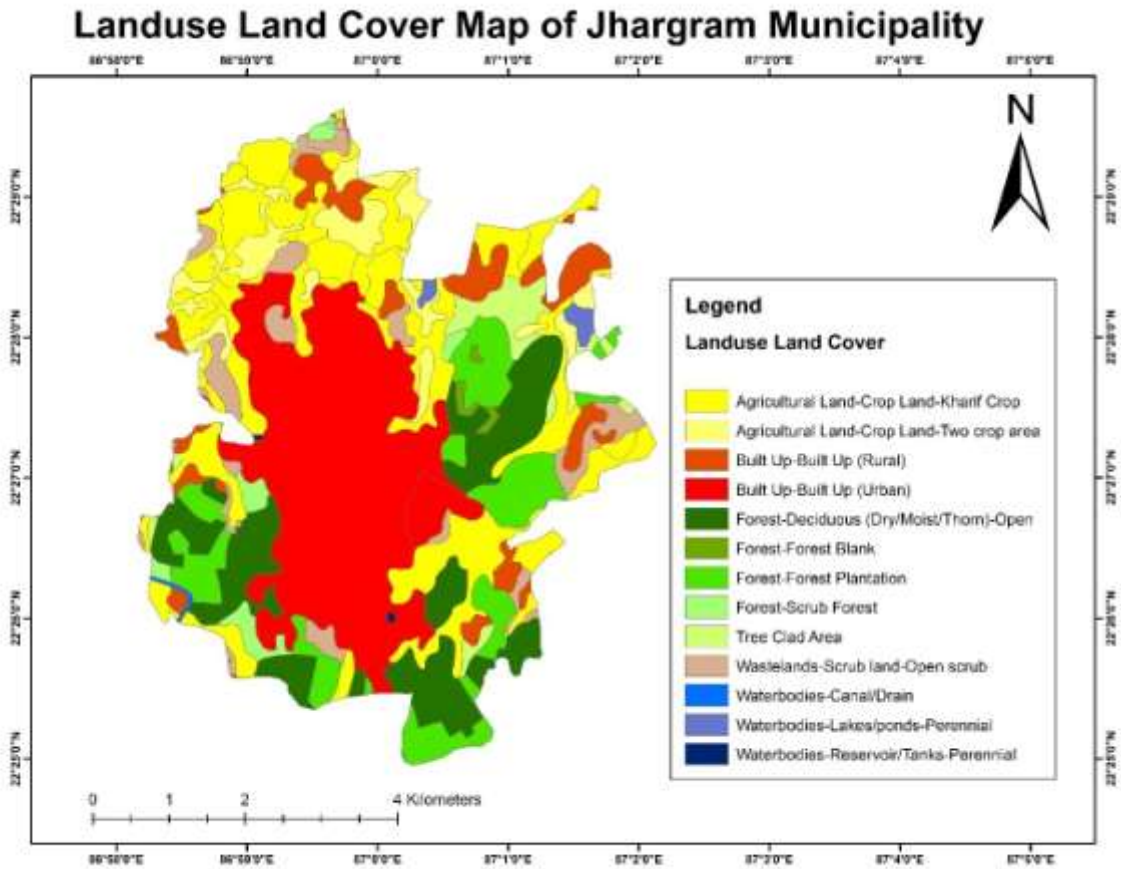
Map2:-



Map 3:-

Organic Waste produced vegetables at Market

Biodegradable Waste producesfruitat Market



Map 4:-

3. Waste Auditing and Assessment:

3.1 Generated Waste

The waste produced from the town includes household waste, commercial waste, and bio-medical Waste and industrial waste. Total solid waste produced in Jhargram Municipality is 79 M.T. Per day (primary data)

3.1.1 Types of Waste to be segregated in the following points:

1. Plastic packets/bags (eg big Bazar plastic packet)
2. Thermacol
3. Laminated pouches (egbhujia packets)
4. Pet bottles (juice,bisleri)
5. Plastic household items and others (chairs,buckets,etc)
6. Another plastic products (pen,box,carton,electric products etc)
7. Glass bottles cutleries (plates,showpieces,etc)
8. Beer/Liquor bottles
9. Electronic waste (Printer,mobile,CPU,battery,etc)
10. Biomedical waste (syringe,hospital waste)
11. Paper waste (sheets,boards,cartons)
12. Aluminum waste (foil,tin, metals)
13. Metal waste (steel,rods,iron products)
14. Wood waste (furniture,small items)
15. Other rubbish products (organic,food)
16. Other liquid products
17. Textile (Cotton/Leather/Wool)
18. Rubber(Tyres/Shoes)

