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Challenges, Issues and Opportunities towards Management of Solid wastes in Indian Cities: A Case Study of Srinagar City

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Abstract: ***Considering the geo-ecological sensitivity, the Himalayan urban centres are seriously struggling to design useful and economical municipal solid waste (MSW) management systems. The Srinagar is the first metropolis and fastest growing city of Western Himalayas and here the management of MSW is a big challenge for local authorities. The aim of this study was to study the overall scenario of MSW in the city. A comprehensive survey was conducted and data were also collected from local municipal department. The results suggested that in most of cases MSW is being dumped openly along roadsides and open spots in the city. Open dumps are responsible for so many negative environmental impacts in the study area. The paper presents the current status of municipal solid waste generation and disposal practices, and different sort of environmental problems arising out of it. Major problems identified include land and water pollution, inadequate technical know-how, shortage of sweepers and collection bins, non-availability of sanitary landfill, uncontrolled disposal of solid waste by people, lack of public awareness, etc. a comprehensive survey of the whole city revealed that biodegradable/ compostable food waste was the major constituent of municipal solid waste (MSW) stream followed by inert material and recyclable materials including polythene, plastic, cardboard and paper. Most of the solid waste generated was found to remain unattended and only 40 – 45% was being collected that too irregularly by municipal workers and unscientifically disposed off at a dumping ground located in the buffer zone of Anchar Lake, around 8 km north of Srinagar city. Irregular and selective waste collection was the major force behind disposal of solid waste in water bodies, roadsides and open spaces by the people. The study reveals that due to lack of funding and unscientific management the existing solid waste management system is not working successfully in the city. Due to shortage of storage bins, collection efficiency is very low which has severely damaged the environmental condition and also induces to stray dog population phenomenally. The acute absence of waste segregation at the source all types of materials are being disposed along with municipal solid waste which make waste handling very risky especially dumping and disposal points. The lack of governance and inadequate infrastructures for waste collection, transportation and management are the major constrains in designing a suitable MSW management plan for the city. Apart to that unplanned urban settlement and encroachments are also responsible for poor waste collection and disposal system.***

Keywords: Municipal solid waste, Srinagar, Waste management, Environmental impacts, Himalaya, Landfill, Biodegradable

I. INTRODUCTION TO SOLID WASTE MANAGEMENT

Management of solid waste is the collection, treatment, and disposal of solid material that has served its purpose or is no longer useful. Improper disposal of municipal solid waste can result in unsanitary circumstances, which in turn can lead to environmental contamination and outbreaks of vector-borne diseases, which are transmitted by rodents and insects.

Solid waste management refers to the process of collecting, treating, and disposing of solid wastes. The waste management process entails the collection, transportation, treatment, analysis, and disposal of wastes from diverse sources. It contributes to both water and air pollution, making it a severe global issue. It demonstrates its direct impact on health, economic growth, and environmental damage. It can cause environmental pollution and vector-borne disease outbreaks (diseases spread by rodents and insects). Solid trash is a non-liquid, insoluble substance that ranges from municipal garbage to industrial waste and can contain hazardous elements.

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Domestic waste, sanitary waste, commercial garbage, institutional waste, catering and market waste, biomedical waste, and electronic waste are included. Each day, several tonnes of trash are left uncollected on the streets of the majority of emerging cities. It serves as a breeding habitat for bugs that spread disease, clog drains, and cause additional infrastructure problems.

Due to "rapid urbanization, population expansion, and economic development," India's annual solid waste production is projected to reach 387.8 million tonnes in 2030 and 543.3 million tonnes by 2050. There are many harmful effects of solid waste like: a foul odour of garbage, Production of hazardous gases, Degradation of natural attractiveness, Air pollution., Water contamination, Soil contamination, Transmission of disease and Effect on biological diversity.

