International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Smart Solid Waste Management in Jalandhar City, Punjab

Sahil Singla[1], Dr. Bhupinder Pal Singh Dhot[2], Ar. Priyanka Malhotra[3]

[1]Research Scholar, GZS School of Architecture and Planning, MRSPTU, Bathinda, Punjab.
[2]Professor, GZS School of Architecture and Planning, MRSPTU, Bathinda, Punjab.
[3]Assistant Professor, GZS School of Architecture and Planning, MRSPTU, Bathinda, Punjab.

Abstract

Solid waste management (SWM) represents a critical challenge for rapidly growing urban centres in India, including Jalandhar. This study examines the existing waste management system in the city through field surveys, secondary data analysis, and institutional assessment based on a detailed municipal and infrastructural study. It examines waste generation trends, composition, collection and disposal systems, existing infrastructure gaps, and recommendations evaluated with reference to the Solid Waste Management Rules (2016). Through primary field surveys, stakeholder consultations, and analysis against the benchmarks of the Solid Waste Management (SWM) Rules 2016, the paper documents critical infrastructure deficits: a shortage of 760 sweepers against the normative requirement, only 20 tippers against a need for 42, non-functional composting facilities, and a Wariana dump that violates multiple siting standards while approaching saturation. The study also draws on case comparisons from Chandigarh and Ludhiana to benchmark performance. Based on waste composition analysis — 58% organic, 18% recyclable and 24% inert — the paper proposes a decentralized composting model capable of treating 220 tonnes of organic waste daily across existing secondary collection points, with an estimated daily revenue potential of ₹9,00,000 after a payback period of 2–3 years. The paper concludes with a phased, implementable solid waste management plan grounded in integrated solid waste management (ISWM) principles, 4R strategy (Reduce, Reuse, Recycle, Recover), and public–private partnership (PPP) frameworks in compliance with SWM 2016 norms.

Keywords: Solid Waste Management, Jalandhar, Waste Segregation, SWM Rules 2016, Urban Sanitation, Decentralized Composting, Landfill, Punjab, Urban Governance, Waste-to-Resource

1. Introduction

Solid waste consists of materials generated from human activities that are no longer considered useful and require disposal or processing. Rapid urbanization and changing consumption patterns have significantly increased the quantity of municipal solid waste (MSW) generated in Indian cities. In India, improper SWM not only impacts environmental health but also contributes to 22 identified human diseases and accelerates climate change. Jalandhar, the second-largest city in Punjab and a key industrial and medical hub of northern India, exemplifies the systemic challenges confronting medium-sized Indian cities. With a population of 8,62,886 (Census 2011), the Municipal Corporation of Jalandhar (MCJ) manages a city that generates approximately 500 metric tons of solid waste per day, yet suffers

from significant infrastructure gaps, non-functional processing facilities, and a critically saturated landfill at Wariana village.

Municipal solid waste management has emerged as a defining challenge of contemporary urban governance, particularly in rapidly urbanizing economies such as India. The expansion of urban populations, coupled with changing consumption patterns, has resulted in not only an increase in waste quantity but also a diversification in waste composition.

Traditional approaches to MSWM in Indian cities have largely been **linear and disposal-oriented**, focusing on collection and dumping rather than recovery and reuse. This linear model is increasingly unsustainable due to:

- Land scarcity for landfills
- Rising environmental externalities
- Increasing operational costs

In contrast, modern planning paradigms advocate for **Integrated Solid Waste Management (ISWM)**, which emphasizes:

- Waste minimization
- Resource recovery
- Environmental sustainability

This study situates Jalandhar within this broader transition and examines whether its current system aligns with contemporary sustainability principles.

2. Review Of Literature

The literature on municipal solid waste management in developing countries consistently highlights three interrelated challenges: rapid waste generation outpacing infrastructure growth, low collection efficiency, and the near-universal reliance on unscientific open dumping. Asnani and Zurbrugg (2008) documented that Indian cities spend between 20–50% of their municipal budgets on SWM, yet achieve collection efficiencies of only 50–70%. This paradox of high expenditure with low service delivery is a recurring theme across the literature.

Chandrappa and Brown (2012) argued that the shift from a linear "collect-and-dump" model to an integrated solid waste management (ISWM) approach is the defining imperative for cities in the Global South. ISWM, as defined by the US EPA and elaborated in India's SWM Manual 2016, encompasses the full hierarchy of waste reduction, collection, composting, recycling, and disposal, evaluated in light of local conditions. The U.S. Environmental Protection Agency describes ISWM as a complete system that considers how to reduce, reuse, recycle, and manage waste in ways that protect human health and the natural environment.

Kurian et al. (2012), in their study of Chennai, emphasized the importance of source segregation as a prerequisite for any processing technology to function effectively. Similarly, Saxena et al. (2010), studying Allahabad city, found that the absence of segregation at source rendered composting plants economically unviable, as the mixed waste produced poor-quality compost with limited market value. These findings are directly relevant to Jalandhar, where the composting plant at the Wariana dump has remained non-functional for over a decade.

Research on the informal sector — ragpickers, kabaddis, and NGOs — has increasingly recognized their critical role in urban waste management. Narain (2016), in the Centre for Science and Environment's landmark report on Indian cities, documented that informal waste pickers are responsible for recovering

15–20% of total recyclable waste in cities, significantly reducing the burden on formal collection systems. Mahajan (2016), studying Chennai's Exnora programme, demonstrated the potential of community-based organizations in achieving near-zero-waste outcomes.

