



Impact of Urban Growth and Population Expansion on Solid Waste Generation: A Case Study of Jabalpur

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ABSTRACT

Rapid growth of urban centres has considerably increased the generation of municipal solid waste, thereby creating serious environmental, administrative, and public health concerns. Urban growth not only increases the quantity of waste generated but also alters its composition due to changing consumption patterns, commercial expansion, and rising living standards. Jabalpur, an important urban center of Madhya Pradesh experiencing considerable demographic and spatial expansion in recent decades. The study examines the pattern of urban growth and population expansion in the city, to analyse the trends and characteristics of solid waste generation, and to study the relationship between increasing population and the rising quantity of municipal solid waste. The study is primarily based on secondary data collected from Municipal Corporation records, Census reports, government publications, and other official documents, supplemented by research papers of waste generation and management practices within the city. The analysis reveals that rapid population growth and the physical expansion of the urban area have significantly increased the volume of solid waste generation in Jabalpur. The findings further indicate that the existing waste management

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infrastructure and municipal services are under increasing pressure due to the growing quantity of waste and changing urban dynamics. The study highlights the need for effective policy interventions to ensure sustainable urban development and improved quality of life in the city.

Introduction

Urbanization is one of the most significant geographical and socio-economic processes shaping contemporary cities across the world. Population growth and urbanization are closely interconnected processes, as the increasing concentration of people in urban centres accelerates the demand for housing, transportation, public services, and basic civic amenities. The unprecedented growth of urban population has significantly transformed the spatial, economic, and environmental characteristics of Indian cities. While urbanization contributes to economic growth and modernization, it also creates serious environmental and infrastructural challenges, among which solid waste generation and management have emerged as critical concerns.

Solid waste refers to unwanted or discarded materials generated from human activities in residential, commercial, industrial, institutional, and municipal sectors. Municipal Solid Waste (MSW) specifically includes waste generated from households, markets, offices, streets, institutions, and other urban activities managed by municipal authorities. The quantity and composition of municipal solid waste are directly influenced by urban growth, population increase, lifestyle changes, income levels, and consumption patterns. As urban populations expand, the demand for goods and services also increases, leading to higher consumption and consequently greater waste generation. Rapid urban expansion further intensifies the complexity of waste management due to the increasing spatial spread of urban areas and the rising diversity of waste materials.

The study of the relationship between urban growth, population expansion, and solid waste generation is highly significant for sustainable urban development and environmental management. Understanding the spatial and demographic dimensions of waste generation helps policymakers and urban planners formulate effective waste management strategies, improve municipal infrastructure, and ensure efficient utilization of urban resources.

The study presents a case study on Jabalpur, an important urban center of Madhya Pradesh that has experienced considerable population growth and spatial expansion in recent decades. The quantity of municipal solid waste generated in the city has also increased significantly, creating mounting pressure on



the existing waste management system. The expanding urban area, rising population density, and changing consumption patterns have intensified the challenges associated with waste collection, transportation, disposal, and environmental management in the city. In this context, the study attempts to analyse the impact of urban growth and population expansion on solid waste generation in Jabalpur and to examine the emerging challenges related to sustainable urban environmental management.

The present study attempts to fill research gap by examining the pattern of urban growth and population expansion, analysing trends in municipal solid waste generation, and studying the relationship between increasing population and waste generation in Jabalpur from a geographical perspective.

Objectives

1. To analyse the pattern of urban growth and population expansion in Jabalpur.
2. To examine the trends and characteristics of municipal solid waste generation in the study area.
3. To study the relationship between population growth and solid waste generation in the study area.

Study Area

The present study has been conducted in Jabalpur; an important urban center located in the central part of Madhya Pradesh. The city is situated in the Maha Koshal region of the state and serves as a major administrative, commercial, educational, and military center. Geographically, Jabalpur is located approximately between latitudes 23°10' North to 23°12' North and longitudes 79°55' East to 79°58' East longitude. The city is strategically situated along the banks of the Narmada River, which significantly influences its physical and socio-economic characteristics. Jabalpur occupies an important regional position due to its connectivity with various parts of central India through road, rail, and air transport networks. The city has experienced considerable spatial and demographic expansion over the past few decades, making it one of the rapidly growing urban centres of Madhya Pradesh.

