Evaluating Garbage Vulnerable Points (GVPs) in fringe areas of Vadodara

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Abstract - *Municipal Solid Waste management has become an urgent issue in the burgeoning informal settlements along the urban fringes. This study aims to address the issues and challenges related to solid waste management in a mixed urban fringe settlement. The collection, storage & disposal of solid waste form the basis of SWM services. While the formal parts of Vadodara receive waste removal services, the informal parts are not being provided with such services. The focus of this study is to evaluate Garbage Vulnerable Points (GVPs) within a mixed urban fringe based on Primary and Secondary data. The genesis of existing scenarios of GVPs along with their risk assessment and effects on the Natural drainage and Sanitation in the areas will be analyzed. Efforts taken by the authorities and their effectiveness are important factors for this study.*

Key Words: Garbage Vulnerable Points (GVPs), Solid waste management (SWM), Vadodara, Municipal Solid Waste Management (MSWM), Fringe Areas

1. INTRODUCTION

With an increase in Population and rapid Urbanization, our nation is facing various developmental challenges. Solid waste Management is one of those major problems that fall under this purview. Municipal Solid Waste Management (MSWM) is crucial not only because of environmental and aesthetic reasons but also for Sustainable Development. An increase in mismanaged solid waste generation leads to numerous issues that affect the livelihood of the people in the cities.

According to the Annual report 2020-21 of CPCB, only 95.4% of the total quantity of solid waste generated in the country is collected. Out of this, 50% of the waste is treated and 18.4% is landfilled. Thus 31.7% unaccounted waste of total solid waste generated in the country, is being disposed of unscientifically or illegally.

Garbage vulnerable points (GVPs) are those spots or areas where the constant piling up of garbage happens because of the constant dumping of waste by the residents, travellers, or people walking by. It is quite likely that these spots must have had dustbins earlier. Waste management in such areas is a huge challenge. GVPs can have a significant impact on public health and the environment, as they can attract pests and contribute to the spread of disease.

By defining and explaining garbage vulnerable points, we hope to increase awareness about current waste management difficulties and inspire action to improve the efficiency and efficacy of garbage management systems. It entails identifying particular areas where adjustments are required and devising methods to address these vulnerabilities in order to create a cleaner and more sustainable environment.

1.1. MSWM and Swachh Bharat Mission

In 2014, the Indian government launched the Swachh Bharat Mission flagship program to provide basic sanitation services, including toilets, and adopt scientific methods for municipal solid waste collection, processing, and disposal. The mission emphasizes quality, sustainability, and commitment from stakeholders for visible societal change. All Urban Local Bodies (ULBs) have the main function of managing municipal solid waste. Despite limited financial resources, technical capacities, and land availability, ULBs plan, implement and monitor all urban service delivery systems, particularly for special wastes such as plastic, biomedical, slaughterhouse, E-waste, waste tires, and lead battery waste. The ULBs are provided with a manual on Municipal Solid Waste Management as a guide to effectively plan, design, implement, and monitor waste management systems over 25 years. The guidance highlights the importance of the environmental and financial sustainability of such systems. The planning process involves adopting an integrated solid waste management hierarchy and preparing short-term and mid-term plans every five years. There is a strong emphasis on inter-departmental coordination and community contributions throughout the manual. It also provides detailed guidance on technical aspects of MSW segregation, collection, and transportation. The guidance includes the requirement for wet, dry, and domestic hazardous waste segregation at the household level as per the SWM Rules. It also includes guidelines on waste collection and transportation systems, segregated secondary storage, appropriate processing and disposal facilities, transfer stations, street sweeping, and resource allocation. It encourages revenue generation and private sector participation and partnerships to ensure the financial viability of these systems. The manual acknowledges the potential for informal sector involvement but recommends that ULBs appropriately recognize their services and focus on their livelihood and health.

1.2. Use of Information Technology for GVP Management in India

Yes, the use of Information and Communication Technology (ICT) for monitoring garbage vulnerable points (GVPs) is being implemented in India. The Swachh Bharat Mission (Clean India Mission), launched by the Indian government, aims to achieve cleanliness and proper waste management across the country.

Under the Swachh Bharat Mission, several ICT-based initiatives have been implemented to monitor and improve waste management practices. For example

- Swachh Bharat Abhiyan Mobile App: The app allows citizens to report issues related to cleanliness, waste management, and GVPs. It enables people to upload photos, geotag locations, and register complaints, which are then addressed by local authorities.

