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Solid waste management in purulia municipality, purulia, WB: Challenges and opportunities

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Abstract---Solid or semisolid matters that originates from human or animal activities, and which are disposed because they are hazardous or useless are known as solid waste. Solid waste management deals with spatial attributes so the role of GIS is important. It play a significant role to improve collection operation, analysing proper location for dumping, planning the route of transportation and to identify exact site for landfill. The present study tries to trace out the existing condition of solid waste management system at source of generation with the help of GIS and trace the benefit of employing GIS for management of wastes. To fulfil the aim of the study both primary and secondary data have been collected. The secondary data has been collected from Purulia municipality and primary data has been collected with the help of hand-held GPS and with the help of observation method. It is revealed that the existing management system of solid waste at source of generation is not enough for proper disposal. There are various problems lying due to improper management of solid waste disposal. Before the situation turns out to be alarming for health hazards, it is much needed to solve the problem from the very ground level in order to enjoy the benefits of nature and environment.

Keywords---solid waste management system, GIS, solid waste collection centre (SWCC), GPS.

Introduction

Various human activity and development including commercial, physical and social activities tend to produce solid or semisolid waste without proper planning. These are disposed because they are hazardous or useless and needs to be managed properly so that it does not affect the environment or wildlife (Kumar and Pandit, 2013). But depositing of waste illegally or improperly is hazardous to the overall society. So, in order to save wildlife health and environment, Solid waste management with help of GIS plays an important role. It helps to improve the collection operation, analysing proper location for dumping, planning the route of transportation and to identify exact site for landfill. Technological development in computer science coined with GIS give a new dimension in solid waste management and landfill process (Kontos et al., 2003; Edema et al., 2014; Khan, 2014; Danbuzu et al., 2014). With the help of this tool it is easy to display the spatial data as per requirement. In third world country proper management of solid waste is a common problem. The improper management of solid waste pollute environment, it also causes road and residential land encroachment (Nwofe, 2015). In Indian cities the problem of solid waste management is a burning issue and till now there is no scientific management system. We have to go a long way to achieve proper management system of disposing wastes (Mutuku and Mwanthi, 2017).

There is clustering with the R value of 0.95 and the Z- score value is -0.50, this indicates that the pattern does not appear to be significantly different than random. Urban solid waste management programme is moving at a very slow place management is still not adequate. Here the percentage of slum population to the total population is 39%.The problems of solid waste disposal are mainly found in the slum areas. The improper management of solid wastes represents a source of air, land and water pollution and poses risks to human health and environment. There are major issues associated with public participation in waste management (Narayan, 2008; Biswas et al., 2010; Kumar et al., 2017). The Government of West Bengal constituted a Solid Waste Management Mission in the form of a project named as “ West Bengal Solid Waste Management Mission” WBSWMM under the chairmanship of the Chief Secretary, Government of West Bengal. Population growth and particularly the development of megacities and rapid urbanisation is making SWM in India a major problem. Moreover, the current situation in India is its insufficient infrastructure for management of wastes.

In a ward wise comparative study for this article, it is seen that the ward no 6, 16, 22 of Purulia municipality have very good facility of drinking water which is very important aspect of human living, saving excess amount of water, separate toilet facility and proper sanitation facility. Medium condition of these livelihood sustainability facility are seen in ward no 2, 8 and 14. The ward 4, 7,11, 17, 18, 20 and 21 are seen to have worst condition and very worse condition in case of slum dwellers are seen in ward no 1, 5, 9, 12, 15, 19 and 23 on the basis of living sustainability (Mandal et al., 2018).

Study area

Purulia district came into existence as a district of West Bengal in 1956, before that the district was a part of undivided Bihar. It is situated in the western most

part of West Bengal. The latitudinal extension of the district is $22^{\circ}42'35''$ north to $23^{\circ}42'0''$ north and the longitudinal extension of the district is from $85^{\circ}49'25''$ east to $86^{\circ}54'37''$ east. There are 3 Municipalities in the district; those are Purulia, Raghunathpur, and Jhalda. Purulia Municipality has been established in the year 1876. The latitudinal extension of this municipality is from $23^{\circ}18'30''$ north to $23^{\circ}21'00''$ north and the longitudinal extension is from $86^{\circ}21'00''$ east to $86^{\circ}23'45''$ east.

