International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Geospatial Analysis for Optimizing Disposal of Solid Waste

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Abstract: ***Solid waste management is a term used commonly for garbage management. Humans have been living in settled communities producing waste which need to be disposed and modern societies generate far more solid waste than early humans ever did. The percentage of India's population living in cities and urban areas is witnessing a massive growth due to rapid urbanization. Waste disposal in most cities/towns in India simply involves collecting up the waste from different parts of the city into local dumps from where they are later collected and transported to the landfill sites or dumping yards for disposal. India's per capita waste generation is so high, that it creates a crisis if the garbage is not collected on a daily basis, and disposed off regularly. Urban solid waste disposal has become a major concern in India and an efficient system for waste collection, transportation and disposal of this solid waste is a major requirement.Geospatial technologyhas become of pervasive use and has enough potential for developing a dynamic management of solid waste in India.The present study utilizes the geospatial techniques to find out the existing dustbin locations in Dehradun city and finding out the relationship between the total waste generated per ward in Dehradun to the existing population of the ward. Further, the number of dustbins available for every ward are evaluated and an analysis on the distribution of dustbins for every ward is presented suggesting the wards with shortfall of proper waste disposal units. The Population sweeper ratio was also analysed to understand the cleaning and waste collection pattern in the wards studied.***

Keywords: Solid waste, Geospatial technology, waste collection

1. Introduction

The rapid increase in population, economic growth, urbanization and industrialization has resulted in increased generation of solid wastes in both urban as well as rural India. Especially in cities, this problem of garbage accumulation has become overwhelming with more and more people migrating towards the cities. According to a report by CPCB in 1998, the annual quantity of solid waste generated in Indian cities has increased from six million tons in 1947 to 48 million tons in 1997 with an annual growth rate of 4.25 percent, and is expected to increase to 300 million tons by 2,047. In India, Municipal authorities provide the basic services of solid waste collection, transportation and disposal. The initial points of collection and storage of garbage is the dumper bins or containers, whichare usually placed at locations that generate large amounts of waste due to their large neighbourhoods or proximity to industrial/commercial areas. A certain numbers of sweepers are assigned by the Municipal corporation for every ward, who collect the garbage and transfer it to the dumper bins. The collected waste from these bins is sentdirectly to the dumping ground using waste transportation vehicles. However, even in this mechanism of waste collection and transportation, we face many challenges starting from inadequate number of sweepers for every locality to improper maintenance/location of dumper bins, non-segregation of recyclable and inert waste, inadequate maintenance of waste transport vehicles to scientific maintenance of landfill sites or identifying new landfill sites.

2. Study Area

The present study area is a part of Dehradun Municipal Area. Dehradun is the state capital of Uttarakhandas well as the District Headquarter and is the only corporation city in the state.The city of Dehradun mainly lies in Doon Valley and is at a varying height from 410m in Clement Town to above 600 m at Jakhan. The general elevation of the city is 450 m above sea level. The Dehradun Municipal Corporation consists of 60 wards. The urbanization level in the state is highest in the capital region, with three other major urban centres, Mussoorie, Hardwar and Rishikesh located within 30-50 Km range.