3.1.2 Reusable waste

1. Plastic packets/bags (eg big Bazar plastic packet)
2. Thermacol
3. Laminated pouches (egbhujia packets)
4. Pet bottles (juice ,bisleri)
5. Plastic household items and others (chairs,buckets,etc)
6. Another plastic products (pen,box,carton,electric products etc)
7. Paper waste (sheets,boards,cartons)
8. Aluminium waste (foil,tin,metals)
9. Metal waste (steel,rods,iron products)
10. Textile (Cotton/Leather/Wool)
11. Rubber(Tyres/Shoes)

3.1.3 Hazardous

1. Electronic waste (Printer,mobile,CPU,etc,battery)
2. Biomedical waste (syringe,hospital waste)
3. Other liquid products

3.1.4 Resell able products

1. Glass bottles cutleries (plates,showpieces,etc)
2. Beer/Liquor bottles

3.1.5 Biodegradable

1. Wood waste (furniture, small items)
2. Other rubbish products (organic, food)

3.1.6 Modus operandi

Sources of Waste collection

1. Municipal landfill- 12 labour,2 supervisors

2. Daily rag pickers- 18 and 2 supervisors
3. Scrap/Kabadi dealers – 2 persons
4. Industries
5. Hotels/Restaurants and Commercial places – 2 persons
6. Societies
7. Roadsides

Table 3:-

List of SLUMS (Ward Wise) of I.H.S.D.P. Scheme			
Sl. No.	**Ward No.**	**Slum No.**	**Name of SLUM**
1	6 & 7	5	Ambagan Para
2	6	6	Tanti-Das & Rana Para
3	6	39	Satbhya&Bijay Para
1	4 & 3	7	SaktinagarUpar&Ruidas Para
2	5 & 4	9	Namojamda&Taldanga Para
3	4 & 3	10	SaktinagarNichu Para
1	6 & 7	5	Ambagan Para
1	4 & 3	7	SaktinagarUpar&Ruidas Para
2	3	8	Adibasi Para
3	4 & 3	10	SaktinagarNichu Para
1	7,2 & 1	11	Majhi-Pandit& Dom Para
2	2	12	Leprocy colony &Sankhari Para
1	1	13	Adibasi Para
2	1	14	ShrischakLodha Para
1	10	15	Shitaladihi Para
2	10	16	Bibekanandapally
1	12 & 14	17	Nripen&Laxmipally
2	12	18	Adarshapally
1	12 & 14	17	Nripen&Laxmipally
2	14 & 18	37	Model Para
1	11	19	Patar Para
2	11	20	Battala&Dakhin Para
3	11	21	Dom Para &Kristan Para
1	13	22	Satyabanpally
2	13	23	Anandapally
3	13	24	Uria-Maji&Babu Para
1	18	25	Raj College Coloney
2	17	26	NunnungeriaDoba Para
3	18	27	Vidyasagar Pally
4	14&18	37	Model Para
1	15	28	SubhaspallyPurba Para
2	15	29	RaghunathpurBastee

1		16	30	Bharatpur&Benagarh Para
2		16	31	Saradapally
3		16	32	Benageria-Subhaspally Paschim Para
4		16	38	Srirampur &Bharatpur Para
1		9	33	Keshabdihi Para
2		9	34	Natun Pally-Chandipur Para
1		8	35	Rajib Colony
2	8	36	Natundihi Baste	