The SWM Rules 2016 marked a significant legislative advance over the Municipal Solid Waste Rules 2000, introducing source segregation, user fees, integration of waste pickers, decentralized processing, and the promotion of waste-to-energy (WTE) plants. However, implementation has remained uneven. Pillai and Shah (2014) noted that the absence of financial sustainability models and inadequate public awareness remain key bottlenecks to SWM reform in Indian cities.

In the Punjab context, Puri et al. (2008), in a study specifically focused on Jalandhar's solid waste and its community health impacts, found significant correlations between poor waste management near the Wariana dump and elevated incidences of respiratory disease, dengue, malaria, and typhoid in surrounding communities — a finding that lends epidemiological urgency to the reforms proposed in this paper.

3. Study Area: Jalandhar City

3.1 Locational and Physical Setting

Jalandhar is situated in the Doaba region of Punjab, at 31°32'N latitude and 75°57'E longitude. It is centrally located within the state, equidistant from the state capital Chandigarh (98 km east) and the international border city of Amritsar. The city lies on a flat alluvial plain — part of the Indo-Gangetic system — at an average elevation of 240 m above mean sea level, with a gradual southward slope. The geomorphological character of flat, loamy-clay alluvial soils is significant from a waste management perspective: it facilitates construction of composting pits, and the risk of leachate contamination into shallow groundwater aquifers is correspondingly high.

Jalandhar has a humid subtropical climate with cold winters (November–February) and hot summers (April–June), with average annual precipitation of approximately 700 mm, concentrated in the July–August monsoon season. The monsoon period is particularly critical for waste management, as stormwater mixes with solid waste at unprotected secondary collection points and the Wariana landfill, generating leachate that contaminates the surrounding environment.

3.2 Demographic and Socio-Economic Profile

Geographical Location: 31°32′ N, 75°57′ E in the Doaba region of Punjab. Population (2011 Census): 8,62,886 (approx. 1.1 million projected) (457,636 male, 405,250 female).

1. Area: 110 km² divided into 60 wards implying an average population density of approximately 7,844 persons per sq. km.
2. Climate: Humid subtropical; average annual rainfall 70 cm.
3. Waste Generation: 500 MTD officially reported; actual ~550–575 MTD.
4. Waste Workers: ~2,000 municipal workers, 650 ragpickers.
5. The sex ratio is 885 per 1000 males and the literacy rate is 82%.

Parameter	Details
Total Area	110 sq. km
Total Population (Census 2011)	8,62,886 persons

Parameter	Details
Literacy Rate	82% (Official); 86.22% (MCJ records)
Number of Municipal Wards	60 wards
Sex Ratio	885 females per 1000 males
Slum Localities	97 localities
Solid Waste Generation (per day)	500 MTD (actual ~550–575 MTD)
Ragpickers	650
MCJ Sanitation Workers	2,000

Table 1: Basic Fact File of Jalandhar City (Source: MCJ; Census of India, 2011)

The city's population has grown steadily over recent decades — from 43 wards in 1981 to 60 wards in 2011 — as peripheral villages and peri-urban areas have been progressively incorporated within municipal boundaries. Population distribution is highly uneven: nine wards have populations exceeding 20,000 persons, while 13 wards have populations below 10,000. Ward No. 1, the largest ward, has a population of 27,750 persons and generates approximately 14 metric tons of waste per day.

3.3 Land Use and Waste Composition Profile

The 8,758.5-hectare municipal area is primarily residential (43.26%), followed by an agricultural zone (27.73%), industrial (8.12%), public/semi-public (7.34%), commercial (6.02%), and other uses. The dominance of residential land use directly conditions the character of solid waste generation: approximately 58% of total waste is organic and biodegradable, 18% is recyclable (paper, plastic, glass, metal), and 24% is inert. This composition profile — particularly the high organic fraction — makes Jalandhar well-suited for decentralised composting-based treatment, as the paper demonstrates.

Land Use Category	Area (Hectares)	Area (%)
Residential	3,789	43.26
Agricultural Zone	2,429	27.73
Industrial	711	8.12
Public / Semi-Public	642.7	7.34
Commercial	527	6.02
Vacant Land	385	4.39
Open Spaces	147	1.69
Water Bodies	88.8	1.00
Transport & Communication	39	0.45

Table 2: Jalandhar City Land Use Pattern (Source: Land Use Map, DTP Office Jalandhar)