Municipal Solid Waste Management (MSWM) is a major challenge in urban areas throughout the world. Most of the cities and health resorts in the world are experiencing unplanned urban sprawl and heavy pressure of population. The net result is an enormous generation of waste. The quantity of generated waste mainly depends on population, economic growth and the efficiency of the reuse and recycling system. Municipal Solid Waste (MSW), generally used to describe most of the non-hazardous solid waste from a city, town or village requires routine collection and transport to a processing or disposal site. It may include domestic waste, commercial waste, Industrial waste, debris or construction waste, dead animals etc. Municipalities, generally responsible for management of waste in the cities, have the challenge to afford an efficient and effective system for the inhabitants.

II. SOLID WASTE MANAGEMENT ISSUES IN SRINAGAR CITY

Srinagar, the summer capital of Jammu and Kashmir, sits among a vast network of lakes and wetlands. Unfortunately, despite its water wealth the growing population and the mismanagement of waste has resulted in grave environmental challenges, underlining the need for an urgent and comprehensive waste management strategy for this beautiful city. Srinagar city is a commercial hub of Kashmir valley and occupies highest position as far as basic and other facilities are concerned. The basic requirements for sustaining living standard are easily available in Srinagar city which is responsible for enhancing the waste generation in this particular district. Human activities create waste, and the ways this is handled, stored, collected, and disposed off can pose risk to the environment and to the public health. Srinagar is the first metropolis and fastest growing city of western Himalayas and here the management of municipal solid waste (MSW) is a big challenge for local authorities. More than 13,000 metric tons of solid waste that is produced in Srinagar every month may become one of the main challenges for the successful implementation of the Smart City project in the summer capital. For the past many years, the government has failed to address the menace of solid waste as nearly 450 metric tons of solid waste is produced in the city every day and is dumped in the heart of Srinagar, at Achan, the only dumping site in the city. Waste is not just dumped at the land filling site, but one can find it everywhere. The waste is directly dumped around a residential area, a government-owned land filling site at Achan without being treated. With a population of 12.36 lakh, spread over an area of 294 sq km on both sides of the Jhelum River, not even in a single residential area or commercial establishment in Srinagar has the facility of segregation of waste; and much of the waste is dumped into water bodies like the Dal Lake. Srinagar city has witnessed an increased population growth rate in the last three decades. This increase in urban growth is a threat to sustainable urbanization and has given rise to many problems. Increase in municipal waste is one among them that needs to be prioritized.

III. SOLID WASTE DISPOSAL & COLLECTION PRACTICES IN SRINAGAR CITY

There is only one sanitary landfill in Kashmir at Saidapora, Achan where Municipal solid waste is dumped in a scientific manner. Every day around 350 tons of garbage is unloaded by vehicles of Srinagar Municipal Corporation (SMC) at Achan site and the waste generation in 2035 is expected to be 1723 tons per day. Thus, there is a dire need to assess the available land in Srinagar city and identify the potential landfill sites before it is too late.

Waste,Collection Point Type	Capacity of Waste Holding Waste	Total No.	Distribution
Dumper bins/containers	2 metric tons	112	Such bins can are mainly found along roads around hotels, main market,old city etc
Garbage sheds	5-7 metric tons	7	Mainly located in city core (CBD)
Open collection points	Variable	400	They spread throughout the city along roads, streets and open urban land patches
	Total	519	

Table 1: Profile Solid Waste Collection Systems in Srinagar City,
Source: Srinagar Municipal Corporation

One of the basic environmental problems in Srinagar city is the Transport and Disposal of Municipal Solid Waste (MSW). A big problem is that there is no proper system to collect and sort waste in the city. Official records of the Srinagar Municipal Corporation (SMC) show that a total of 450 metric tonnes of waste is generated per day in Srinagar, 62% of which is organic waste, while the rest is inorganic including 7% of plastic waste. There are more than 520 open dumping points across the city according to official documents. The most important function of the Corporation is to provide better and efficient sanitation. At present 60% of total waste generated is being collected and this is as per national standards comparing the infrastructure and manpower available with SMC for this purpose. For collection and lifting of the city waste from interiors at ward level, hand carts etc. are being used to collect the waste and take it to specific collection points.