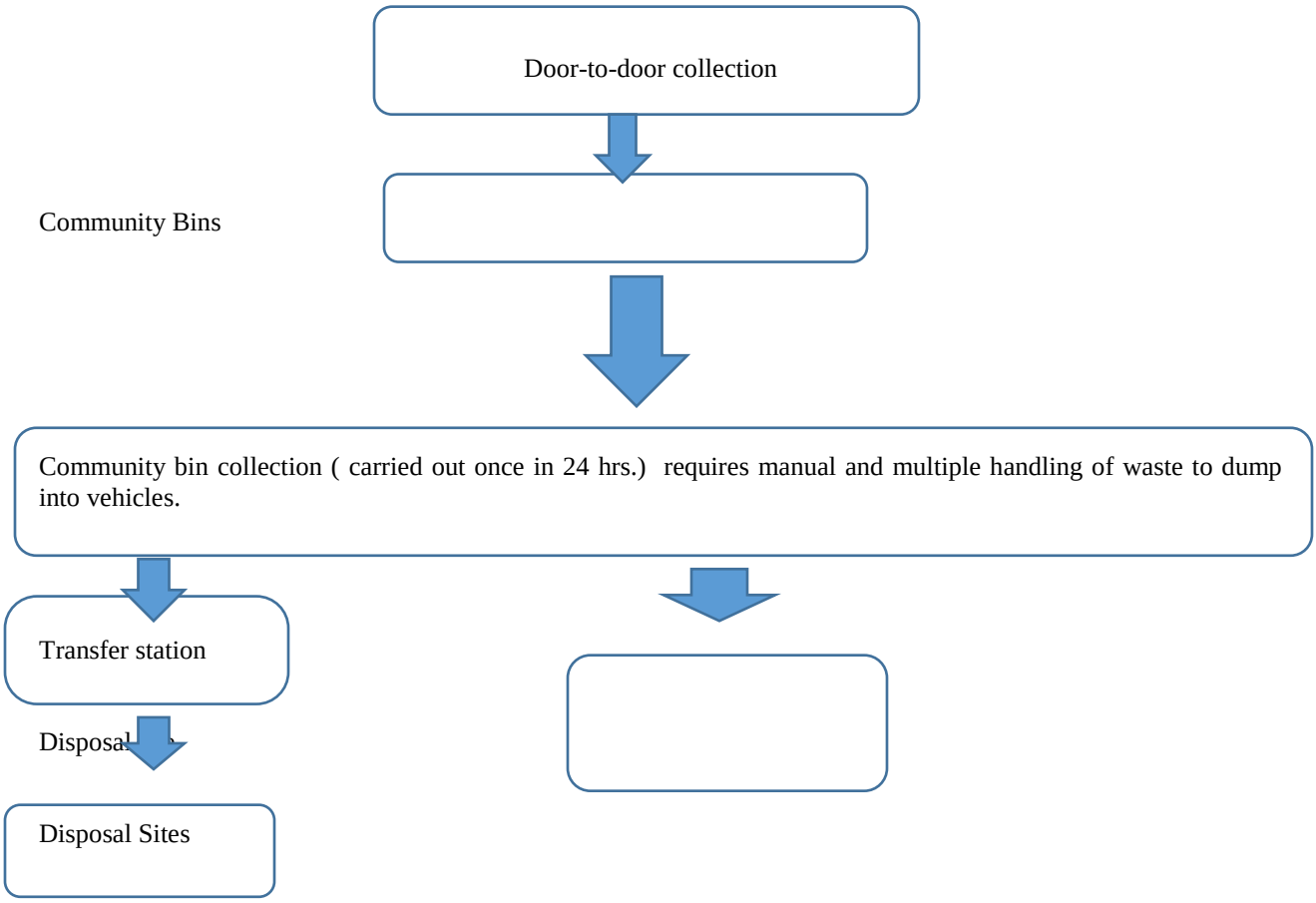
Source: Jhargram Municipality

List of SLUMS (Ward Wise) of I.H.S.D.P. Scheme (PH.-I)			
Sl. No.	Ward No.	Slum No.	Name of SLUM
1	5	1	BhalukkhuliaLodha Para
2	5	2	ChandabilaLoadha Para
3	5	3	BalaramdihiJharna Para
4	5	4	Uttar Bamda Para
5	5 & 4	9	Namojamda&Taldanga Para