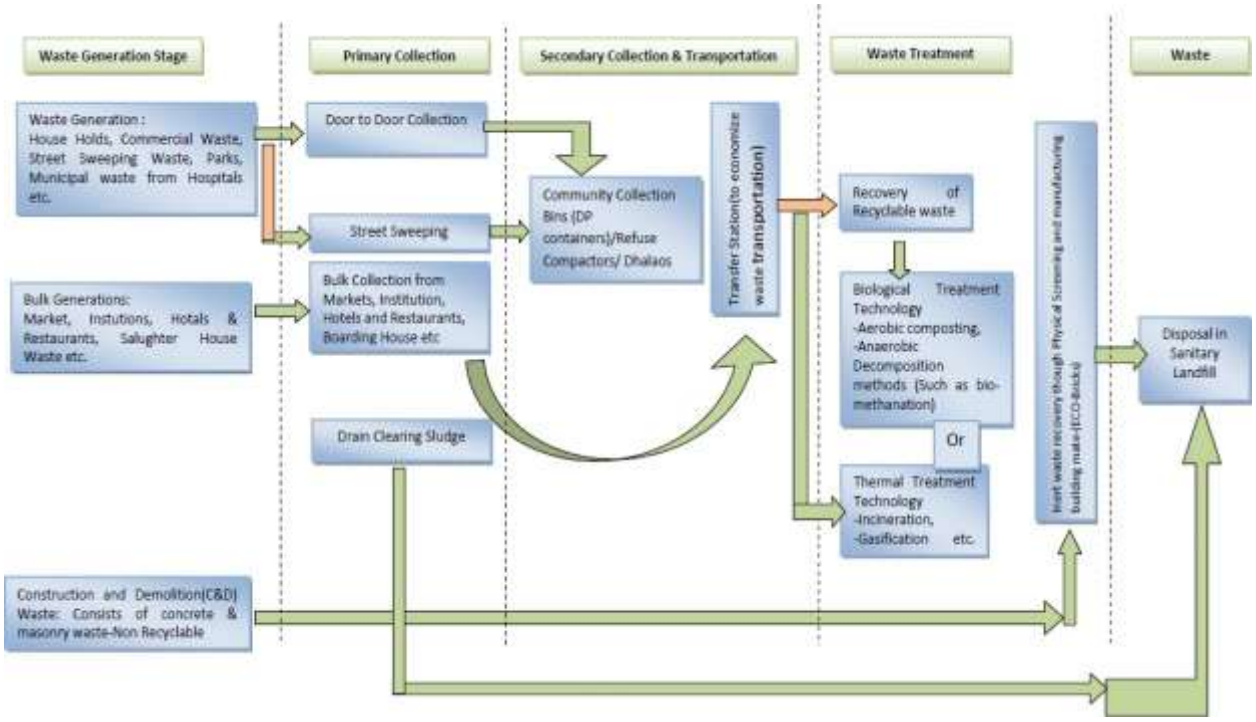


Figure 1 SWM Process

4. Methodology

This study employs a mixed-methods research design combining quantitative data analysis with qualitative fieldwork. The methodological framework proceeds through seven sequential steps:

- Literature Review: Study of SWM rules, guidelines, and norms including SWM Rules 2016, SWM Manual 2016, Punjab MSW Bye Laws 2018, and international best practices.
- Compilation of Secondary Data: Analysis of Census 2011 data, CPCB reports, MCJ administrative records, Punjab Pollution Control Board (PPCB) annual reports, and DTP land use maps.
- Primary Field Survey: Door-to-door surveys in sample wards (Ward No. 1 and Ward No. 18), visual observation of secondary collection points, routing analysis, and inspection of the Wariana landfill.
- Stakeholder Consultations: Structured interviews with the health officer, chief sanitary inspectors, sanitary inspectors, and field workers of MCJ, as well as informal discussions with ragpickers, kabadis, and local residents.
- Micro-level Ward Studies: Detailed case studies of Ward No. 1 (large, peripheral, mixed socio-economic) and Ward No. 18 (small, centrally located, commercial-dominated) to represent contrasting urban morphologies.
- Comparative Case Analysis: Benchmarking against the solid waste management systems of Chandigarh (best practice within Punjab), Ludhiana (comparable city scale), and Indore (national benchmark).
- Gap Analysis and Proposal Development: Systematic assessment of shortfalls against SWM 2016 norms in manpower, vehicles, infrastructure, and processing, followed by design of technically and financially grounded proposals.

5. Existing Solid Waste Management System In Jalandhar

5.1. Waste Generation and Composition

The waste profile is dominated by:

- Biodegradable waste: 58% (food, green waste)
- Recyclable waste: 18% (plastics, metals, paper)
- Inert waste: 24% (construction debris, street sweepings)

The MCJ officially records daily MSW generation at 500 metric tons per day (MTD). Primary field surveys and demographic calculations suggest the actual figure is closer to 550–575 MTD, with the gap attributable to infrastructure shortfalls in collection coverage. Based on an estimated population of approximately 11 lakhs (including peri-urban areas and unregistered migrants), the per-capita generation rate is approximately 500 grams per person per day — consistent with CPCB norms for cities with populations between 1 and 2 million (0.19–0.53 kg/capita/day).

The three major sources of waste generation are residential and open areas (56.31%), commercial establishments including street sweeping (24.95%), and small and medium-scale industries (19.74%). The residential sector alone generates approximately 212 metric tons daily, followed by commercial establishments (124 MT), hospitality sector (85 MT), street sweeping (65 MT), industrial sector office and canteen waste, institutional sources (13 MT), and parks and green belts (7 MT).