- Swachh Nagar App: The app enables urban local bodies and waste management agencies to monitor waste collection, track collection vehicles, and manage GVPs. It provides real-time data on waste collection and disposal activities, helping authorities identify GVPs and take necessary actions.

- Swachh Survekshan: Swachh Survekshan, the annual cleanliness survey conducted by the Government of India, incorporates ICT-based monitoring and evaluation mechanisms. The survey assesses waste management practices, including the identification of GVPs, and ranks cities based on their cleanliness and sanitation efforts.

- Digital Waste Management Platforms: Various digital waste management platforms have emerged in India, offering solutions for waste collection, tracking, and monitoring. The government's focus on promoting digitization and smart city initiatives provides an enabling environment for the integration of ICT in waste management practices, including the monitoring of GVPs.

1.3. Smart city Initiatives for Garbage Vulnerable Points (GVPs)

- Surat: Surat, located in the state of Gujarat, has been at the forefront of adopting smart city technologies for waste management. The city has implemented sensor-based waste bins that monitor fill levels, enabling efficient collection and reducing overflowing bins. Surat also uses GIS mapping and real-time tracking of waste collection vehicles to optimize routes and improve overall waste management.

- Indore: The city has implemented an integrated waste management system that includes IoT-enabled waste bins and GPS tracking of collection vehicles. The system enables real-time monitoring of GVPs and efficient waste collection and disposal operations.

- Bengaluru: The city has deployed IoT-based sensor systems in waste bins to monitor fill levels and optimize waste collection routes. Bengaluru has also introduced a mobile application called "Sahaaya" that allows citizens to report GVP-related issues and complaints.

- Pune: It has implemented a smart city initiative called "Pune Smart City Development Corporation Limited" (PSCDCL). The city uses IoT sensors in waste bins to monitor fill levels and collect real-time data on waste generation and collection which helps in optimizing waste management operations and addressing GVPs effectively.

- Chennai: The city has implemented IoT-based sensor systems in waste bins to monitor fill levels and track waste collection vehicles. Real-time data collected from these sensors help in identifying GVPs and improving waste collection efficiency.

These cities have leveraged smart city initiatives to implement advanced technologies and real-time monitoring systems for GVPs. The integration of IoT, GPS, and data analytics has facilitated efficient waste management, reduced overflowing bins, and enhanced the overall cleanliness and sustainability of these cities.

1.4. Significance of the study

GVPs not only make the surroundings filthy and unlivable, but they also pose a threat to the environment. GVPs are generally caused due to the unscientific disposal of waste. This unaccounted waste is part of informal disposal in the solid waste management chain, therefore it becomes extremely important to analyse the cause of such activities.

The need to understand the adverse effects of such GVPs on natural drainage and sanitation is also important. With an aim to understand the shortcomings within solid waste management, this study is intended to address the GVPs in order to create a cleaner and more sustainable environment.

2. STUDY AREA

2.1. About the city

Vadodara is a class A tier 2 city. It is the 10th largest city in India, spreading over an area of 400 km². It has 19 administrative wards and 19 election wards Vadodara Mahanagar Palika VMC is the main urban local body. It ranked 79 out of 425 cities nationally in Swachh Sarvekshan. It spans an area of 220.33 sq. km. (Approx.) with an altitude of 35.5 meters above sea level. According to the 2011 census of India, A population of 17,41,791 (As per 2011 Census) 22,40,522 (Approx.), resides within the Vadodara Municipal Corporation and the associated outgrowth. It lies predominantly in the fertile plains of Gujarat region surrounded by vast expanses of flat or gently sloping land making it suitable for agriculture and urban development.

2.2. Administrative Divisions and wards

Vadodara district is divided into eight taluks which form its administrative divisions for effective governance and administration. These talukas are Vadodara city Savli, Dabhoi, Karajan, Padra, Sinor, waghodia, and rural Vadodara. While Vadodara taluka is the main administrative division and headquarters for Vadodara district it encompasses the city of Vadodara and its surrounding areas.

At present, there are 19 administrative wards and 19 election wards in VMC

2.3. Fringe areas in Vadodara

The fringe areas, located on the outskirts of Vadodara, play a crucial role in the city's growth and development. They offer a mix of urban and rural landscapes, attracting residents, industries, and commercial activities.