3.2 Solid Waste Management

The slum residents usually throw out ménage's exterminations outside the doors and on the road. This system is creating vexation and nuisance among the slum residents and others who are using the road. Ourproposed scheme will induce public sense and general mindfulness, and therefore will ameliorate general environmental conditions in the slum area. No methodical solid waste process has yet been introduced in the slums. The scrap is extensively thrown out at the doorway in an utmost erratic manner due to the availability of scrap lockers or vats at colorful points as well as due to a lack of mindfulness. The slums are distributed in all the wards of the municipality. The demographic profile of the slums is given in the table below:

Waste Management at Jhargram Hospital



Flow chart illustration collection of solid waste

Table 4:- Type of Waste per day/ Ton:

Type of Waste Per day	Amount in Ton
Biodegradable	65
Non-Biodegradable	14

Table 5:-

Different Biodegradable Waste of the Jhargram Municipality Area	Waste in Ton/Day
Organic Waste	58
Paper Waste	02
Cotton, Clothes, Sanitary Napkin Waste	03
Others Waste	02

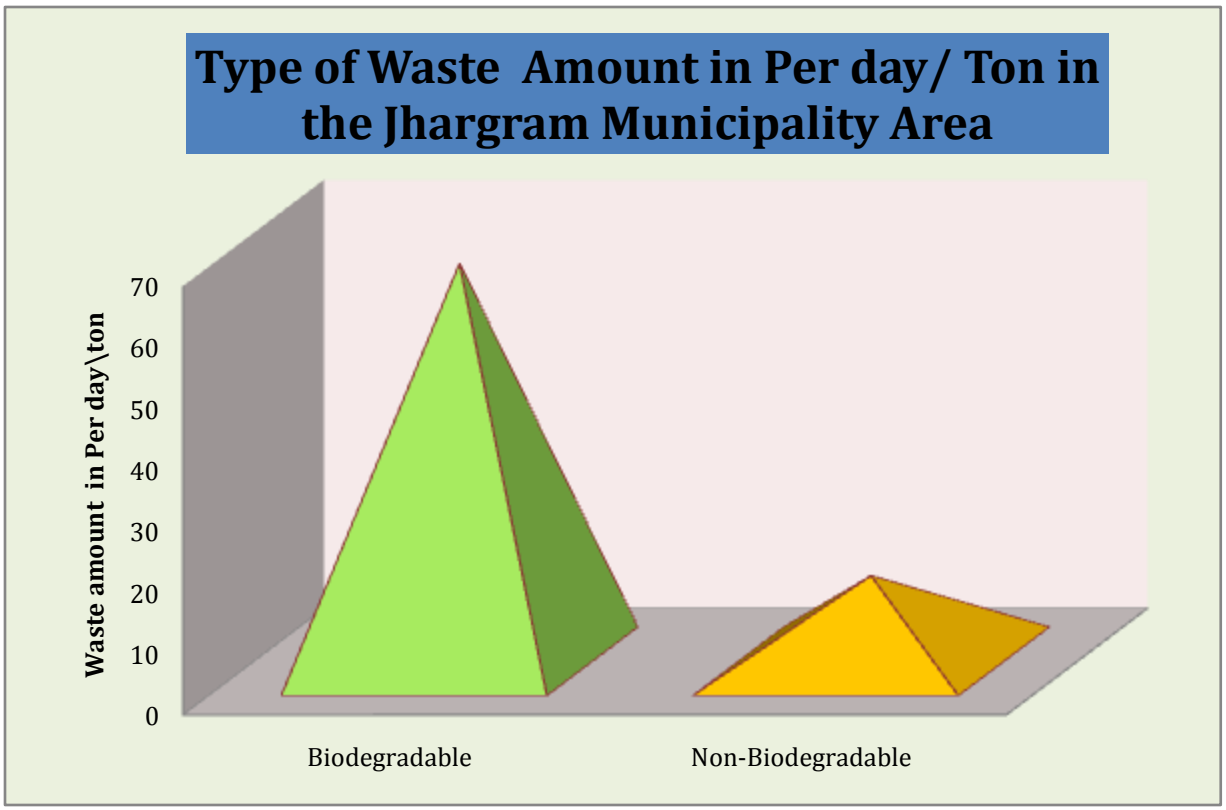


Fig1:- Types of Waste.