Figure 1 Residential Area Waste Composition

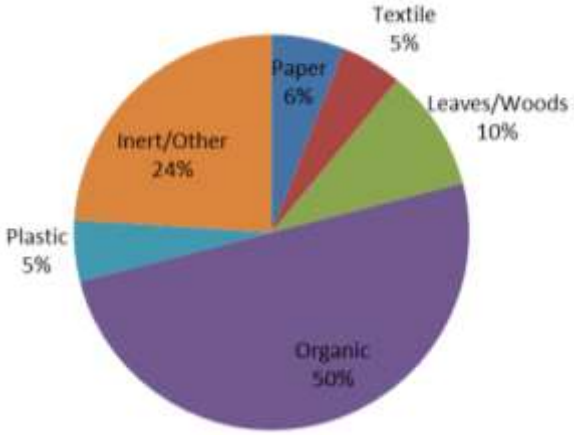


Figure 2 Commercial Area Composition

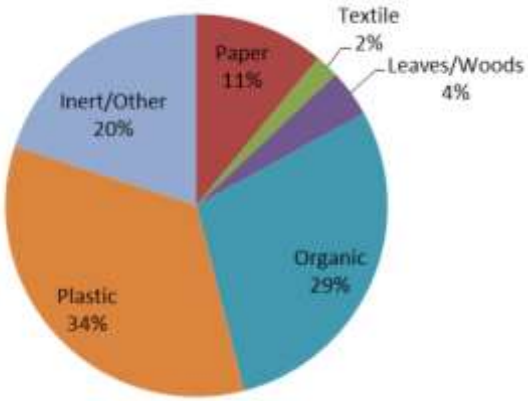
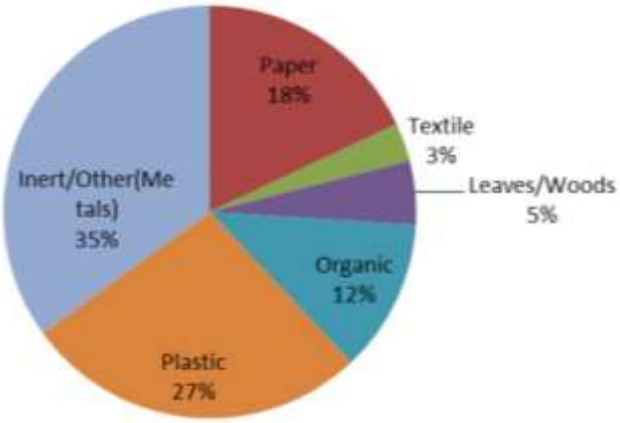
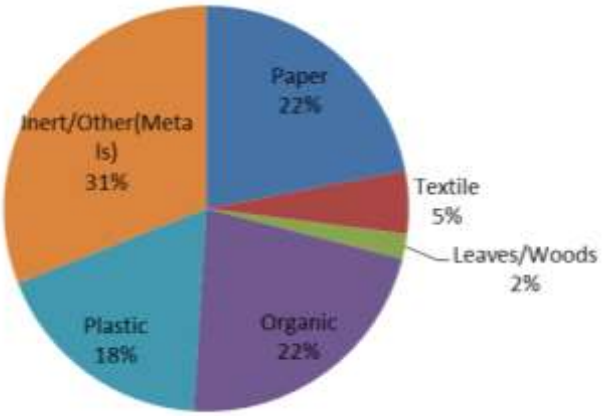


Figure 3 Public/Semi Public Area Waste Composition



(Source: SWM Rules,2016)

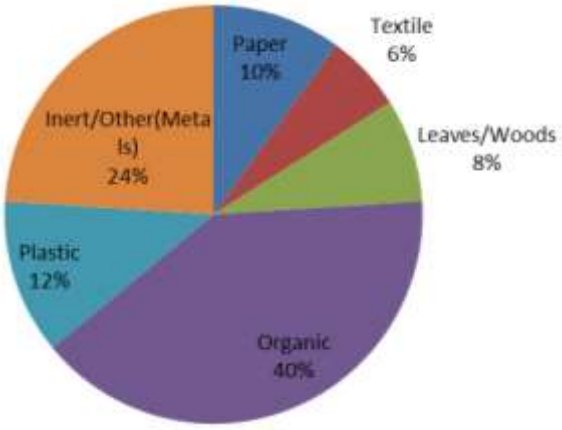
Figure 4 Industrial Area Waste Composition



(Source: SWM Rules,2016)

Based upon analysis of composition of waste of various sectors & Jalandhar's Land use profile. Jalandhar's waste composition computed as below:

Figure 5 Jalandhar's Waste Composition



(Source: SWM Rules,2016)

5.2 Primary Collection

Primary collection is carried out via handcarts, tricycles, and small vehicles (Tata ACE). Door-to-door collection is inconsistent, particularly in wards lacking secondary points. Many residents' resort to open dumping in vacant plots, drains, and roadsides. Municipal workers perform door-to-door collection using manually operated tricycle carts (cycle rickshaws), typically covering 250 households per worker per day. Private workers charge Rs. 30–70 per household per month from approximately 250 houses per worker. Collection efficiency varies significantly by sector: household collection achieves approximately 85%, industrial 70%, hospital and healthcare 90%, and hospitality 80% (MCJ data).

- Total Municipal population of Jalandhar City is 8,81, 635.Diving into 60 wards total waste generated per day in Jalandhar city is 441 Mt/P/Day, with average per capita Municipal Waste taken 500g m per person.
- Highest Solid Waste Generating wards are 1,3,15,23, 46 which produces more than 10Mt/P/day.
- Total organic waste /Bio Degradable waste is 58% & Recyclable waste 18%, which is dumped into Wariana dump without any treatment.

5.3 Secondary Collection

The city has 53 identified secondary collection points (SCPs), primarily roadside open grounds where waste from door-to-door collection is temporarily deposited before being loaded onto tipper trucks for transport to the Wariana dump. The analysis reveals that 24 wards — including Wards 3, 6, 7, 8, 15, 16, 17, 20, 27, 28, 29, 32, 40, 41, 42, 44, 45, 46, 47, 50, 52, 53, 58, and 59 — have no designated secondary collection points, forcing residents to dump waste on roads, open plots, and drains.

The total daily MSW received across the 53 SCPs ranges from 1.5 MT (Fauji Tea Stall) to 20 MT (Shamshan Ghat Model Town). Collectively, the existing SCPs receive approximately 440 MT per day — the remaining 110–135 MT is either dumped indiscriminately or handled by the informal sector. The space available at most SCPs is technically adequate for the daily waste volume, but poor boundary demarcation, lack of cover, and insufficient frequency of tipper collection cause chronic overflow.