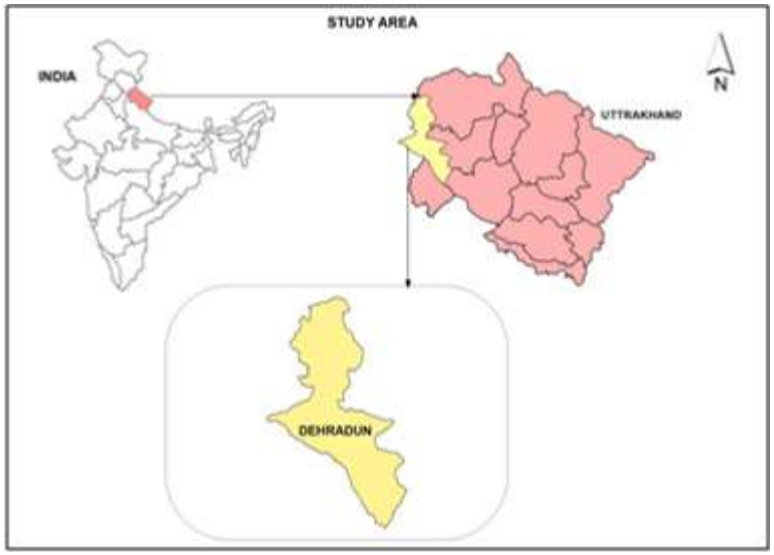

Figure 1: Location map of the study area

Figure 2: Dehradun Municipal Corporation Wards under Study

3. Methodology

Data collection & analysis

Data for the project was mostly collected from the Municipal Corporation of Dehradun and Census of India. The dustbins in Dehradun city were geotagged to get their locations in different wards. The unstructured ancillary data was organizedinto structured data and imported data into Arc GIS for further processing, presenting and analyzing.

4. Result and Discussion

Waste Generation

Dehradun with a population of 5, 69, 578 generates about 220 MT of waste daily. The average rate is about 0.393 kg/head/day. Average solid waste generationrateisin control yet about 42 percent of the population has reported generation rate of more than 400 grams per head per day, which convey that sooner or later the suggested population will fall in this significant category.

The geographical pattern is specific in nature. All the wards falling in the north-east of the town recorded very low generation rate (<350gm./head/day). With few exceptions, all such wards have a low concentration of population. And wards belonging at the south of thecity are biggest generators of solid waste.The low rate of waste generation is recorded in the central part and eastern part of the town. Wards like Govindgarh, Dalanwala (north), Jakhan, Indiranagar, Kanwali etc. have the waste generation more 0.399kg/head/and they are populated (>10000 persons) area in thecity. It is found that there are only like Vasant Vihar, Rajeev Nagar, Kargi, Defence colony, Mata Mandir road, and wards with generation rate of more than 0.400 kg /head /day. These wards account for about 12.55 per cent population and 15 percent waste.