Table 6:- Biodegradable Waste of the Jhargram Municipality Area.

Different Biodegradable Waste of the Jhargram Municipality Area	Waste in Percentage
Organic Waste	89.23
Paper Waste	3.08
Cotton, Clothes, Sanitary Napkin Waste	4.61
Others Waste	3.08

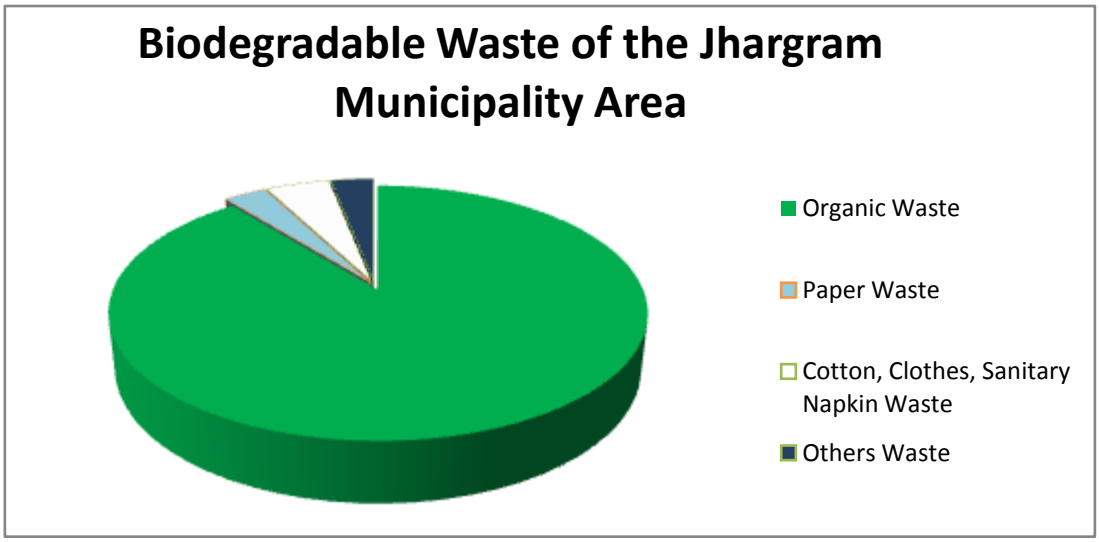


Fig 2:-

Table 7:- Non-Biodegradable Waste of the Jhargram Municipality Area.

Different Non-Biodegradable Waste of the Jhargram Municipality Area	Waste in Percentage
Bottle and Glasses Waste	21.43
Housing Fragments Waste	35.72
Plastic, Thermocol, and Polythene Waste	7.14
Metallic Scrap Waste	21.43
E-Waste	7.14
Others Waste	7.14

Table 8:-

Different Non-Biodegradable Waste of the Jhargram Municipality Area	Waste in Ton/Day
Bottle and Glasses Waste	03
Housing Fragments Waste	05
Plastic, Thermocol, and Polythene Waste	01
Metallic Scrap Waste	03
E-Waste	01
Others Waste	01