Table 2: Characterization of MSW

Component	CPCB-NEERI	ERA	SMC	Average
Biodegradable Waste	61.77%	58.50%	41.19%	53.82%
Recyclable Waste	17.76%	10.30%	19.54%	15.87%
Inert Waste (Combustible & Non combustible	20.47%	31.20%	39.27%	30.31%
Moisture Content	61%	25.88%	----------	43.44%
Calorific Value	1264 kcal/kg	1579 kcal/kg	----------	1421.5 kcal/kg

Source: Srinagar Municipal Corporation

The Srinagar Municipal Corporation (SMC) has the mandate for waste management system in Srinagar city. The SMC has provided the small waste bins to every household. The collected waste is transported to the landfill site near Achan. Waste segregations into different categories viz., composting, recycling etc. is yet not practiced in Srinagar, though the authority is collecting and dumping the waste since 1984.

The other districts are lacking this facility as collection of waste is done around the main towns and dumped into the nearby water bodies, open fields or sometimes dumped directly into fresh water bodies.

The unwanted practices like dumping in fresh water bodies, agriculture lands, forests, road sides and burning of waste leads to environmental pollution. These practices may indirectly alter the physicochemical characteristics of fresh water bodies and soils. The improper waste management has changed the structure and quality parameters of water bodies.

MSW disposal has been a chronic problem and are being continuously added to water bodies hence affect the physiochemical quality of water making it unfit for use of livestock and other organisms. The water holding capacity has been reduced due to accumulation of waste. If an adequate MSWM strategy is not in place, human and environmental health would be jeopardized. It has been generally observed that less attention is being given towards the increasing soil pollution due to improper management of waste in Jammu and Kashmir.

Srinagar's waste problem had got so big that the National Green Tribunal, India's top environmental court, had to intervene. The court issued several orders to J&K government since 2013 asking it to convert the waste into energy. This rubbish poses a serious health hazard for the nearly 80,000 people who lived around the site and an environmental threat for the entire area. To implement the system of cleaning the whole city on regular basis, the residential as well as commercial waste collection method has to be implemented.

After the implementation of daily Door to Door garbage, the collection timings of the segregated waste have to be morning hours; and it will become the practice of every citizen to store the household waste temporarily in twin dustbin as segregated (Dry and Waste) till Door-to-Door garbage collection vehicle arrives. This will make a good improvement in the overall scenario. Sense of hygiene and awareness towards environment will be visible. For the shopkeepers, waste collection system can be made operative in second shift from 5 pm to 11 pm to facilitate commercial units as bulk generators. Door to Door collection system needs to be implemented as a pilot project. Considering the nature and components of waste generated by households and business places, the waste reduction, reuse, recycling and composting processes would be more suitable in managing the challenge. These management options should be integrated in a sustainable framework.

A. Srinagar City at a Glance

Table 3: Overview of Srinagar City

S. No.	Particulars	Nos.	Unit
1	Population as per Census 2011	11,86,767	Souls
2	Projected Population in 2021 (Geometric method adopted)	15,50,342	Souls
3	Projected Population in 2025	17,25,251	Souls
4	Households as per Census 2011	180,382	Nos.
5	Projected Households in 2021	239,156	Nos.
6	Area of the Srinagar Municipal Corporation	246	Sq. Km
7	Population Density of the City	4057	Persons/Sq. km
8	Literacy Rate	61	%
9	Number of Zones	(i)East Zone (ii)West Zone (iii)North Zone (iv)South Zone	Nos.
10	Number of Electoral Wards	74	Nos.
11	Number of Administrative Wards	35	Nos.
12	Road Length of the City	2060	Km