Physically, Jabalpur is characterized by a tropical monsoon type of climate with distinct summer, monsoon, and winter seasons. The drainage system of the city is mainly influenced by the Narmada River and its tributaries, which play an important role in the regional hydrological system. The relief of the area is characterized by undulating topography with a combination of plains and rocky uplands associated with the central Indian plateau region. Administratively, Jabalpur is one of the major urban centres of Madhya Pradesh and functions as the headquarters of Jabalpur district as well as the Jabalpur division. The city is governed by the Jabalpur Municipal Corporation, which is responsible for urban administration and civic

services including solid waste management, water supply, sanitation, transportation, and infrastructure development. The municipal area of Jabalpur extends over approximately 263 square kilometres and is administratively divided into multiple municipal wards for effective governance and service delivery. The urban agglomeration of Jabalpur accommodates a population exceeding one million, making it one of the important medium-sized metropolitan centres of central India. The city has a comparatively high literacy rate and serves as an important educational hub with several universities, colleges, and research institutions. Economic activities in the city are diverse and include trade, commerce, administration, transport services, education, tourism, and small- and medium-scale industries. Industrial activities related to manufacturing, defence establishments, and service sectors have contributed significantly to urban growth and employment generation.

The selection of Jabalpur as the study area is highly relevant due to its rapid urbanization, increasing population, and rising municipal solid waste generation. The city represents a typical medium-sized Indian urban center experiencing growing environmental challenges associated with urban expansion and changing consumption patterns. Increasing waste generation, pressure on municipal infrastructure, and environmental concerns make the city an appropriate area for examining the relationship between urban growth, population expansion, and municipal solid waste generation. Therefore, the study of Jabalpur provides important geographical insights into the emerging urban environmental problems and the need for sustainable waste management strategies in rapidly growing Indian cities.

Map of Jabalpur





Data Base and Methodology

The present study is primarily based on secondary sources of data. Secondary data has been collected from various government publications, municipal records, census documents, reports, journals, books, and other authenticated sources relevant to urban growth, population expansion, and municipal solid waste generation. The use of secondary data is appropriate for the study because it enables temporal analysis of demographic growth, urban expansion, and changing trends in solid waste generation over a long period of time. Population-related data for the study have been collected mainly from the Census of India reports of 2001 and 2011, along with projected population estimates obtained from municipal and planning documents. Information related to urban growth and expansion of the municipal area has been obtained from Jabalpur Municipal Corporation records, Town and Country Planning Department reports and urban development reports. Data related to municipal solid waste generation and management have been collected from Jabalpur Municipal Corporation reports, annual municipal records, State Pollution Control Board reports and government environmental reports. Additional information regarding urban environmental issues, solid waste management practices, and population–environment relationships has been collected from research journals, books, conference proceedings, dissertations, and published academic literature.

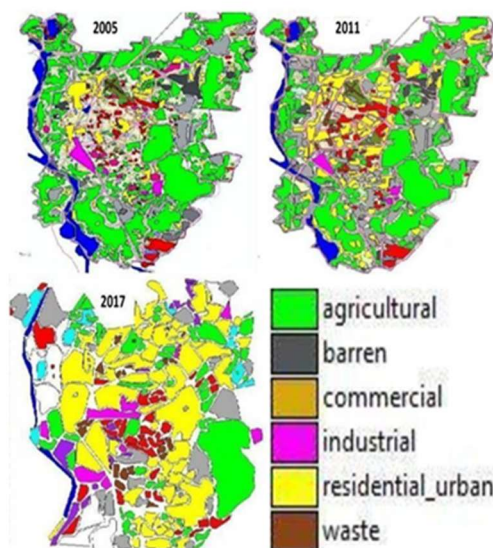
The collected secondary data have been carefully classified, tabulated, and analysed according to the objectives of the study to ensure reliability and consistency in interpretation. The present study is descriptive, analytical, and geographical in nature, focusing on the relationship between urban growth, population expansion, and municipal solid waste generation in Jabalpur. The methodology adopted for the research is based mainly on secondary data analysis supported by geographical interpretation and statistical technique of correlation. To fulfil the first objective, namely analysing the pattern of urban growth and

population expansion, demographic and urban development data of different census years have been comparatively analysed. For the second objective, which focuses on examining trends in municipal solid waste generation, secondary data regarding waste quantity, waste composition, and municipal waste collection records have been analysed for different years. Temporal trend analysis has been used to identify the trend. To achieve the third objective, namely studying the relationship between population growth and solid waste generation, comparative and correlational analysis has been applied.

In the present study, urban growth and population expansion are the independent variables, while municipal solid waste generation is the dependent variable. The independent variables include factors such as increase in urban population, expansion of built-up area, growth of residential and commercial establishments, rising population density, and spatial expansion of the municipal area in Jabalpur. On the other hand, municipal solid waste generation, including the quantity and composition of waste produced within the city, has been considered the dependent variable because it is directly affected by the processes of urbanization and demographic growth. The study attempts to examine the relationship between these variables by analysing how increasing population, urban expansion, contribute to the rising generation of municipal solid waste. The analysis covers the period from 2001 to 2025 in order to examine the long-term changes and emerging patterns associated with urban development and waste generation in Jabalpur.