Vadodara is witnessing frequent changes in the rural-urban fringe limits. Some of the areas that are located on the periphery of Vadodara are:

Ajwa Road: Located on the southern outskirts of Vadodara, Ajwa Road is known for its scenic beauty and the famous Ajwa Water Park

Atladara: Situated in the north-eastern part of Vadodara, Atladara is a rapidly developing area known for its residential and commercial developments.

Dabhoi Road: Located on the eastern fringe of Vadodara, Dabhoi Road connects the city with the town of Dabhoi.

Gotri: Situated in the south-western part of Vadodara, Gotri is a residential area that has experienced significant growth in recent years. It is known for its well-planned layouts, modern housing societies, and proximity to educational institutes and hospitals.

Harni: Located on the northern outskirts of Vadodara. It is well-connected to the city center and is known for its residential projects, educational institutions, and healthcare facilities.

Sama-Savli Road: Situated in the western part of Vadodara, Sama-Savli Road is a growing area known for its residential and industrial developments. bungalows.

Vasna-Bhayli: Located in the southern part of Vadodara, Vasna-Bhayli is an emerging residential area known for its modern housing projects and amenities.

Waghodia Road: Situated in the south-eastern part of Vadodara, Waghodia Road is a developing area with residential and commercial projects. It is known for its educational institutions, hospitals, and industrial zones.

2.4. About the study area

Our study area lies partly in Ward 10 and Ward 9 as shown in Fig-1. The important areas that lie in wards 9 & 10 are Gotri, Bhayli, Vasna & Sevasi. Ward Office 9 lies in Vasna whereas Ward Office 10 lies in Subhanpura.

Below shown Table 2-2 shows the total population in Ward 9 & ward 10 as per Census 2011.

Area name	Population	Population Density	Total Area
Ward 9	236097	15739.8/km2	15 km2
Ward 10	177287	8058.5/km2	22 km2

Table -1: Population data for ward 9 & 10

2.5. Aim

To Evaluate Garbage Vulnerable Points (GVPs) in the Fringe areas of Vadodara

2.6. Objectives of the study

- To Analyse the causes of GVPs in fringe areas of Vadodara

- To Assess the efficiency of governmental and municipal efforts regarding waste removal in fringe settlements

- To provide a sustainable model towards community participation in waste management

2.7. Neighbourhood study

Our study area is a well-established neighbourhood situated in the outskirts of Vadodara. It has witnessed significant development over the years and has emerged as a preferred residential destination for many. It is well-connected to other parts of Vadodara through various modes of transportation and offers a range of housing options, including apartments, villas, and independent houses. The study area is situated 5 km away from the railway station or Central Bus depot and 9 km from the airport. It is considered one of the fastest-developing realty markets in the city. At the same time, the study area is also developing fast in terms of social and physical infrastructure. This neighbourhood once considered a small village situated in the outskirts of Vadodara city is now being considered as a developing counterpart of Alkapuri, which is one of the posh localities within Vadodara city. It offers a maximum number of apartments with respect to other residential areas of the city along with other types of residential units. It comprises all types of residential units from apartments to bungalows and villas catering to the middle-income upper middle and higher-income groups.
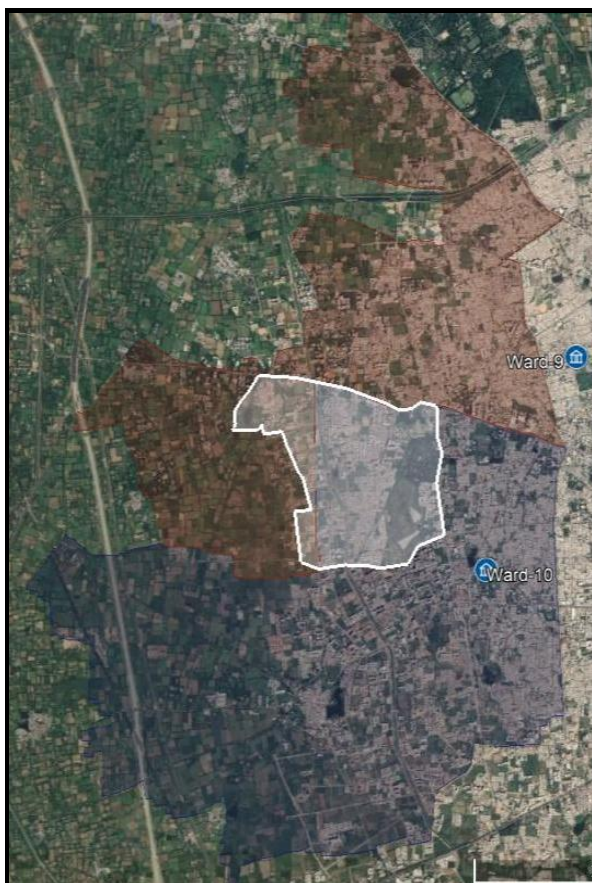