Fig 1: Dumper Bins



Fig 2: Open Waste Collection Point



Fig 3: Improper land Filling of waste at Achan dump site

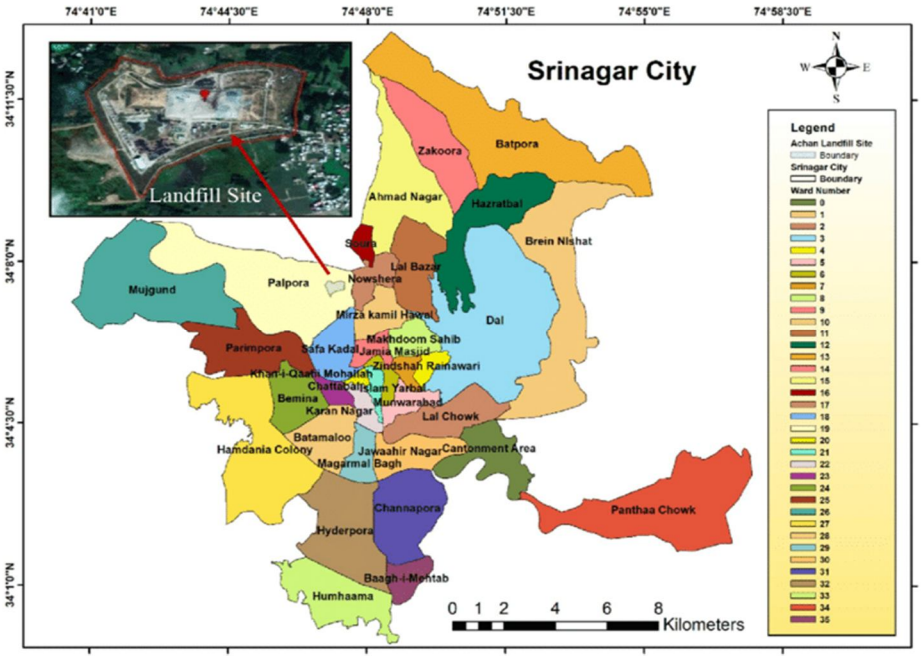


Fig. 4: Srinagar municipal boundary showing ward-wise location map with google aerial view of Achan landfill site

IV. CLASSIFICATION OF SOLID WASTE GENERATION IN SRINAGAR CITY

In Srinagar city, the source of municipal solid waste generation is from households, commercial shops, hotels, restaurants, institutes, vegetable/fruit markets, lakes cleaning, street sweeping and others. The solid waste generation sources are mainly residential, commercial slaughterhouses, institutions, organization like hospitals, hotels and restaurants, small scale industries, construction and demolition waste (debris) etc. Waste collected from the wards are of mixed kind i.e., it consists of both biodegradable and nonbiodegradable waste and temporarily stored in open collection spots, waste sheds or waste dumpers before being lifted for final disposal. Stray animal feed on the waste at open spots resulting in littering of waste.

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At times it was observed that the areas are not attended for days together resulting in un-hygienic conditions, unpleasant look and appear tension of an epidemic as the use of disinfectant at the storage sites is not followed. The characteristics of municipal solid waste are critical in planning, designing, operating or upgrading the solid waste management systems.