5.4 Transportation and Routing

Waste transportation from SCPs to the Wariana dump (25 km from the city centre) is conducted by tipper trucks. The MCJ operates 8 defined routes. The analysis reveals a severe deficit: against a requirement of 42 tippers (calculated on the basis of route length and waste volume), only 20 are currently operational — a deficit of 22 units. Routes operating below 15 km allow tippers to make three daily trips; routes above 15 km are limited to two trips.

Route No.	Route Length (km)	Daily Waste (MT)	Tippers Required	Current Tippers
1	18	95.2	19	5
2	25	79.1	16	4
3	10	35.7	8	2
4	29	54.6	11	3
5	9	21.7	5	1

Route No.	Route Length (km)	Daily Waste (MT)	Tippers Required	Current Tippers
6	9	36.4	8	1
7	7	47.6	10	1
8	15	70.7	14	3
TOTAL	—	441.0	91 trips/day	20

Table 3: Route-wise Transport Analysis (Source: Primary Survey, MCJ)

5.5 Disposal and Treatment

Currently, almost all collected waste is dumped at Wariana without treatment. There is no functional composting, bio methanation, or recycling plants at operational scale. Industrial and biomedical wastes are handled separately but without adequate monitoring. The lack of sanitary landfill facilities leads to leachate contamination, GHG emissions, and vector breeding.

- Wastes are dumped into site and left open without any cover or any treatment on site.
- With passage of time Heap of Waste is getting higher it's almost 30M from nearby Road Level &it's getting Higher due to High waste Generation around 45 Mt/P/Day. Soon Jalandhar is going to face a huge problem if alternative is not found.
- Site has no check and boundary wall, No check on Rag pickers.
- There is Composting Plant at Site which as per sanitary Inspector is not working for 10 years, Hence No treatment is done.

Infrastructure at Dump Site is not adequate, not fulfilling Standards.

5.6 Workforce Analysis

A comparison of normative SWM 2016 manpower standards against current deployment in Jalandhar reveals critical shortfalls at every level of the sanitation hierarchy.

Category	SWM 2016 Standard	Required (Jalandhar)	Present	Gap
Sweeper	1 per 625 population	1,410	650	760
Jamadar	1 per 25 sweepers	56	55	1
Sub-Sanitary Inspector	1 per 40 sweepers	35	20	15
Sanitary Inspector	1 per 80 sweepers	17	6	11
Sanitary Officer	1 per lakh population	9	3	6
Junior Engineer	1 per 2 lakh population	4	4	0

Table 4: Manpower Gap Analysis for Jalandhar City (Source: SWM Manual 2016; Primary Survey, MCJ)

Required sweepers: 1,410; present: 650 (gap: 760). Shortages exist across all supervisory levels. Lack of protective gear, training, and mechanization limits operational efficiency. Ragpickers operate informally without integration into the formal SWM framework.

Table: Street Sweeper Work Norms and Standards

Types	Area in RMT (Running Meter)	**Currently in Jalandhar City**
High density area & markets (Population above 50000 per sq. Km.	**250 to 350 running meters (RMT)**	**500-600 RMT**
Medium density area	**400 to 600 RMT**	**900-1000 RMT**
(Population from 10000 to 50000 per sq. Km.)		
Low density area	**650 to 750 RMT**	**1500-1600 RMT**
(Population less than 10000 per sq. Km.)		

(Source: Municipal Solid Waste Management Manual-2016 & Primary Survey, Sanitary Inspector, MC Jalandhar City)

5.7 Landfill Site Analysis

All collected MSW from Jalandhar is disposed of at the Wariana dump in Village Wariana, approximately 25 km from the city Centre. The dump covers approximately 6.6 hectares and has reached near-saturation, with a waste mound height of approximately 30 meters above road level. The composting plant at the site has been non-functional for over a decade. A systematic assessment against SWM 2016 landfill siting norms reveals multiple violations:

Siting Criterion	SWM 2016 Norm	Status	Remarks
Distance from habitation	500 m	VIOLATED	Adjoining at ~100 m (Jalandhar Vihar/Kunj)
Distance from highways/railways	300 m from centerline	VIOLATED	NH-703A at ~100 m
Distance from rivers/lakes	200 m	Compliant	No major water body in proximity
Distance from canals/drains	30 m	Marginal	Canal passes nearby; risk of leachate contamination
Boundary wall / fencing	Required	ABSENT	No perimeter fencing; ragpickers and stray animals enter freely
Daily cover of waste	Required	ABSENT	Waste left exposed; fire incidents common
Processing plant	Required	NON-FUNCTIONAL	Composting plant non-operational for >10 years
Leachate management	Required	ABSENT	Leachate contaminating

Siting Criterion	SWM 2016 Norm	Status	Remarks
			surrounding soil and groundwater
Equipment at site	3 bulldozers, 3 loaders, 3 excavators, 3 compactors (200–500 T range)	DEFICIENT	Only 2 bulldozers, 1 loader, 1 excavator, 1 compactor present

Table 5: Wariana Landfill Compliance Assessment
(Source: SWM Rules 2016; Primary Survey)

The social and health impact of the Wariana dump on surrounding communities is severe. Residents of nearby localities — including the approximately 1,000 residential plots in Jalandhar Vihar and Jalandhar Kunj (PUDA-approved developments) — suffer from chronic exposure to leachate-contaminated groundwater, airborne pollutants from waste fires, and vector-borne diseases including malaria, dengue, and typhoid. The MCJ is aware of these conditions but has been unable to identify an alternative landfill site at Jamsher due to community and political resistance — a classic NIMBY (Not in My Backyard) situation that is increasingly common in Indian cities.