Findings and Analysis

The analysis of demographic and urban development data reveals significant growth in population, urban expansion, and infrastructural development in Jabalpur during the study period. Between 2001 and 2011, the city recorded a growth rate of approximately 13.19 percent. The trend analysis clearly reveals that



population growth in the city has followed a steadily increasing pattern, which has significant implications for municipal solid waste generation, environmental management, and sustainable urbanization. Urban growth sprawl map of Jabalpur also highlights the spread of residential urban sprawl which supports the growth of urbanization in the study area.

Table1-Population Growth Trend (2001–2025)

*2015, 2020, and 2025 figures are projected estimates based on municipal growth trends, Census growth pattern, and urban development reports.

Year	Population	Growth Rate (%)
2001	9,32,484	—
2011	10,55,525	13.19
2015*	11,68,000	10.66
2020*	13,10,000	12.15
2025*	15,42,000	17.71

Urban Growth Sprawl polygon map of Jabalpur for year 2005, 2011, 2017

The study further reveals that increasing demographic concentration and changing urban land use patterns have intensified environmental pressure and increased the demand for municipal services. The statistical findings support the hypothesis that rapid urban growth and population expansion significantly influence urban environmental conditions and municipal management systems. The increase in population density and urban sprawl has emerged as an important factor contributing to increasing municipal solid waste generation and associated environmental challenges in Jabalpur. The study further suggests that increasing ward-wise population density has intensified pressure on municipal services, particularly solid waste management systems. Highly populated wards generate larger quantities of municipal solid waste due to increased residential concentration, commercial activities, and changing consumption patterns. Thus, spatial variation in population density plays a significant role in influencing waste generation patterns and environmental management challenges within the city.

The analysis of municipal records, urban development reports, and secondary data related to municipal solid waste management reveals that Jabalpur has experienced a substantial increase in solid waste generation during the study period from 2001 to 2025. Temporal trend analysis indicates that both the quantity and composition of waste have undergone considerable changes over time. The findings reveal that daily municipal solid waste generation in Jabalpur increased from approximately 250–270 metric tonnes per day (TPD) in 2001 to nearly 420–450 TPD in 2011. Recent municipal estimates and urban reports indicate that waste generation has further increased to approximately 650–700 TPD by 2025 due to continuous population growth and urban expansion.

Table 2: Trends in Municipal Solid Waste Generation in Jabalpur (2001–2025)

Year	Estimated Population	Total Waste Generation (TPD)	Per Capita Waste Generation (kg/day)	Percentage Increase in Waste Generation
2001	9,32,484	260	0.28	—
2011	10,55,525	440	0.42	69.23%
2015*	11,68,000	510	0.44	15.90%
2020*	13,10,000	610	0.47	19.61%
2025*	15,42,000	700	0.45–0.50	14.75%

Projected estimates based on municipal trends, CPCB reports, and urban growth analysis.

(Source: Jabalpur Municipal Corporation reports, CPCB publications, Swachh Bharat Mission reports, and urban development estimates.)

Relationship Between Population Growth and Municipal Solid Waste Generation in Jabalpur

The comparative and correlational analysis conducted for the present study reveals a strong positive relationship between population growth and municipal solid waste generation in Jabalpur during the study period from 2001 to 2025. Rapid urbanization, demographic expansion, increasing household concentration, changing land use patterns, and expansion of commercial activities have significantly influenced the quantity and spatial distribution of municipal solid waste within the city. The statistical comparison of population data and municipal solid waste generation data demonstrates that as the urban population increased, the quantity of waste generated within the city also increased proportionately. The city recorded a population of approximately 9.32 lakh in 2001, which increased to more than 15.42 lakh by 2025. During the same period, municipal solid waste generation increased from nearly 260 tonnes per day (TPD) to approximately 700 TPD. The analysis clearly indicates that demographic growth has emerged as one of the principal factors responsible for increasing pressure on municipal waste management systems. Between 2001 and 2011, population growth was approximately 13.19 percent, whereas waste generation increased by nearly 69.23 percent during the same period. This trend suggests that rising urban consumption patterns, commercialization, and changing lifestyles have accelerated waste generation beyond the rate of demographic increase alone. Similarly, per capita waste generation increased steadily from 0.28 kg/day in

2001 to nearly 0.50 kg/day by 2025, reflecting increased use of packaged commodities, plastic materials, and commercial products in urban areas. Core urban areas with high population density and mixed land use patterns generate substantially larger quantities of municipal waste compared to peripheral and newly urbanized zones.

