GEOGRAPHICAL ANALYSIS

RESEARCH ARTICLE

Geospatial Analysis of Bio-Medical Waste Generation in Mysore District, Karnataka: Implications for Sustainable Waste Management

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Abstract

Based on information gathered in 2019, this study offers a thorough analysis of Bio-medical waste management practices in five taluks in the Mysore District, Karnataka: K.R. Nagar, Hunsur, H.D. Kote, Nanjangud, and Periyapatna. The investigation reveals a significant amount of variability in the amount of biomedical waste generated by healthcare facilities, including government hospitals, community health centers, and private clinics; the highest monthly average was recorded at 135.64 kg at the Government Hospital in K.R. Nagar. The study emphasizes the urgent need for customized waste management strategies that take into account the size and capacity of healthcare establishments as well as regional geographic considerations in order to guarantee compliance with federal biomedical waste management regulations. This localized assessment of biomedical waste management practices offers valuable insights for policy formulation and implementation in rural and semi-urban areas of Karnataka. It does this by showing regional disparities in waste management practices and emphasizing the importance of infrastructure development, regulatory adherence, and increased awareness among healthcare providers to mitigate environmental and public health risks. The research is based on a detailed geographical mapping of healthcare facilities and their waste output.

Keywords: Biomedical waste; Waste management; Healthcare facilities; Geospatial analysis; Sustainable disposal; Health centers; Environmental impact; Public health

1 Introduction

Bio-medical waste (BMW) poses significant risks if not properly managed. The geographical context of healthcare facilities can significantly influence the quantity and management of BMW. In Karnataka, the Mysore district, with its varied topography and demographic distribution, presents a unique challenge for effective BMW management. Biomedical waste management in India has been critically appraised in various studies, highlighting the gap between policy and practice.

Datta, Mohi, and Chander (2018)[(1)] provided a comprehensive review of the challenges in implementing effective

biomedical waste management practices across the country. They emphasized the need for stricter enforcement of regulations and better infrastructure to manage the increasing volume of biomedical waste. Similarly, Kumar, Abinaya, Venkatesan, and Natrajan (2019)[2] discussed the practical challenges faced in the disposal of biomedical waste in India, highlighting how existing policies often remain on paper without substantial implementation on the ground. Pasupathi, Sindhu, Ponnusha, and Ambika (2011)[3] explored the management of biomedical waste in healthcare settings, stressing the importance of proper segregation and disposal to prevent environmental contamination and health hazards. Bhalla, Bandyopadhyay, and Saha (2019)[4] further underscored the need to keep pace with the new Biomedical Waste Management Rules, noting that healthcare facilities must be vigilant and updated on regulatory changes to ensure compliance and safety. Biomedical waste management remains a significant global concern, as emphasized by Mohammed Noor Shaida and Sandeep Singla 2019[5] in their study, where they outline the various challenges and practices related to managing biomedical waste. The complexity of addressing these challenges is further highlighted by N.K. Sharma and Dr. Lata Sharma[6], who provide an overview of different technologies available for biomedical waste management. They stress the need for adopting advanced and effective waste management strategies to mitigate the health and environmental risks posed by improper disposal.

This paper aims to assess the generation of bio-medical waste across different taluks within the Mysore district, with a focus on how geographical factors such as location, accessibility, and population density impact waste generation and management practices.

2 Study Area

The study area focuses on five taluks within Mysore District, Karnataka: K.R. Nagar, Hunsur, H.D. Kote, Nanjangud, and Periyapatna. These taluks exhibit diverse geographical characteristics, which influence both the distribution of healthcare facilities and the management of biomedical waste.

- **K.R. Nagar (Latitude: 12.46° N, Longitude: 76.39° E):** Located in the northern part of Mysore District, this taluk is predominantly agricultural, with several small clinics and healthcare establishments catering to the rural population.
- **Hunsur (Latitude: 12.30° N, Longitude: 76.28° E):** Situated in the northwest, Hunsur is known for its agricultural activities, particularly tobacco cultivation. It features a mix of urban and rural healthcare centers, serving a population with diverse healthcare needs.
- **H.D. Kote (Latitude: 12.10° N, Longitude: 76.34° E):** Positioned in the southwestern part of the district, H.D. Kote is bordered by forested areas, including parts of the Nagarhole National Park. This taluk has a combination of government and private healthcare facilities, with unique challenges in waste management due to its proximity to environmentally sensitive zones.