Table: Equipment's Required at Land Fill Site

Waste Received at Landfill Site Per Day	Bulldozer's	Loaders	Excavators	Compactors	Water Tanker	Tractor-trailer /Tipper
up to 200 tons	2	2	2	2	1	2
200 to 500 tons	3	3	3	3	1	4
At Present	2	1	1	1		2
Gap	1	2	2	2	0	2

(Source: Municipal Solid Waste Management Manual-2016 & Primary Survey, Sanitary Inspector, MC Jalandhar City)

6. Comparative Case Studies

6.1 Chandigarh: A Model for Punjab

Chandigarh — India's best-planned city, conceived by Le Corbusier in the 1950s and serving as the joint capital of Punjab and Haryana — offers the most relevant regional benchmark for Jalandhar's waste management aspirations. With a population of 10.55 lakh (Census 2011) spread across 114 sq. km and a population density of 9,252 persons per sq. km, Chandigarh generates approximately 500 MT of MSW per day — a figure comparable to Jalandhar's.

The Municipal Corporation Chandigarh (MCC) has implemented a colour-coded waste segregation system across residential and commercial areas, supplemented by a community-based primary collection model. The Dadumajra waste processing facility — serving as the city's primary solid waste treatment plant — handles wet and dry waste streams separately. Ongoing bio-remediation of the legacy waste site

at Dadumajra is expected to reclaim approximately 20 acres of land. Key lessons from Chandigarh include: the viability of sustained source segregation through awareness campaigns and enforcement; the value of investing in legacy site remediation; and the importance of integrating informal waste workers into the formal system.

6.2 Ludhiana: A City of Comparable Scale

Ludhiana — Punjab's largest city and India's industrial hub nicknamed "Manchester of India" — generates approximately 1,100 MT of MSW per day for a population of 16.18 lakh (Census 2011). Its primary collection system uses a combination of tricycles (600 units), wheelbarrows (465), tractor trolleys (8), mini-Tata vehicles (15), and truck tippers (14). The city faces challenges broadly similar to Jalandhar: inadequate secondary collection infrastructure, non-scientific disposal at landfills (Jamalpur: 25 acres; Jainpur: 10 acres; Noorpur Bet: 20 acres), and low public awareness of segregation. The Ludhiana case demonstrates the risks of allowing SWM infrastructure to lag behind population growth and the consequent escalation of remediation costs.

6.3 Indore: The National Benchmark

Indore, Madhya Pradesh, has achieved 100% door-to-door waste collection efficiency across all households, supported by a GPRS-enabled fleet of mechanized collection vehicles and sustained enforcement of source segregation through a policy of refusing to collect mixed waste. The city has topped the Swachh Survekshan rankings for multiple consecutive years and operates functional composting plants, RDF production facilities, and a waste-to-energy project. Its experience demonstrates that, with political will and consistent enforcement, even medium-sized Indian cities can achieve transformative results in solid waste management.

7. Key Findings And Problem Analysis

7.1 Generation Stage Problems

The absence of source segregation is the foundational failure of Jalandhar's MSWM system. Without separation of wet (biodegradable) and dry (recyclable) waste at the household level, all downstream processing technologies — composting, RDF production, recycling — are rendered technically and economically inefficient. The heterogeneous, mixed waste that arrives at the Wariana dump has negligible processing value. This problem is compounded by the absence of any public awareness campaign, user fee system, or enforcement mechanism for waste segregation as required under SWM 2016.

Open littering is endemic across all income categories. The waste is routinely thrown into vacant plots, open drains, and roadside areas, particularly in low-income localities. Because municipal collection occurs only once in the morning, waste generated in the afternoon and evening inevitably accumulates in open spaces, creating conditions for vector breeding and disease transmission.

7.2 Collection Stage Problems

The primary collection fleet — predominantly manual tricycle carts — is undersized, outdated, and lacks segregated chambers for dry and wet waste. The sweeper workforce deficit of 760 posts means that each worker covers 1.5–2 times the normative road length, leading to inconsistent collection quality. In congested areas of the old city (Ward No. 18, Attari Bazar, Rasta Mohalla), the narrow street widths preclude the use of mechanized collection vehicles, and tricycles — already inadequate — are the only viable option.

7.3 Transportation Problems

With only 20 tippers against a requirement of 42, the transportation system is under chronic stress. Multiple SCPs remain filled for extended periods before collection, causing overflow, odor, and vector proliferation. The 25 km distance to Wariana dump — combined with inadequate vehicle numbers — means that some collection points in the outer wards go unserviced for days at a time. No GPRS tracking is installed on vehicles, making monitoring and route optimization impossible.

7.4 Disposal Stage Problems

The Wariana dump is operating in violation of at least five key SWM 2016 siting and operational standards. With a mound height of 30 metres and no alternative site yet secured, the city faces an imminent crisis. Fires at the dump — caused by self-ignition of organic waste and waste burning by informal workers — are a recurring occurrence, releasing dioxins and other toxic gases into surrounding communities. The canal passing near the dump site poses a significant risk of leachate contamination to downstream agricultural areas.