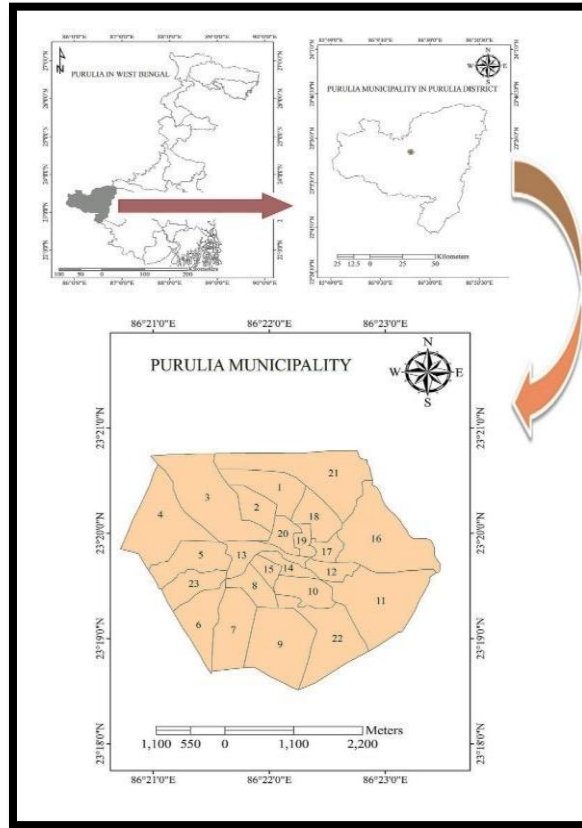


Figure 1. Location of the study area showing the position of the various wards of Purulia Municipality

Objectives

The main objectives of the present work are:

- To study the spatial distribution of solid waste collection centres (SWCC).
- To study the present condition of solid waste management systems at its source of generation.
- To highlight the existing problems related to improper management of solid waste at source of generation and the possible mitigations.

Methodology

The methodological aspects of this present study can be divided into three parts: Firstly, a few numbers of books and a large numbers of topic related articles have been reviewed. Secondly, the secondary data have been collected from Purulia municipality and primary data have been collected with the help of hand held GPS. Along with this, some data is also collected from the field survey of temporary dumping sites of solid waste. Lastly, the collected data have been analysed to fulfil the above mention objectives with the help of MS Word, MS Excel and Arc Map 10.

Results and discussions

The problem of solid waste management is growing severely day by day in various emerging cities and Purulia is no exception (c.f., Rakib et al., 2014). The spatial distributions of SWCCs are displayed below. These are of two types viz. one is cemented and another one is made by plastic.

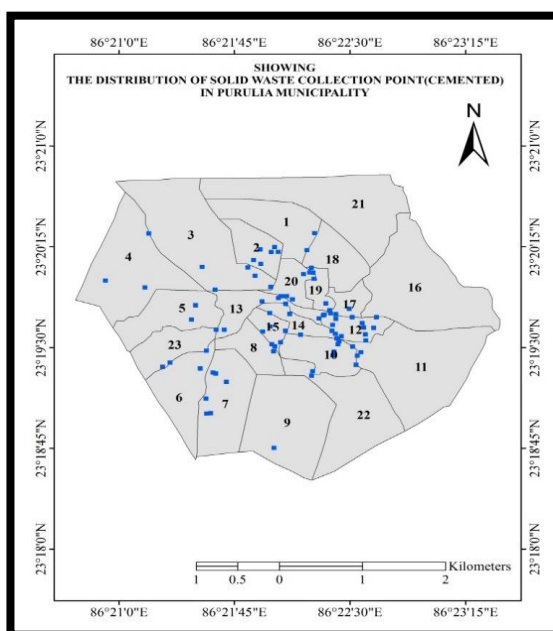


Figure 2. Map of Purulia Municipality wards showing the distribution of solid waste collection points (cemented) in the region.

From figure 2 we can say that ward number 12 have highest number of cemented dustbin to collect the solid waste at source whereas ward numbers 9, 22, 16, 18, 1 and 5 have only one or two cemented dustbin. The important thing to be mentioned is that there is not a single dustbin in ward number 21.