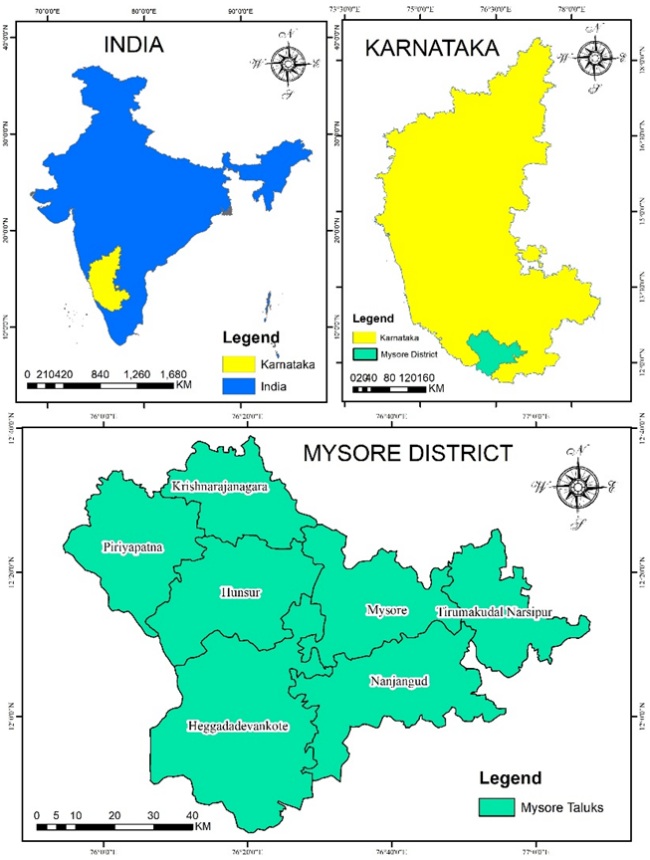

Fig. 1. Study Area Map of Selected Taluks in Mysore District, Karnataka

- **Nanjangud (Latitude: 12.12° N, Longitude: 76.68° E):** Located southeast of Mysore, Nanjangud is an industrial hub with several healthcare institutions. These facilities serve both the local population and workers from nearby industries, contributing significantly to the generation of biomedical waste.
- **Periyapatna (Latitude: 12.34° N, Longitude: 76.11° E):** In the western part of Mysore District, Periyapatna is known for its coffee plantations and Tibetan settlements. The presence of these settlements adds a unique demographic dimension to the healthcare landscape, influencing the types and quantities of biomedical waste generated.

The geographical coordinates and diverse topography of these taluks highlight the challenges and variability in managing biomedical waste across different regions. This

study examines the spatial distribution of waste generation within these taluks, considering both environmental and public health implications.

3 Methodology

Data was collected from healthcare establishments in the Mysore district, particularly in the taluks of K.R. Nagar, Hunsur, H.D. Kote, Nanjangud, and Periyapatna. The data includes the number of beds and the average monthly bio-medical waste generated, recorded in kilograms, for the year 2019.

A geographical analysis was conducted by mapping these facilities and overlaying the data with geographical features such as population density, proximity to urban centers, and road networks. Geographic Information Systems (GIS) tools were used to visualize and analyze spatial patterns in BMW generation.

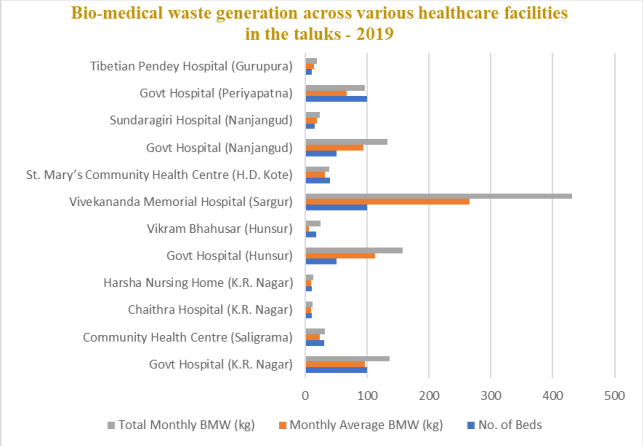

Fig. 2. Bio-Medical Waste Generation Across Various Healthcare Facilities in the Taluks of K.R. Nagar, Hunsur, H.D. Kote, Nanjangud, And Periyapatna, 2019

4 Results and Discussion

4.1. Geographical Distribution of Healthcare Facilities

Urban vs. Rural Areas: Government hospitals, which are larger and generate more BMW, are primarily located in or near urban centers within each taluk. These urban centers, such as K.R. Nagar and Nanjangud, have better access to healthcare services, leading to higher patient intake and consequently more BMW.