7.5 Institutional and Financial Problems

The MCJ's health department, which manages MSWM, operates with significant capacity constraints: no dedicated office for public redressal, no ERP system for waste management monitoring, limited supervisory staff, and chronic vacancy in sanitary inspector positions. The absence of any user fee collection mechanism means the MCJ bears the full cost of waste management — approximately Rs. 4,00,000 per day in transportation alone — without any cost recovery. Political interference has stymied both the Jamsher WTE project (closed after agitation by local residents) and the Nangal Shama compost pit (closed after agitation), undermining long-term infrastructure planning.

8. Proposals For Sustainable Solid Waste Management

8.1 Framework: Four-Stage Reform Programme

The proposals presented in this section are structured as a four-stage integrated solid waste management reform programme, aligned with SWM Rules 2016 requirements and grounded in the resource and spatial realities of Jalandhar. The four stages are: (1) Source Segregation and Primary Collection Reform; (2) Secondary Collection and Transfer Station Upgradation; (3) Decentralised Composting and Resource Recovery; and (4) Scientific Landfill Management and Transition.

8.2 Stage 1: Source Segregation and Primary Collection Reform

The primary reform intervention must be the mandated introduction of source segregation across all waste generating categories. Each household should be provided with two colour-coded bins — green for biodegradable/wet waste and blue for dry/recyclable waste — with a third category (red) for domestic hazardous waste managed separately. The MCJ should adopt a strict policy of non-collection of mixed waste (as practiced in Indore), enforcing spot fines for non-segregation as provided under SWM 2016.

The primary collection fleet should be upgraded to covered, segregated tricycles and e-rickshaws. The Punjab government's scheme for electric vehicles in urban sanitation should be leveraged to replace diesel-powered collection vehicles, reducing fuel costs and emissions. A minimum fleet of 350 rickshaws/handcarts, 60 auto tippers, 10 JCBs, 6 tipper trucks, and 18 compactors is required (per Punjab MSW Management Plan norms). Collection timings should be fixed between 7:00 AM and 12:00 PM, with a dedicated commercial sector collection shift from 8:00 PM to 12:00 midnight to avoid traffic disruption.

8.3 Stage 2: Secondary Collection Point Upgradation

The existing 53 SCPs should be upgraded to enclosed, bounded transfer stations with minimum area requirements as computed in the feasibility analysis (see Table 6). An additional 24 wards currently without SCPs require new transfer stations to be identified and established. The MCJ already has legal possession of land at most existing SCPs; formalization and boundary construction can be completed within a short timeframe. Each SCP should be equipped with separate storage bays for wet and dry waste, a weigh bridge, GPRS tracking for incoming and outgoing vehicles, and regular herbal spraying for odour control and disinfection.

8.4 Stage 3: Decentralized Composting for Organic Waste Recovery

The most financially transformative proposal involves the installation of decentralized composting machines — based on the BARC "Nisargruna" technology developed by Dr. Kale — at existing large-volume SCPs. The feasibility analysis demonstrates that all major SCPs have adequate space to accommodate 1-tonne capacity composting units (requiring only 40 sq. m floor area).

SCP Location	Daily MSW (MT)	Min. Area Required (sq. m)	Area Available (sq. m)	Composting Viable?
Shamshan Ghat Model Town	20	167	290	YES
Kannian wali	16.5	138	250	YES
Mitha Pur	16	133	375	YES
Barring	11	92	350	YES
Verka Milk Plant	10	83	250	YES
Bus Stand (Indo Canada)	10	83	200	YES

Table 6: Feasibility of Decentralized Composting at Key Secondary Collection Points (Source: Primary Survey)

The financial viability of this model can be assessed as follows: with approximately 58% of 500 MT daily = 290 MT of organic waste available for treatment, a 220-tonne capacity system distributed across multiple SCPs is proposed. Each 1-tonne composting unit produces 100 kg of compost and 50 kg of biogas (usable for cooking or power generation) per day, at an estimated capital cost of Rs. 4–6 lakh per unit.

Total investment for 220 tons of daily composting capacity: Rs. 13–17 crore (including civil works and overheads). Daily production: 22,000 kg of compost and 11,000 kg of biogas. Daily revenue at current market rates (compost at Rs. 10/kg; biogas at Rs. 15/kg): Rs. 2,20,000 + Rs. 1,65,000 = Rs. 3,85,000. Additionally, the MCJ currently spends approximately Rs. 4,00,000 per day transporting waste to Wariana; with decentralized treatment, this cost is eliminated, and the 160 drivers currently employed

can be redeployed. Total net daily benefit to MCJ: approximately Rs. 7,85,000–9,00,000, implying a full capital recovery within 2–3 years.

Energy for the composting machines can be generated from rooftop solar panels installed at SCPs, making the model self-sustaining and aligned with the smart city and renewable energy goals of the Government of India. The remaining 24% inert waste (approximately 120 MT per day) and 18% recyclable waste (approximately 90 MT) can be channeled through a Material Recovery Facility (MRF) where kabaddis and trained ragpickers formally process and sell recyclables, with the MCJ receiving a revenue share.

8.5 Stage 4: Landfill Management and Transition

In the immediate term, the Wariana dump must be brought into basic SWM 2016 compliance: perimeter fencing, daily soil/cover application, leachate management channels, fire suppression systems, bio-gas capture infrastructure, and piezometer installation for groundwater monitoring. The MCJ must also urgently revive the Jamsher waste-to-energy project, engaging with community stakeholders proactively to address NIMBY concerns through transparent environmental impact assessment, community benefit agreements, and employment guarantees for local youth.