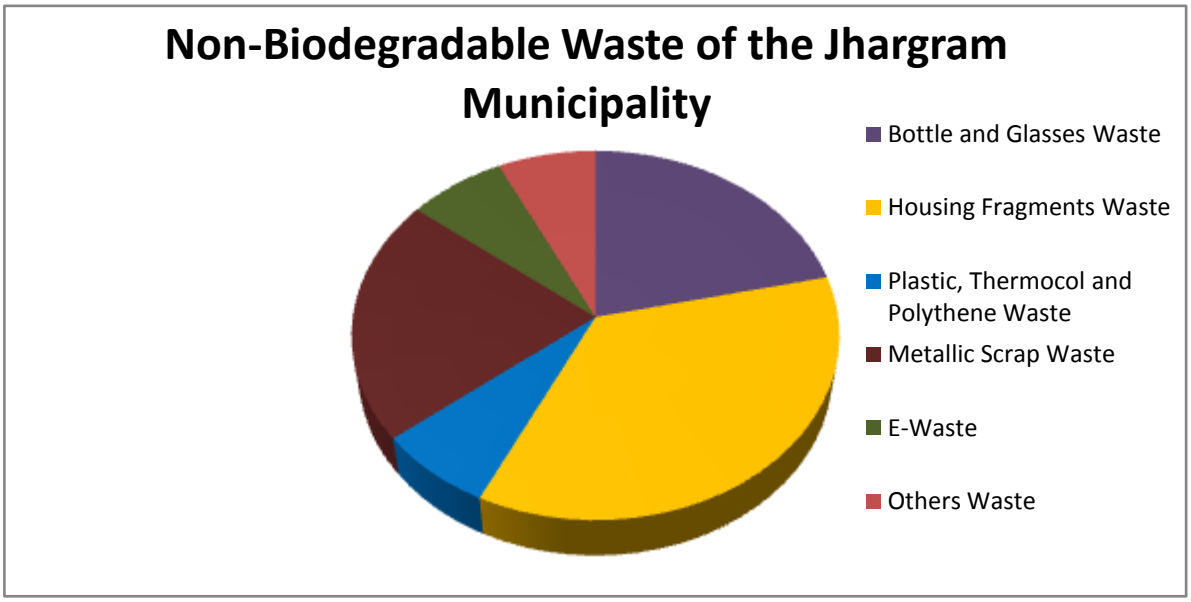


Fig 3:-

3.3 Solid waste

It was observed that:

a) Wet waste and dry waste segregation are not practiced in the area. No separate bins are provided for wet biodegradable and dry recyclable waste.

b) Combined waste is directly handed over to the open dumping station.

c) Hospital and market complexes and residences are the main areas where biodegradable and non-biodegradable waste is generated.

d) In the back of the nursing homes, quarters, and girls' hostels, sanitary napkins are mostly observed scattered here and there.

e) In other areas like colleges, offices, schools, and small industries there are mostly paper waste and plastic wrappersproducers places.

3.3.1 Plastic Waste:
A plastic three-dimensional package of practices is suggested. First of all, awareness of plastic material (and its life cycle), its uses, and disposal will be there regularly among beneficiaries. In the second stage, the practice of keeping plastic wrapping, packaging, and other plastic-made things in asuitable bin should be there. A mechanism will be there for regular collection by dedicated manpower. In the end, the plastics will be recycled by grinding/ chopping instruments and the final material is to be dispatched to the market and Disposal side. The institution has established the suggestion of the use of such a groundbreaking recycling machine and suggested designing the machine.

3.3.2 Paper Waste Management:
In**a**ll offices and academic institutions, waste paper is the main solid waste generated on the premises. The institution has taken steps to minimize and avoid paper usage. Faculty and administration staff use old papers and envelopes for internal usage as rough work, file markers, page separators, etc. Paper notices are displayed on the notice boards.The dissertation reports, journals, and answer papers are stored as per the College rules after that the waste paper is supplied to the nearest paper mill. After one month, all paper scrapswere collected by Feriwala and the industrial man of the paper millfor disposal and reuse.

3.3.3 E-Waste Management:
Maximum storage of E- Wastes is in Schools, Colleges, Offices, Health departments also Residential and Market complexes. There is no standard policy for the collection or segregation of e-waste.

3.3.4 Waste prevention
Since waste strainsthe cost of recycling, it is better to design such a product that takes less recycling cost. So, at the design phase, the proper need assessment is to be undertaken to reduce the target cost for disposal.
Major audit issues in the management of waste:
The following are being highlighted during the audit of waste management:
a) Name of the waste
b) Category of waste
c) Quantity of waste
d) Hazardous effect of the waste
e) Institutional action and mechanism for waste management

3.3.5 Compliance audit of waste issues:
At the present stage, the institute is capable of managing its waste. They are observing the essential requirements of waste management although suggestions are given for future improvements.

3.3.6 Disposal of Municipal solid waste
One of the foremost essential steps in a solid waste management system is to dispose of the waste materials properly. Uncontrolled selling is discovered throughout the full municipality which could be a significant issue. Construction of a perpetual selling yard within the town is one of all the long unfinished comes. The condition of the disposal website of this municipality isn't maintained scientifically and properly.