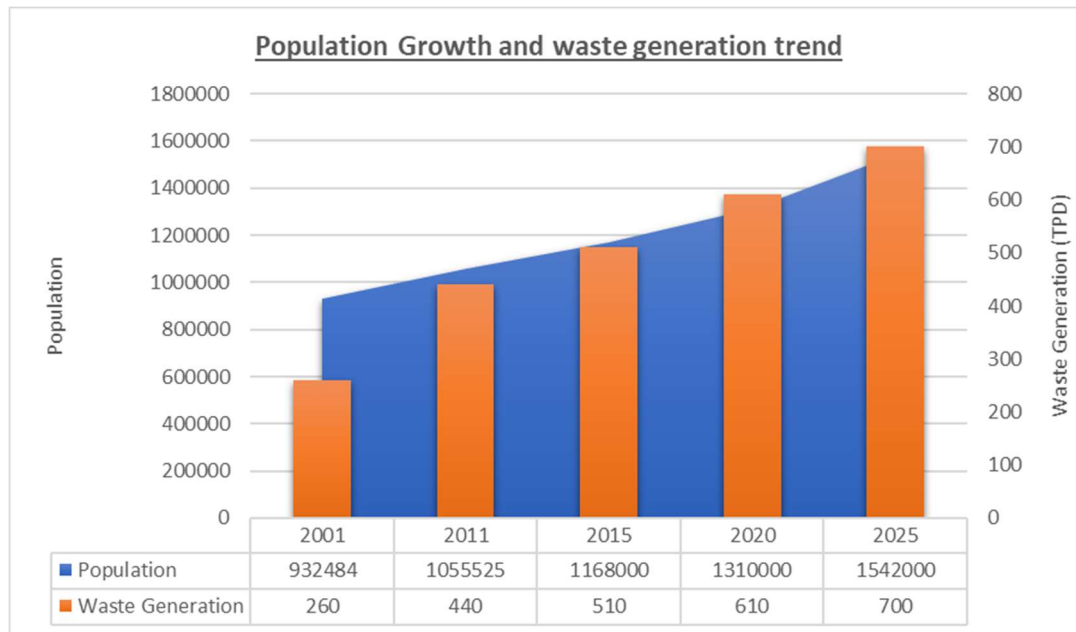


Table 3: Comparative Analysis of Population Growth and Solid Waste Generation in Jabalpur (2001–2025)

Year	Population	Population Growth (%)	Waste Generation (TPD)	Increase in Waste Generation (%)	Per Capita Waste Generation (kg/day)
2001	9,32,484	—	260	—	0.28
2011	10,55,525	13.19	440	69.23	0.42
2015*	11,68,000	10.66	510	15.90	0.44
2020*	13,10,000	12.15	610	19.61	0.47
2025*	15,42,000	17.71	700	14.75	0.45–0.50

**Projected estimates based on municipal trends, Census analysis, and urban development reports. TPD stands for Tonnes Per Day (or Metric Tons Per Day) (Source: Census of India, Jabalpur Municipal Corporation records, CPCB reports, and urban planning estimates.*

Table 4: Correlation Between Population Growth and Waste Generation

Variables	Correlation Interpretation
Population Growth vs Waste Generation	Strong Positive Correlation
Urban Expansion vs Waste Quantity	Positive Correlation
Population Density vs Waste Generation	High Positive Relationship
Commercial Growth vs Plastic Waste	Significant Positive Relationship

The correlation analysis indicates a positive relationship between increasing population and rising municipal solid waste generation in Jabalpur. The urban growth not only increases the quantity of waste generated but also alters its composition. The study supports the hypothesis that rapid demographic and urban growth significantly contribute to increasing environmental pressure through rising solid waste generation.

Conclusion

The study was undertaken with the objectives of analysing the pattern of urban growth and population expansion, examining trends in municipal solid waste generation, and establishing the relationship between population growth and solid waste generation in Jabalpur. The findings of the study clearly demonstrate that the rapid pace of urban growth and continuous increase in population have significantly influenced the quantity, composition, and spatial distribution of municipal solid waste, thereby creating mounting pressure on the city's waste management infrastructure and environmental systems. The study reveals that municipal solid waste and per capita waste in the city has increased significantly during the study period. The correlation and comparative analysis establish a strong positive relationship between population growth and municipal solid waste generation in Jabalpur. Waste generation has grown at a comparatively faster rate than population growth, indicating that changing lifestyles, increasing consumerism, commercial expansion, and land use transformation have further intensified waste generation.

In conclusion, the study establishes that rapid urban growth and population expansion are major determinants responsible for increasing municipal solid waste generation in Jabalpur.

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