Table 4: Classification of Solid waste

TYPES OF SOLID WASTE	DESCRIPTION	SOURCES
FOOD WASTE (GARBAGE)	Wastes from the preparation, cooking, and serving of food. Market refuse, waste from the handling, storage, and sale of produce and meats and vegetable	
RUBBISH	Combustible(primaryorganic) paper,cardboard,cartonswood, boxes, plastics, rags, cloth, bedding,leather, rubber, grass, leaves, yard trimmings Non-combustible(primaryinorganic) metals,tin cans, metal foils dirt, stones,bricks,ceramics,crockery, glass bottles, other mineral refuse	Households, institutions and commercial such as hotels, stores,restaurants,markets etc
ASHES AND RESIDUES	Residue from fires used for cooking andfor heating buildings,cinders,clinkers,thermal power plants.	
BULKY WASTE	Large auto parts, tyres, stoves, refrigerators, others large appliances, furniture, large crates, trees, branches, palm fronts, stumps, flotage	
STREET WASTE	Street sweepings, Dirt, leaves, catch basin dirt, animal ,droppings, contents of litter receptacles dead animals	Streets,sidewalks,alleys, vacant lots, etc
DEAD ANIMALS.	Small animals: cats, dogs, poultry etc. Large animals: horses, cows etc	
CONSTRUCTION&DEMOLITION WASTE	Lumber, roofing, sheathing, scraps, crop residues, rubble, broken concrete, plaster, conduit pipe, wire, insulation etc.	Construction and demolition sites, remodelling, repairing sites
INDUSTRIAL WASTE & SLUDGES	Solid wastes resulting from industry processes and manufacturing operations, such as food processing wastes, boiler house cinders, wood, plastic and metal scraps and shaving, etc. Effluent treatment plant sludge of industries and sewage treatment plant sludges, coarse screening, grit &septic tank	Factories, power plants, treatment plants, etc

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HAZARDOUS & BIO-MEDICAL WASTES	Hazardous wastes: pathological waste, explosives, radioactive material, toxic waste etc.	Households, hospitals, institution, stores, industry, etc.
HORTICULTURE WASTES.	Tree-trimmings, leaves, waste from parks and gardens, etc	Parks, gardens, roadside trees
	Source: Solid Waste Management in Developing Countries by Bhide & Sunderasan, INSDOC, April, 1983	

Year	Population	MSW (Mt year−1)	Households
2010	984,537	76,856	171,550
2011	1,236,829	82,585	178,213
2012	1,259,463	87,738	181,777
2013	1,282,511	95,510	185,413
2014	1,305,981	160,168	189,121
2015	1,329,880	135,922	192,903
2016	1,354,217	131,967	196,762
2017	1,378,999	141,506	200,697
2018	1,778,999	148,520	204,711
2019	1,811,554	159,950	208,805

Table 5 Historical data on MSW generation of Srinagar city
Source: Srinagar Municipal Corporation

A. Quantification of Waste

S.No	Particulars	Quantity
1	AveragePer Capita of MSW	0.40 kg/person/day
2	Total MSW Generation in the City (Year-2021)	620 Tons Per Day
3	Projected Waste Generation in (Year – 2025)	690 Tons Per Day
4	Construction & Demolition Waste Generation	100 Tones Per Day
5	Domestic Hazardous Waste Generation	5 Tons Per Day
6	Quantity of E-waste Generation	2 Tons Per Day
7	Poultry Waste Generation	6 Tons Per Day

Table 6: Quantification of Waste
Source: Srinagar Municipal Corporation

The quantity of waste has been estimated based on the survey done by Srinagar Municipal Corporation. Accordingly, Average Per Capita is calculated at 0.40 kg.

Table 7: Break-up of MSW Generation

S.No.	Sources of MSW Generation	Percent	Quantity of Waste (TPD)
1	Households	55%	341
2	Shops & Establishments	20%	124
3	Street sweeping	8%	49.6
4	Lakes	1%	6.2
5	Markets	4%	24.8
6	Hotels/Restaurants	10%	62
7	Others	2%	12.4
		100%	620

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V. MISMANAGEMENT IN SOLID WASTE HANDLING

Proper management and handling of solid waste in Srinagar city has been reduced to mere collection of some portion of the waste generated and its transportation to sites outside the habituated areas. The basic administrative structure at local level, to manage the affairs of the solid waste in Srinagar has remained unaffected due to various inter related administrative, financial, political and managerial problems. In short, the management and administrative services rendered by the municipal bodies in Srinagar have remained well below the desired satisfaction level; ratherthe level of services is highly inadequate and inefficient. The management setup of Municipal Solid Waste is not in position to play its assigned role in providing appropriate solid waste management services. The factors like undefined role, erosion in municipal domain, in adequate resources, weak executive system and indifference towards certain important relevant and innovative provision of 74th- Amendment of constitution of India are directly or indirectly affecting the capabilities of Solid Waste Management operations. As per standard norms there should be 2.4 Safai karamcharies per 1000 population for door-to-door collection of waste and cleaning of interior lanes and bye lanes.