Fig -1: Delineated study area in wards 9 & 10

2.8. Major Roads & Landmarks

Gotri Road which lies in the north of our study area has direct connectivity with Gujarat State Highway 11 which provides major connectivity to the area. Vasna Bhayli Road to the South of our study area connecting the neighbourhoods of Vasna and Valley serves as a major arterial road, providing convenient connectivity between these two areas. The Bhayli-Sevasi Canal road passes through our study area and connects Bhayli and Vasna to Gotri and Sevasi.

Major landmarks are Gujarat Engineering Research Institute (GERI), Vinoba Bhave Ashram, Nilamber Circle, Sevasi Step Well, Priya Cinemas, and Gotri Lake.

2.9. Waterbodies

The city water supply canal that connects with the vishwamitri river passes through our study area beside the Bhayli Sevasi canal road. It is heavily polluted with dumping of garbage from neighboring areas which causes blockage during monsoon and other sanitary issues that we will discuss in the later part of this study.

3. Municipal solid waste management & GVPs

To understand the position of GVPs in the solid waste management chain we need to go back to the entire process of solid waste management in India. The solid waste management process includes three major steps: waste generation, waste collection & waste disposal as shown in Fig-2. Waste generated at different sources like households, commercial places, small industries, recreational spots, etc. is collected in various waste containers or dumper trucks is collected in various waste containers or dumper trucks. These dumper trucks carry the waste containers and transport them to various transfer stations or disposal sites. After the waste is at the disposal site it is sent for waste processing or treatment where the waste is again segregated and sent for recycling. The waste that cannot be treated further is sent to the landfill. This entire chain of waste generation, waste collection, and disposal is a formal process of solid waste management. The disposal of unaccounted waste that is dumped in an unscientific or improper manner at places that are not formally for garbage dumping is known as informal disposal. Garbage vulnerable points thus come under informal disposal in the solid waste management chain. The waste which is dumped informally or which is not collected through a formal chain ends up in garbage vulnerable spots or informal dump sites.

3.1. Solid waste management in Vadodara City

According to the Vadodara Municipal Corporation (VMC), the quantity of MSW generated per day is 750 M.T., out of which 730 M.T. (Yearly average) is collected and transported. The Vadodara Municipal Corporation has put in place several

policies and measures to manage the city's solid waste. Some of the important policies and measures are as follows:
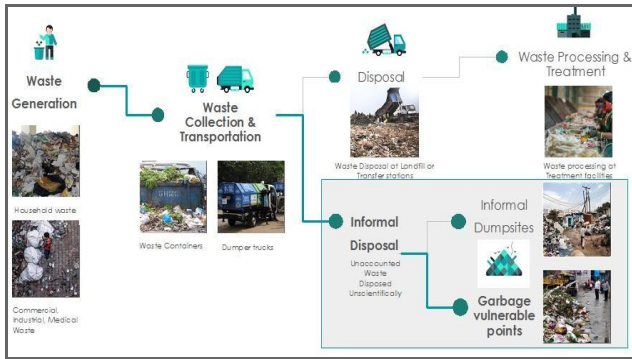

Fig -2: GVPs in Solid Waste Management Chain

Door-to-Door Collection: The VMC has implemented a solid trash collection system that includes both wet and dry waste. Garbage collectors visit each residence in the city and collect waste from their doorsteps under this system.

Segregation: The VMC has made it essential for homeowners to separate their trash at the source into wet and dry waste. The moist trash is composted, while the dry waste is recycled.

Waste-to-Energy Plant: In the city, the VMC has established a waste-to-energy plant that turns non-recyclable garbage into power. The facility has a 5 MW capacity and can handle up to 600 tonnes of garbage per day.