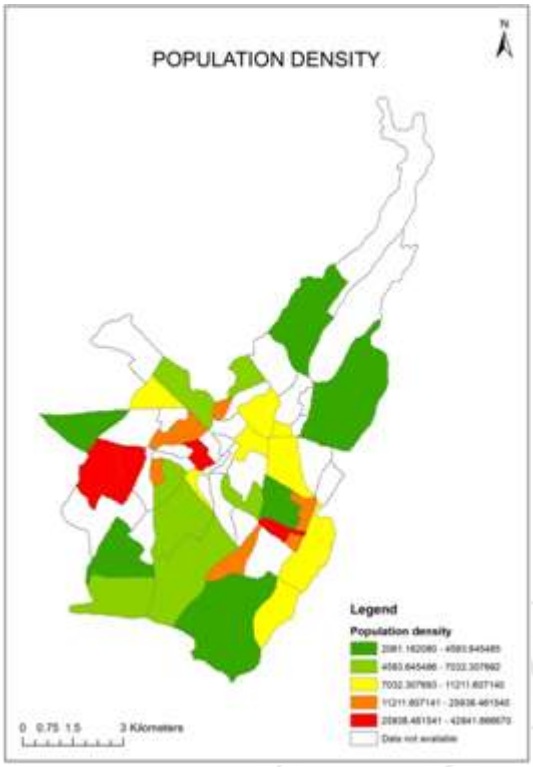

Figure 3: Population Density map of Dehradun Wards

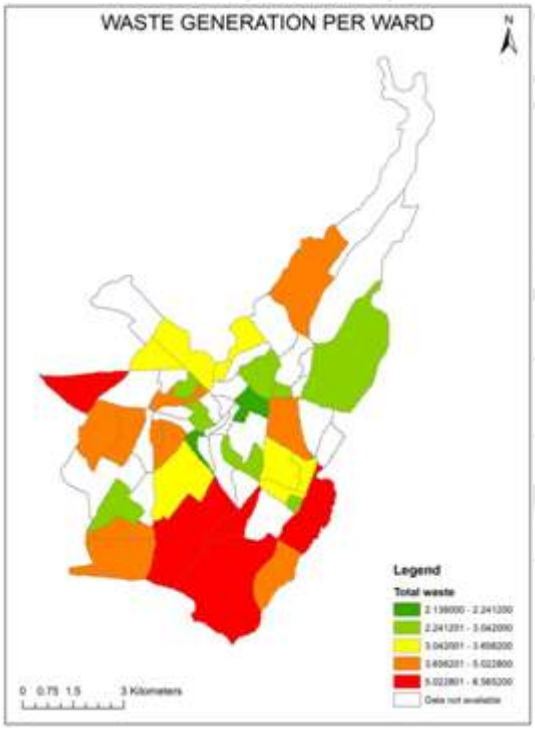

Figure 4: Total Waste Generated per ward

The difference between recyclable, biodegradable, and inertwasteis significant. Of the total waste, about 53.36 percent is biodegradable, about 3.7 percent is inert and the remaining 43.28 percentis a recyclable waste. The settlement along the clock tower, Majra (Sabji Mandi) is the core of the town and generates maximum quantity of recyclable, inert and biodegradable waste; even the different type of waste is high because of local bus stand and markets.

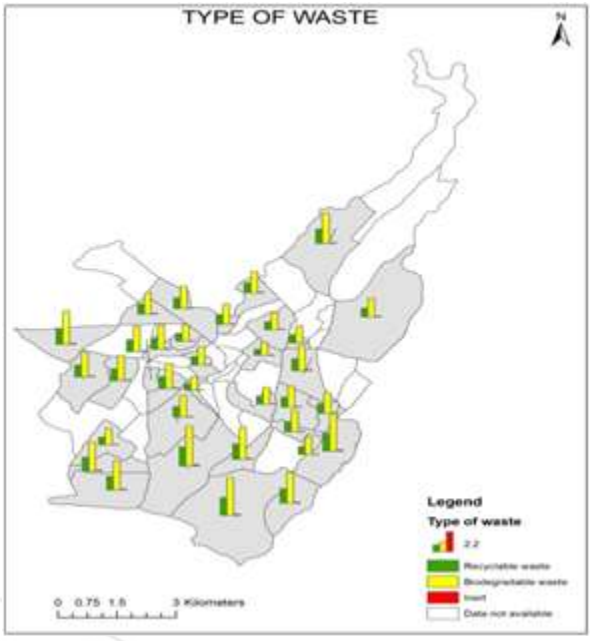

Figure 5: Type of Waste Generated per ward

Generation and Transportation

The analysis of the rate of disposal and generation of solid waste suggest that Dalanwala north has the worst disposal rate. Here more amount of waste is generatedin comparison to the amountthat is being disposed of, leadingto accumulation of waste in the area. The average rate of solid waste generated and transported is 1.9, which range minimum 0.11 in IndraNagar and maximum 3.11 in Dalanwala north.

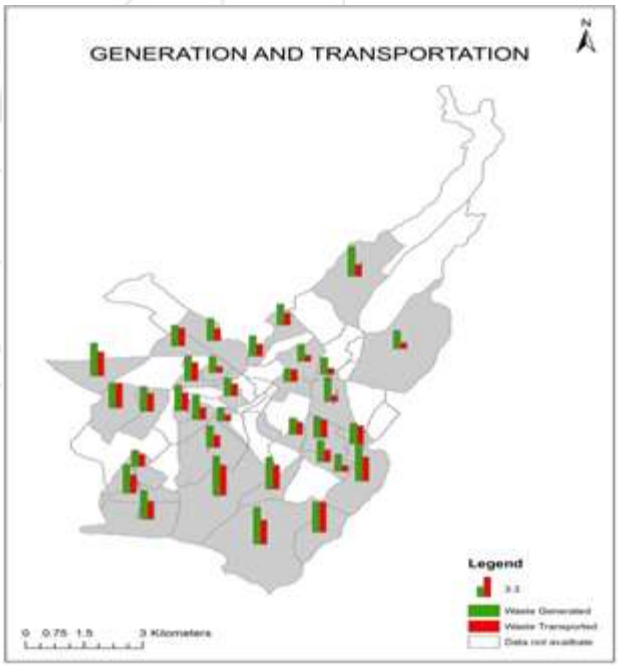

Figure 6: Generation and Transportation of waste in the study area

Waste Collection

It has been seen that uncollected waste has become a common sight in most of the wards. The situation in the inner parts of the town is terrible as less than 49per cent of the waste is collected and disposed of. Whereas, 51 percent of waste is not collected and which increases the amount of

uncollected waste. Various reasons are responsible for this situation like lack of vehicles, lack of sweepers, finances and poor planning. It is seen that the low-income areas of the town have poorer solid waste management practices.