Similarly for road sweeping of main 1475.02 running km (which includes both macadamized and other roads) in Srinagar City, there should be 1400 Safai-karamcharies.As against the requirement of 3700 Safai-karamcharies the Srinagar Municipal Corporation is presently having only 2700 Safai-karamcharies (1400 on regular basis and 1300 on consolidated/casual labour). This includes 600 Sanitary Workers who have been appointed in recent years thus there is still shortage of Safai-karamcharies.

The existing strength is insufficient to cater 100% collection of solid waste on door-to-door basis and to sweep all main city roads regularly. This shortage obviously affects the overall waste collection and road sweeping performance of the Srinagar city. However, to overcome shortage of staff we are encouraging “Sanitation Club Scheme” on Public Private Partnership basis where SMC provides all logistic support to a Mohalla/area and citizens of a particular locality, who pay wages of the labourers being engaged for collection of solid waste. About 250 such Sanitation Clubs have been created and results are encouraging.

Solid waste management is not an isolated phenomenon that can be easily compartmentalized and solved with innovative technology or engineering. It is particularly an urban issue that is closely related, directly or indirectly, to a number of issues such as urban lifestyles, resource consumption patterns, jobs and income levels, and other socio economic and cultural issues. All these issues have to be brought together on a common platform in order to ensure a long-term solution to urban waste.

VI. CONCLUSION

The study is found that with the increase in global population and the rising demand for essential products and services, there has been a rise in the amount of solid waste throughout the world. Waste that is not properly managed will obviously generate a serious environmental and health impact to the society on the whole. Municipal solid waste of Srinagar city is generated from households, offices, hotels, shops, schools and other institutions were portrayed in categories as Bio-degradable, Non- bio degradable, Plastic, Paper and others. Waste management techniques are followed by the corporation, but still there was an issue. Vermin composting were regarded as a clean, sustainable and zero waste approach to manage organic wastes but still there were some constraints in the popularization of vermicomposting in the city. Still there is a need for reuse, reduce and recycling the waste materials.

A. Suggestions to improve MSW management

Srinagar city has a fragile ecosystem and urgently needs to implement eco-friendly treatment alternatives and solutions for MSW. Although the waste cannot be managed or controlled by single technologies, implementation of integrated MSW management system is highly recommended. The integrated waste management facility should be implemented as per the compliance of Solid Waste Management (SWM) Rules, 2016

1) Introducing waste segregation at the source with a dual wastebin system (i.e., biodegradable and non-biodegradable), and waste collection fees from MSW generators should be implemented. Also, the concerned department should come up with strict laws against illegal dumping, which can reduce waste crime and save the environment
2) Collection of waste at regular intervals by informing residents with proper timings and utilization of the central bin system in each predetermined colony or society. Each roadside collection point should be designated at equal distance, and this will cater to more households.
3) The advanced technologies can be applied to existing landfills, where the problem of bad landfill gases and bad odour can be diagnosed by installing biochemical reactors and the landfill gas collection system. Further, leachate plants should be upgraded with high-capacity treatment plants to get maximum efficiency in the treatment of the leachates.
4) Also, the implementation of smart policies, current laws and regulations, involving private sectors with public–private partnership (PPP) model, educating people by organizing awareness camps in local communities, schools, colleges and at institutional levels