Awareness programs: The VMC runs awareness programs on a regular basis to educate the public about the importance of solid waste management and the need to segregate waste at the source. The campaigns also emphasize the negative consequences of littering and encourage residents to take responsibility for keeping the city clean.

Plastic Ban: The VMC has forbidden the use of plastic bags with a thickness of less than 50 microns, as well as the usage of plastic in specific businesses. The prohibition was enacted to minimize the amount of plastic waste in the city's surroundings.

3.2. System of collection and transportation of Solid waste in Vadodara City

a) Primary collection and transportation:

Primary collection happen through following process:

Sweeping during the day and at night. Lifting of containers.GPS-equipped door-to-door garbage collection vans. Scraping and brushing at night.

b) Secondary transportation:

Dumper trucks, container lifting vehicles, garbage compactors, and vehicles are used for waste transportation. A dumper placer and closed dumper trucks move the gathered waste from the storage receptacles to the landfill site. Since VMC began the door-to-door waste collection, the waste is being carried straight to the compost plant/disposal site. The city's existing 261 containers are/would be adequate for waste storage.

c) Disposal of M.S.W.

Vadodara Municipal Corporation has also built a second processing plant adjacent to the landfill cell phase I site with a capacity of 300 MT/day which can expand up to 700 TPD) based on Integrated Processing Technology to reduce the waste load on the landfill site and thus increase the landfill site's life span.

4. Data Collection & Findings

Multiple site visits to the study area were done to collect primary data for the GVPs.

GVPs were marked, along with the collection of other data like photographs, exact location, waste quantity, nature of the waste, and presence of water bodies nearby. Various observations were made to check if GVPs were cleaned or not, and if cleaned what was the time of recurrence of such GVPs. It was important to collect accurate data through multiple site visits for the proper analysis of GVPs. Various interviews were conducted with Ward officials, Residents, Safai karamcharis and with D2D waste collection in charge

Secondary data was collected from ward offices and from the safai karamcharis for existing GVPs and garbage collection routes & timings. This data was collected through surveys and interviews.

4.1. Primary Survey methodology

Interviews and surveys were conducted at three levels:

- At Municipal Ward - with ward officials

- At Garbage collection level - with Door to Door collection route incharge personnel

- At Household level - with residents and individuals at three locations:

  LIG - Gokul Nagar, gotri

  MIG - Datt Nagar, gotri

  HIG - Avalon greens, sevasi

The findings obtained from these interviews and surveys are as follows

4.2. Ward level analysis (Ward 10)

An Interview with ward officer (ward 10) was conducted to understand the existing chain of waste handling and collection for ward 10. Following were the outcomes:

- 100% door to door collection is done

- Total 30 dumper trucks as used for waste collection. 23 dumper trucks are used for door to door collection. 7 trucks are used for open spots/GVP & Garden waste collection trucks

- Door to Door waste collection is done primarily in three shifts.

- Dumper trucks collect waste from designated routes and segregate waste within the trucks and dispose at Atladara transfer station. Disposal at Atladara transfer station happens thrice in a day.

- There are 62 GVP spots/ open spots for ward 10 which are catered to by the collection trucks.

4.3. Zonal level analysis

Interview conducted with Door to Door waste collection in charge

- Partial segregation is done at source

- Garbage collection is done in two shifts and disposal/dumping of collected garbage is done at Atladara station twice in a day.

- Collection efficiency changes from one residential society to another depending upon the cooperation received from the residents.

- Some residential societies hire sweepers (third party) to collect garbage. The sweepers collect the garbage from each household of the society and discard it in the drums at society level. Residents of the societies without sweepers dump garbage directly in the collection trucks individually.

- Announcements about the arrival of garbage collection trucks are done daily. If certain societies complain about the loud noise, they won't be notified.

- Residents, who have missed the d2d collection in their route, come on two wheelers and dump garbage in the truck.

4.4. Analysis of Household

Interviews and surveys were conducted with residents and individuals at three housing locations to understand the existing garbage collection at LIG, MIG & HIG housing.

I.　　Residents at LIG housing (Gokul Nagar, Gotri)

- No segregation is done at source & No announcement from garbage collection trucks is done

- Garbage collection trucks come at irregular timings, usually early in the morning around 7 AM. In most of the households, all members in the family are working outdoors from 7am to 6pm, which makes it very difficult for them to give their daily household waste in door to door collection.

- Proximity from individual household to garbage collection truck arrival spot is very low which discourages the residents from giving their waste for formal collection.