While not segregated, solid waste is dropped on the selling ground. Environmental degradation and pollution manifest themselvesaround the lowland as a result of there's no arrangement of a scientific lowland site in this Municipality. There’s presently no treatment plant for solid waste utilization. The selling website of this municipality is placed on the far side of the municipality boundary. As the selling space is little, gift website is unable to sustain the large waste, different selling sites must be searched out for effective functioning.

Waste produces by day population at 5 point crossing

4.1Assessment

This method consists of discoveringsuitable sitesthat may present auspicious conditions for solid waste disposal. The various datasets were evaluated based on environmental and social criteria. Based on the available data, the site suitability map and suitable sites are presented. The result indicates maximum parts of the study area have very low suitability for the disposal site. Only two areas in this municipality have been proposed fordisposal sites, one is situated in ward no. 16 and another in ward no. 8. The result is compatible with our field observations. Two sites are suggested for disposal sites because these regions were strongmindedto be high suitability regions by the GIStechniques (Map 5). When the disposal sites are determined, the location of settlements.

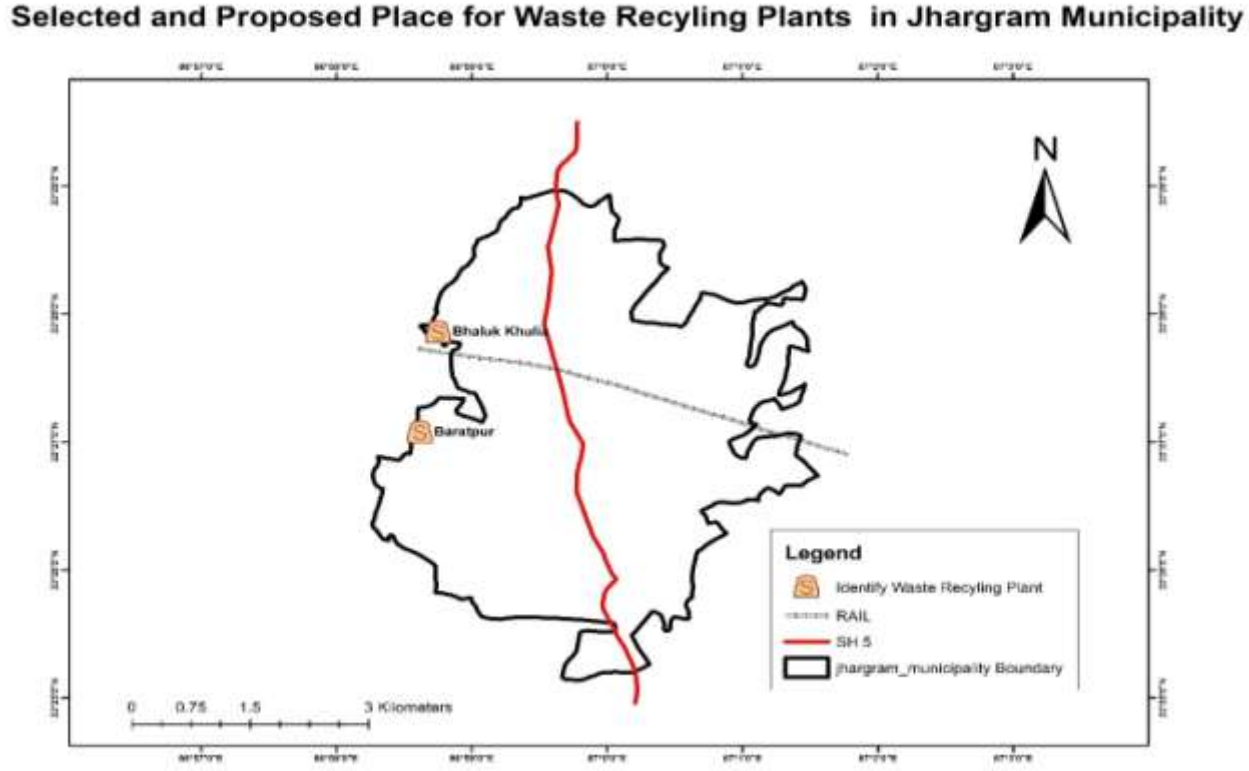


Fig 5:-

4.2 ProposedManagement Strategies and Policies:

Sustainable managementincludes scientific, hygienic, measured, and proper management of solid wastewhich decreasesenvironmental degradation and health risk. The following recommendations aresuggested to minimize the disadvantages of solid waste management inJhargram Municipality.Some recommendations are as follows regarding the collection of solid waste:

1. Number of the public bin should be improvedand properly placed.
2. Economically backward people may be engagedin this work.
3. The workers should be trained and well prepared.
4. Care should be taken during carrying.
5. Vehicles should be well covered.
6. Municipal authority essentials to provide red and green buckets to every household for no degradableand degradable waste correspondingly.
7. Municipal authorities should apprentice expertsin every ward for good monitoring of solid waste.management.
8. Solid waste disposal side should be established at BhalukKhulia and Bharatpur which distance from the municipality office is about 3km.
9. The plastic and polymer innovative small industry can be established inNaharkhal's surrounding area for proper disposal and reuse of plastic and polythene waste.
10. More Crasher machines should be placed at different offices, schools, colleges, market complexes, and residential apartments.

Implemented traditional Waste Management system

Waste Collection by open Truck

4.3 Proposals fora better system of waste management:

1. 211 vat trolleys can be used daily and properly by the well-trained employee.
2. Truck and vat trolleys both should be covered to reduce environmental pollution.
3. Dispersed vat trolleys should be properlyused fornon-biodegradablewastes.
4. Green footpaths can be introduced in several market complex areas.
5. Organic fertilizer and vermin compost units can be established around the Ru-urban area on the North-eastern side of the Municipality
6. The number of compactors should be improved.

Waste collected by Covered trallly

5. Conclusion:-

By doing this, therefore, the Jhargram Municipality stands to achieve on many alternative fronts. Foremost, public involvement in deciding might facilitate the Jhargram Municipality to bring the problem at hand to the folks. At the current state of affairs, in Jhargram Municipality, the construction of lowland is of prime importance, which is additional healthful than open marketing ground. This could be equipped, well managed, and lined properly with materials like plastics as a protection against contamination of soil, surface water also, and groundwater. The essential principles of lifeare to deposit the rubbish, compact it with a dozer and canopy the materials with a minimum of half a dozen inches of dirt. There should be a provision to faucet greenhouse gas, alkane series gas, and different greenhouse gases (GHGs) from the lowland site throughout the anaerobic decomposition of waste. Before casting off waste materials to a lowland, the degree of waste may be reduced through thermal treatment. The excessive quantity of warmth made throughout this treatment may be used as non-conventional energy. Oneof the vital strategies for managing and treating organic waste (plant materials, food scraps, etc.) is composting. For the aim, compost plants with windrows (8-10ft wide, 4-6ft high) necessary, wherever beneath controlled conditions of temperature (140°F), wetness, and O2, the organic materials reborn into compost which will be used as biofertilizer in encompassing agricultural field of the rice bowl of West Bengal. Regular ward-level conferences ought to be organized to stay the folks concerned and upon. Baseline knowledge on the standing of waste generated, collected, properly disposed of, recycled, composted, and thrown within the street, etc - ought to be generated. For this, the native body's associate degreed establishments will play a considerable and active role. Analysis and development ought to be promoted and inspired.

The present work was preoccupied to review the issues of solid waste management and open selling of MSW at Jhargram Municipality. The study additionally suggests a property answer for the solid waste issues. The result showed that this solid waste management is unsustainable at the end of the day supported by some key factors like waste generation, waste disposal practices, waste assortment and transportation, the ever-changing nature of waste, etc. The projected system is an associate degree improvement on the present system and has abundant strength; however, it doesn't address the total issue. 2 disposal sites are known during this study as property lowland sites. The method of solid waste management has been initiated by the local government and has additionally taken some new concepts to boost. Following the socio-cultural and geo-political setting of the world, in conjunction with the understanding of the strengths, weaknesses, and issues related to the current waste management system and practices, recommendations were created that supported this standing. These recommendations have the potential to form the solid waste management system in Jhargram Municipality's additional property in the future

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