Though the sweeper- population ratioappears verybad, there are variations within the town. Around 36.33 percent wards have good sweeper population ratio and are quite clean, whereas 64.67 percent of the wards have high sweeper population ratio that signifies that these wards are facing shortage of sweeper. The average ratio is 346.74;itranges between 200.10 in Lakhibagh and 535.44 in Rajeev Nagar ward. These variations could be attributed to the political influence and randomness in the deputation of sanitary staff in some wards.

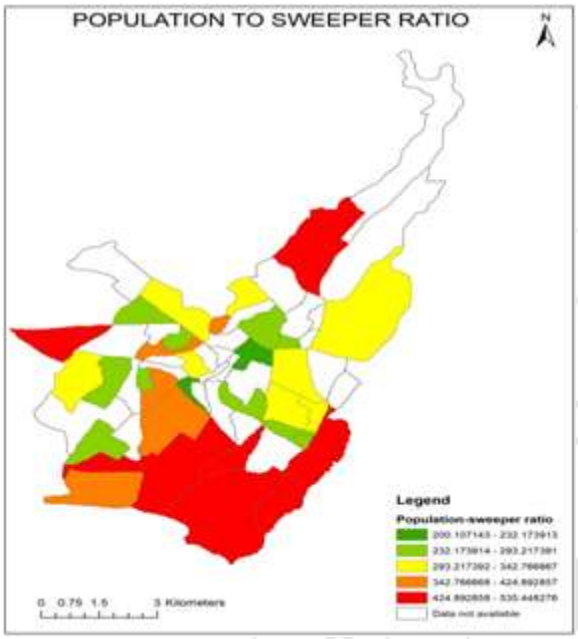

Figure 7: Population-Sweeper ratio in the study area

There are no rules provided by municipal or Nagar Nigam for street sweeping. Generally, the assigned road length for sweeper ranges between 250 to 1000 meters. However, in some place sweepers are allotted an area of about 3000sq. meters or more. The Central Public and Environmental Engineering Organisation (CPHEEO) estimates that a sweeper can sweep 300 to 350 running meters in high-density areas, 500 to 600 meters in medium density areas and 650 to700 running meters in low-density areas. However, in Dehradun, the average is around 858 sq. meters per sweeper.

As per analysis in Dehradun city minimum length-sweeper ratio is 636 Meters in Ballupur ward and the maximum length sweeper ratio is 1173 meters in Yamuna colony. In the remaining wards, this ratio seems to be worse than recommended.This suggests that there is more need of sweepers per ward and as we know that garbage is thrown on the roadside irresponsibly, more number of sweepers need to be deployed for cleaning up of the garbage in the wards.