- Thus, most of the garbage disposal is done in small carts, open spots/GVPs, steel containers near grounds or any moving D2D collection truck.

II.　　Residents at MIG housing (Dattanagar, Gotri)

- D2D collection vehicles come at irregular timings daily and they don't wait for the residents to come and dump their waste for more than 2 minutes. Trucks don't even wait for residents with houses on the Main Road.

- Notification about the arrival is not done by the vehicle in charge.

- It becomes very difficult for senior citizens to observe irregular timings and give waste in the truck within 1-2 minutes.

- D2D collection vehicles don't come inside the society, the residents need to take waste till the main road where the vehicles arrive for collection. The proximity from their house to the vehicle arrival spot is very low.

- D2D vehicles won't even lift the garbage bags, dumping has to be done by individuals directly inside the truck container

III.　　Residents & individuals at HIG housing level (Avalon Greens, Sevasi)

- D2D collection trucks come twice a day regularly. Once at 8:30 AM and second at 2 PM

- Third party sweepers hired to collect the garbage from each apartment and discard it in the waste bins kept at the ground floor which is common for all. D2D collection vehicles come inside the society and collect from these waste bins.

- Announcements by collection vehicles are done properly and regularly.

- Waste Segregation is done at source.

- External third-party agencies hired for collecting plastic and paper/cardboard waste.

- Fruit compost plants are installed in the society. Agencies of the compost plant come twice a week to dump the fruit waste in the compost plant and to collect plastic and paper waste.D2D collection trucks only collect segregated green waste.

4.5. Findings through Site Visits

Multiple site visits were conducted in the study area for data collection. GVPs were marked based on periodic observations and its recurrence. Total 31 GVPs were mapped in the study area through these observations as shown in Fig -3.
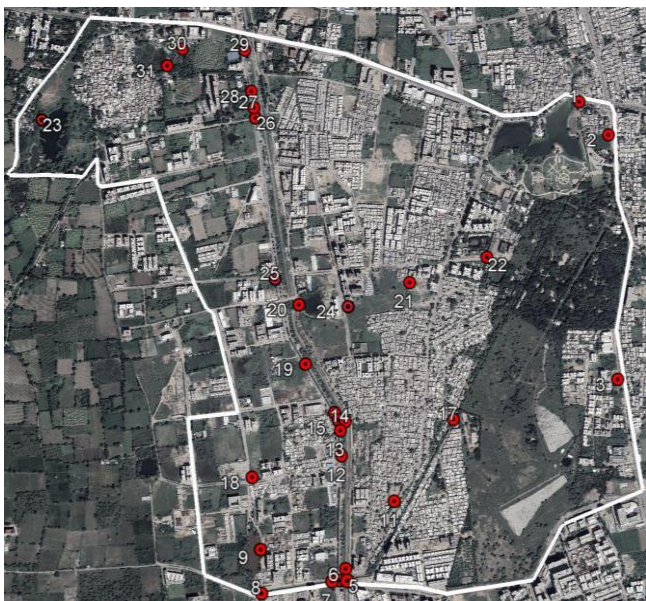

Fig -3: GVPs mapped in Study Area

5. Summary & Conclusion

As discussed in our study, GVPs pose a direct threat to our surroundings and to the existing solid waste management chain. There are various causes of such GVPs as per our study.

The waste management services provided by the ULBs in the fringe areas, especially the waste collection services, pose multiple concerns like there is no insistence for waste segregation at source, the efficiency for D2D collection is very poor, waste collection routes are not decided on the basis of number of households in a society, IoT based monitoring system is not introduced properly, lot of discrepancy between services provided to HIG housing societies as opposed to the LIG & MIG societies.

Few of the issues regarding waste management at household level are also contributing factors in causing GVPs. Some of the issues are negligence in waste segregation at source, lack of awareness, lack of means to follow instructions, etc.

To provide a way forward, following are a few suggestions: Cleaning of GVPs using various approaches like creating self help groups, creating awareness and ensuring public participation should be done. Introducing IoT based monitoring for waste management services, trucks and garbage bins with GPS tracking should be encouraged. Decentralizing D2D waste collection with regular monitoring could help in addressing this situation. Community participation to bring a positive change and to create awareness should be encouraged and incentivized.

In conclusion, management of garbage vulnerable points forms an essential part of solid waste management and it is vital for any sustainable development.

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