Remote and Rural Areas: Smaller clinics in rural areas, such as those in Hunsur and Periyapatna, generate less BMW. These areas have lower population densities and limited access to healthcare services, resulting in lower patient volumes and waste generation.

4.2. Geographical Impact on Waste Generation

The Table 1 summarizes the bio-medical waste generation across various healthcare facilities in the taluks of K.R. Nagar, Hunsur, H.D. Kote, Nanjangud, and Periyapatna for the year 2019.

4.3 Key Observations

- **K.R. Nagar Taluk:** The Government Hospital in K.R. Nagar, located near the taluk's administrative center, produces the most waste (135.64 kg/month). Its central location within a densely populated area contributes to higher patient intake.
- **Hunsur Taluk:** The Hunsur Government Hospital, located at a major junction connecting Mysore to Coorg, generates 157.43 kg/month of waste. Its strategic location makes it accessible to a large population, including those from neighboring rural areas.
- **H.D. Kote Taluk:** The Vivekananda Memorial Hospital in H.D. Kote, situated near the edge of the Western Ghats, produces 430.83 kg/month of waste, despite its relatively remote location. This high figure suggests the hospital serves a wide catchment area, likely due to the lack of alternative healthcare facilities nearby.
- **Nanjangud Taluk**: The Government Hospital in Nanjangud, close to Mysore city, generates 133.17 kg/month. The proximity to an urban center and industrial areas increases its patient load.
- **Periyapatna Taluk:** The Government Hospital in Periyapatna, located in a more rural and agriculturally focused area, produces less waste (96.58 kg/month), reflecting the lower population density and healthcare demands.

4. 4. Geographical Challenges in Waste Management

Transportation and Disposal: Facilities in remote or rural areas, like those in H.D. Kote and parts of Periyapatna, face challenges in transporting waste to centralized disposal sites. Poor road connectivity and distance from urban centers complicate timely and safe waste disposal.

Population Density and Waste Management: In densely populated areas like K.R. Nagar and Nanjangud, the higher concentration of healthcare facilities results in larger waste volumes, necessitating efficient and frequent waste collection and disposal systems. In contrast, sparsely populated areas generate less waste but face logistical difficulties in managing it due to fewer resources and infrastructure.

Table 1. Bio-medical waste generation across various healthcare facilities for the year 2019

Taluk	Facility	No. of Beds	Monthly Average BMW (kg)	Total Monthly BMW (kg)
K.R. Nagar	Govt Hospital (K.R. Nagar)	100	95.79	135.64
Community Health Centre (Saligrama)	30	23.04	31.13	
Chaithra Hospital (K.R. Nagar)	10	9.41	12.17	
Harsha Nursing Home (K.R. Nagar)	10	9.24	12.68	
Hunsur	Govt Hospital (Hunsur)	50	112.23	157.43
Vikram Bhahusar (Hunsur)	18.10	6.21	24.31	
H.D. Kote	Vivekananda Memorial Hospital (Sargur)	100	265.26	430.83
St. Mary's Community Health Centre (H.D. Kote)	40	31.29	38.89	
Nanjangud	Govt Hospital (Nanjangud)	50	93.68	133.17
Sundaragiri Hospital (Nanjangud)	15	18.32	23.95	
Periyapatna	Govt Hospital (Periyapatna)	100	67.18	96.58
Tibetian Pendey Hospital (Gurupura)	10	13.54	18.35	

5 Conclusion

The geographical analysis of bio-medical waste generation in Mysore district reveals significant spatial disparities in waste production and management challenges. Urban centers with better access to healthcare facilities generate more waste, while rural areas, despite generating less waste, face greater challenges in managing it due to logistical constraints.

The findings emphasize the need for geographically tailored waste management strategies. Urban areas require robust infrastructure to handle high volumes of waste, while rural areas need improved transportation and disposal systems to ensure safe waste management. Future research could explore the integration of GIS-based monitoring systems to enhance BMW management across different geographical contexts.

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