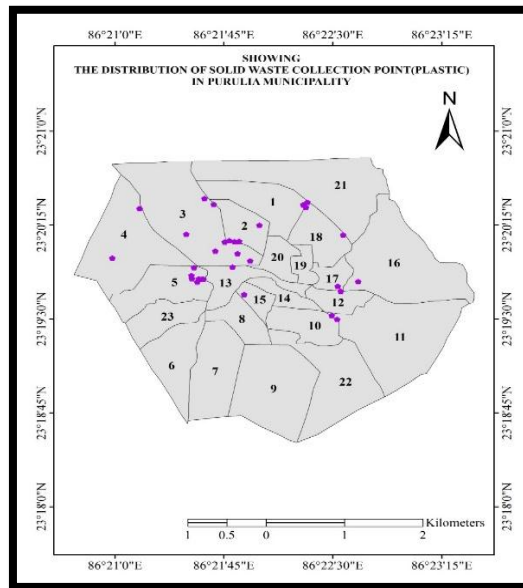


Figure 3. Map representing of the distribution of solid waste collection points (plastic) in Purulia municipality.

From figure 3 it is seen that ward number 3 have highest concentration of plastic made dustbins and ward numbers 23, 6, 7, 8, 22, 21 and 14 have no dustbin made by plastic. The rest of the wards have only one or two dustbins.

Spatial patterns using Nearest Neighbour Analysis of the Solid Waste Collection centres (cemented)

The calculation is done by using Arc Map 10 (figure 4). The result of the analysis shows that there is clustering with an R value of 52.28 and the Z- score value is 915.17. This result indicates that there is less than 1% likelihood that this dispersed pattern could be the result of random chance.

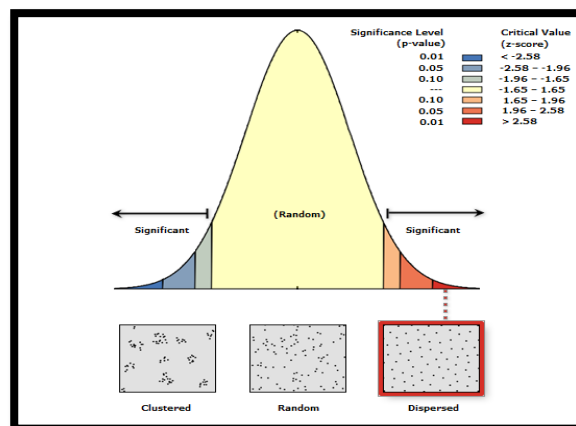


Figure 4. Graph showing the result of nearest neighbour analysis of solid waste collection points (cemented) in Purulia municipality

Spatial patterns using Nearest Neighbour Analysis of the Solid Waste Collection centres (Plastic)

The distribution of solid waste collection points (plastic) in Purulia municipality (figure 5) shows that there is clustering with the R value of 0.95 and the Z- score value is -0.50, this indicates that the pattern does not appear to be significantly different than random.

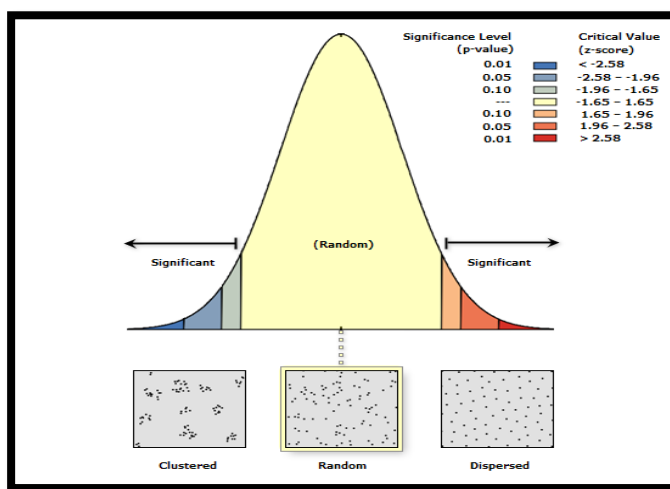


Figure 5. Result of the nearest neighbour analysis of solid waste collection points (plastic) in Purulia municipality