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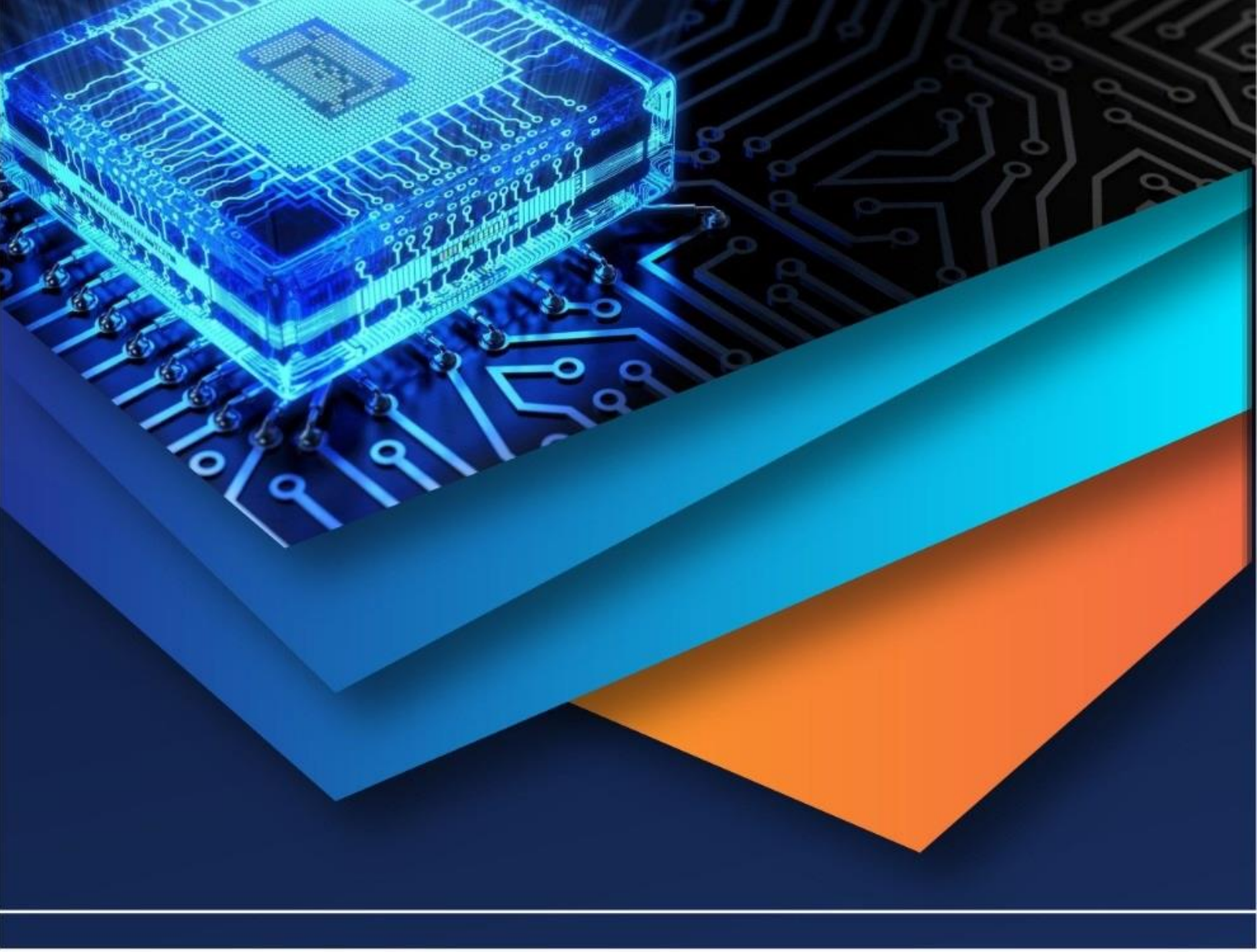
5) The installation of a smart monitoring system like waste transmitters and sensors can be applied on waste bins and GPS tracking system on collection vehicles, which will help to optimize the MSWM system.

6) Implement of 3R's (reuse, reduce and recycling) concept in waste management practices with proper observation.

7) The collection routes and location of wastebin can be optimized by using geospatial technology which will provide the best collection routes and suitable wastebin location for the Srinagar city.

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