Over the medium term (3–5 years), as decentralised treatment becomes operational and reduces the volume of waste reaching Wariana, bio-mining and bio-remediation of the existing waste mountain should be commissioned. Global experience (including Indore's remediation of its Devguradia dump) suggests that bio-mining can recover 70–80% of the land area within 3–5 years, generating recyclable materials and reducing the mound to a residual engineered landfill. The recovered land can be developed as a green park or recreational space.

8.6 Institutional and Governance Reforms

In parallel with technical interventions, the following institutional reforms are proposed: (a) Establishment of a dedicated public grievance redressal cell with a toll-free helpline for waste management complaints; (b) Introduction of user fees under SWM 2016 authority, beginning with bulk generators (commercial establishments, hotels, hospitals) and extending gradually to households; (c) Deployment of GPRS-enabled fleet monitoring for all MCJ collection and transport vehicles; (d) Formal integration of ragpickers into the SWM system, providing them with uniforms, identity cards, health insurance, and access to SCP facilities; (e) Ward-level awareness campaigns on segregation, in collaboration with schools, RWAs, NGOs, and local councilors; and (f) Annual Swachh Bharat Mission-aligned performance reviews with published ward-level scorecards.

9. Policy Recommendations

Based on the foregoing analysis, the following policy recommendations are presented for the consideration of MCJ, the Punjab Urban Development Authority, and the Government of Punjab:

9.1 Prioritize source segregation enforcement as the single most impactful policy intervention. Without segregation, no processing technology will deliver its design efficiency. This requires a combination of public awareness, material support (bins), and graduated enforcement of user fees and spot fines.

9.2 Adopt a decentralized composting model at existing secondary collection points as the primary waste treatment strategy for Jalandhar. The financial case — an estimated Rs. 9,00,000 daily benefits to MCJ — is compelling and achievable within 2–3 years of investment payback.

9.3 Bring the Wariana dump into immediate SWM 2016 compliance through perimeter fencing, daily waste cover, leachate management, and bio-gas capture. Concurrently, commission a detailed study for

bio-mining of the existing waste mountain, targeting recovery of at least 50% of site area within five years.

9.4 Fill the workforce gap of 760 sweepers, 15 sub-sanitary inspectors, and 11 sanitary inspectors through a phased recruitment programmed, funded through a combination of user fees and the Swachh Bharat Mission (SBM) grant framework.

9.5 Introduce GPRS fleet monitoring across all MCJ collection and transport vehicles, enabling real-time tracking, route optimization, and public accountability.

9.6 Formally integrate the informal sector — 650 ragpickers, ~50 kabaddis, and active NGOs — into the municipal solid waste management system with formal identity, benefits, and dedicated roles in the Material Recovery Facility (MRF).

9.7 Expedite a politically managed resolution of the NIMBY conflict over the Jamsher WTE project, utilizing community engagement, transparent EIA processes, and community benefit agreements, as the city cannot sustain long-term growth on a single, saturated landfill.

10. Conclusion

Jalandhar — a city of profound historical, industrial, and cultural significance in northern India — is at a crossroads in its approach to municipal solid waste management. The existing system, characterized by manual collection without segregation, inadequate transport infrastructure, a non-functional composting plant, and a saturated landfill violating multiple SWM 2016 norms, represents a costly, inefficient, and environmentally damaging status quo. The city currently spends Rs. 4,00,000 per day simply transporting waste to the Wariana dump — with zero recovery and growing community health impacts.

The analysis in this paper demonstrates that this situation is neither inevitable nor irreversible. Jalandhar's waste composition — 58% organic — is ideally suited for decentralized composting. Its secondary collection points already possess the physical space to accommodate composting units. Its informal waste sector is active and knowledgeable. And its regulatory framework — the SWM Rules 2016 — provides both the authority and the mandate for transformation.

The transition from a "collect-and-dump" model to an integrated solid waste management system that generates daily revenues of Rs. 9,00,000, recovers 76% of its waste as compost, recyclables, and energy, and operates within SWM 2016 norms is technically feasible, financially self-sustaining, and replicable across Punjab's other medium-sized cities. It requires primarily political will, institutional capacity, and sustained community engagement — not unprecedented new resources.

The experience of Indore, Pune, and increasingly Chandigarh shows that such transformation is achievable within a 4–5 year planning horizon. Jalandhar has both the obligation and the opportunity to join this cohort of cities that have made waste management a vehicle for environmental quality, public health, and municipal financial sustainability. The proposals outlined in this paper provide a technically grounded, financially viable, and institutionally feasible roadmap for that journey.

References:

1. https://jda.gov.in/en
2. Jalandhar Development Authority
3. Municipal Corporation, Jalandhar
4. https://swachhbharaturban.gov.in/writereaddata/Manual.pdf
5. Solid waste Management Rules, 2016
6. https://www.jetir.org/papers/JETIREO06150.pdf

7. https://www.eeer.org/upload/eer-2022-249.pdf
8. https://www.researchtrend.net/ijet/pdf/90-%204.pdf
9. http://dspace.lpu.in:8080/jspui/bitstream/123456789/3205/1/11009347_5_5_2015%2010_11_37%20AM_complete%20project.compressed.pdf
10. https://www.worldwidejournals.com/global-journal-for-research-analysis-GJRA/recent_issues_pdf/2021/May/solid-waste-managementa-way-to-sustainable-development-in-jalandhar-city_May_2021_4191128066_2110624.pdf
11. https://iieng.org/images/proceedings_pdf/U0716310.pdf
12. https://mcjalandhar.in/wp-content/uploads/2024/07/Solid_Waste_Management_Cleanliness_And_Sanitation_Bye-Laws_2024.pdf