Problems related to improper management of solid waste at source

Any solid waste generated at any site can be categorized in to either biodegradable or non-biodegradable. It has been observed that out of the total garbage organic waste share the major percentage, along with paper, metal, concrete, plastic, glass and many more waste types. Organic waste mostly includes kitchen wastes apart from twigs, dry flowering plants, leaves, vegetable, hotels wastes etc. Paper waste includes the used paper plates after eating, old newspapers, packing paper boxes, paper bags, paper wrappers and many more. Plastic carry bags make the highest percentage for plastic waste never the less also includes broken plastic materials like mug, bucket, pipes, plastic covers and plastic wrapping material etc. Metal waste includes broken and bend nails, nuts and bolts, wires, electronic parts, construction site wastes etc. Glass waste includes broken glass materials for households as well as commercial wastes along with medicine syrup and alcohol bottle, fused glass lamps, bulb and tube lights. Various other wastes includes all types of sanitary waste. The concerned municipality has taken several initiatives regarding solid waste management since long time back. In present, there are 840 *safai karmachari* including both permanent and contractual, 12 tractors, 4 small pick-up vans (TATA ACE), one pic-up van (TATA 407) and three highway compactor which have been launched recently (Purulia Municipality, 2019). In spite of the endless efforts of the municipality there are some drawbacks. The problems related to improper management of solid waste which have been observed in this study area are discussed below.

Air pollution

When air is not suitable for human consumption then it is called as polluted. The air may be polluted from decay of organic waste, emission of toxic materials and the air may also be polluted from open burning of solid waste. Here, the unused part of vegetables and another organic waste are the major source of air pollution. The photograph (Figure 6) showing the useless part of vegetables and fruits left out near road side.



Figure 6. Dumped waste along the road side evidencing the source of air pollution near Madhya bazar region of Purulia Municipality

Environmental pollution

Dumping of solid waste in open space is a threat to the environment. First of all it makes the urban area ugly. The decompose-able waste may emit toxic gases and the non-decompose able solid waste materials may cause water and soil pollution in many way. As mentioned earlier a number of wards are there which have no dustbins thus open dumping is practiced here. The photograph (Figure 7) displaying the picture of open dumping ground of solid waste.

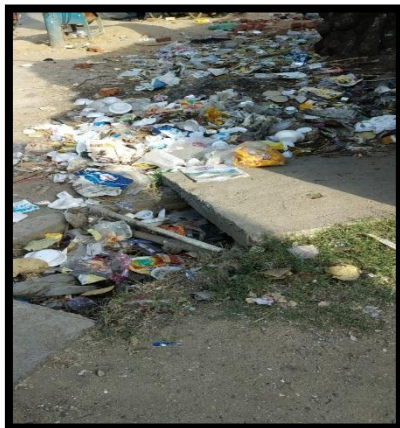


Figure 7. Pockets of open dumping ground of solid wastes; one at Raghabpur more near Purulia Municipality.

Road encroachment

Road is one of the most important mediums of connecting people and exchanging goods from one place to another place. Road should be clear so that the places are easily accessible and it also reduce the risk of accidents. But in most of the developing countries the road is illegally occupied by spread of the solid waste materials along the road in case of open dustbin. In various parts of Purulia municipality the solid waste occupies the road. The photograph (Figure 8) highlights how the road is occupied by solid waste. Figure 8. Pocket of open dumping ground of solid wastes near Purulia Railway station showing gradual road encroachment.

Residential land encroachment

Land is more valuable than any other subsistence especially in urban area. Land is supposed to be used for different purposes to gain more profit. In the study area a large amount of land are encroached as illegal solid waste dump sites. The captured photograph (Figure 9) shows how the un-constructed residential lands are misused due to improper management of solid waste.