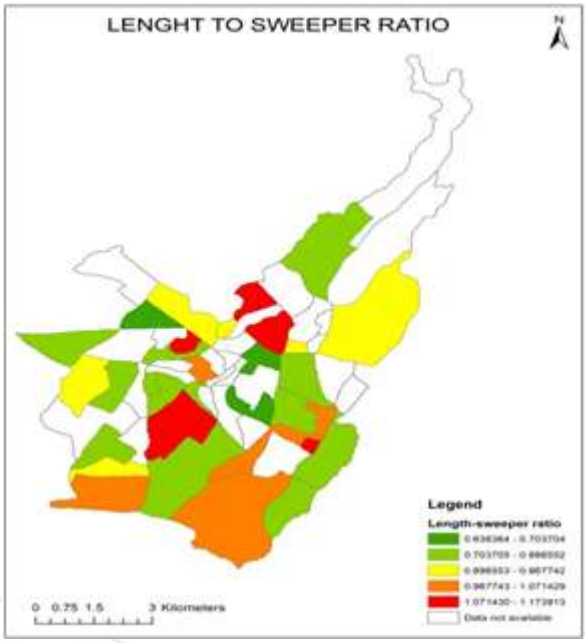

Figure 8: Length to Sweeper Ratio

Population to Dustbin Ratio

From our survey, it is estimated that out of 33 wardsonly 20 wards andabout1, 98,000 persons have one dustbin per ward.This fact is enough to prove the story of waste management. The average ratio is 1:9900, which suggests that one dustbin is not sufficient for these 20 wards.The minimum ratio is 1:6740isrecordedin Niranjanpur, whereas the worst ratio of 1:16413 is in Kargi ward. The analysis shows that this ratio is inverse to the density of the wards. Higher the population density, poorer is the ratio.

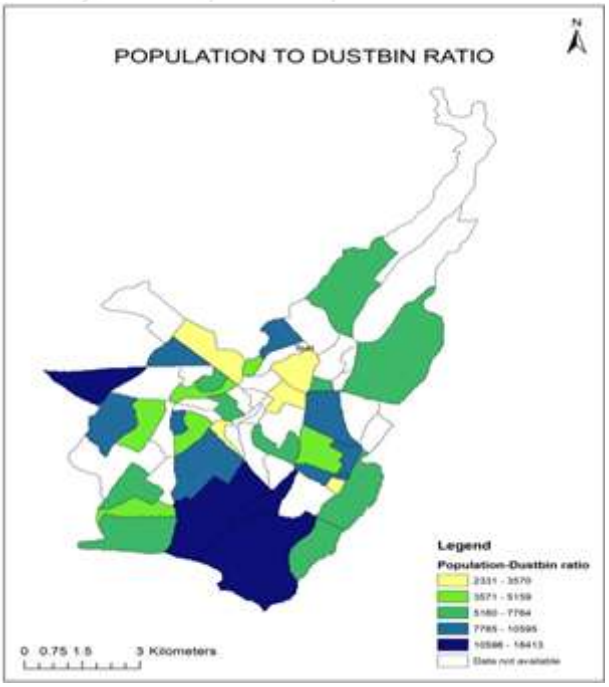

Figure 9: Population to Dustbin Ratio

To improve the existing bin-population ratio, a buffer of 500 meters for every dustbin is drawn in each ward considering the population served. These buffered zones are the areas where thenumber of binsseems to be sufficient forsolid waste collection and proper disposal.

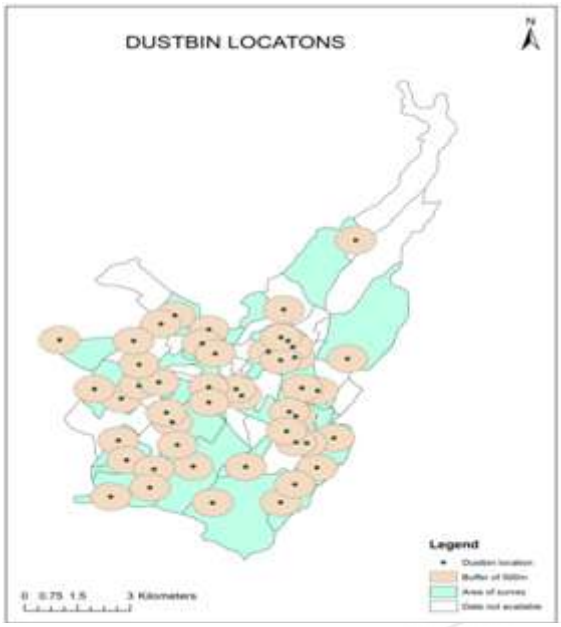

Figure 10: Dustbins with a buffer of 500 metres

5. Conclusion

The configuration of municipal solid waste generation and disposal is related to the cultural and social habits of the inhabitants, their economic status, density of population as well to the availability and distribution of the cleaning mechanism. Being one of the very fast growing capital cities in India, Dehradun is passing through a phase of rapid urbanization and population growth, thus increasing waste volumes considerably. Proper strategies need to be formulated to address this increasing waste generation and their disposal. The present work was able to highlight the areas in Dehradun that are lacking in adequate waste management strategies andcould prove helpful for the decision-making authorities in determining and incorporating proper strategies to address proper solid waste management in Dehradun.

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