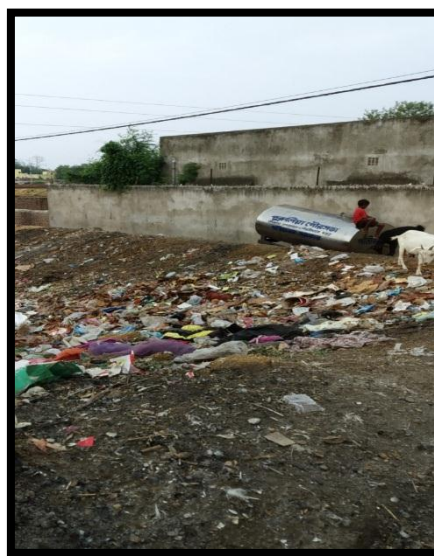
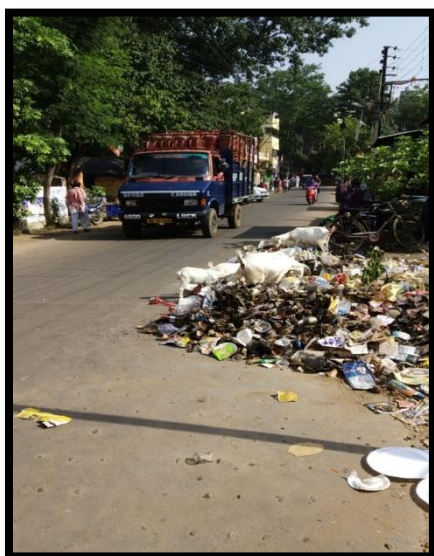


Figure 9. Residential land encroachment through dumping of wastes in ward number 21

Health Hazards

According to the field surveys and results of this study it is apparent that the local people are conscious of the fact that if they are exposed to the harmful and pungent solid wastes it may lead to different types of diseases. Already people are suffering from various health issues are sourced from the solid wastes like common cough and cold, allergies, skin problems, frequent diarrhoea, respiratory problems, malaria etc. The problem is exaggerated when in the same dumping area, diseased person's wastes are also dumped haphazardly and carelessly that increase the spread of infections. Waste extracts also percolates up to the

groundwater that increase the risk of groundwater contamination and infections as the well water is used for drinking, domestic and commercial purposes. It is observed that the people living in these areas will sooner or later has the tendency to develop health and hygienic complications like as allergies, asthma, bronchitis, skin irritation-rashes and gastro intestinal syndromes.

Conclusion

The municipal authorities have been trying to make the community conscious and educate people how to handle the various types of wastes and packaging and proper disposal. They have been repeatedly instructing people not to throw litter, plastic carry bags here and there and store their wastes may it be domestic or establishment/commercial level and do proper disposal. Although in many places in our country, there is the absence of a basic facility of collection of waste from source; however, still there are pockets containing dust bins at many street corners for disposal of wastes. But still it is unfortunate to observe that people have grown a bad habit to dump waste on the streets, open spaces, drains and water bodies and anywhere they feel like thereby creating unhygienic conditions for themselves only without even bothering (Okalebo et al., 2014). People have grown a conflicting mentality of considering that waste can be thrown on the streets as these would be picked up by the municipality through street sweeping and carriage vans. Thus air, water and soil pollution is a major threat to both human health and environment, especially pollution from unscientific disposal sites that leads to acute health complications to the surroundings inhabitants (Visvanathan and Trankler 2003).

On the other hand the municipal authorities have selected particular sites as dump-yards in the nearby outskirts of the town to deposit the daily solid wastes haphazardly without any precaution or sealing of the wastes. These sites generate foul smell and are affluent breeding grounds for flies, rodents and pests. Liquid extracts from the rotting organic waste called leachate pollutes percolate and contaminate underground water and poses a serious threat to health and environment. Also these dumping grounds are set on fire that leads to an added problem of smoke in the nearby region. People residing in the vicinity of these types of polluted region are reported to have a higher risk of asthmatic and cardiovascular diseases (Nautiyal et al., 2007).

For obtaining a very wide range of information rapidly of a large region the geographical information system (GIS) is generally deployed for spatial analysis. In the present study too the GIS system is deployed for viewing and analysing of solid waste disposal in the region. This tool straightforwardly helps to simplify spatial data and ease interpretation for waste management of the dumped materials in outskirts and also monitoring the spread of the dumping ground. It has been observed that the spatial distribution of SWCCs is neither equal nor proportionate with respect to the population of all the wards. Moreover, the collection and disposal of the solid wastes lacks planning and needs substantial modification of the existing management system. Although the residents are aware enough, still they are still made aware through various programs about the deficiencies and hazards of dumping wastes unconsciously and incautiously in open areas. Unfortunately even after all these cautions still various problems exist

due to improper management of solid waste that are disposed in the region. In a country like ours where the population is very high and management system needs modifications and modernization, the GIS technology has been very helpful to monitor large areas of waste disposal and management extremely rapidly and easily and in a cost-effective manner. Data are captured from aerial photography, videography, and optical, thermal, microwave or LiDAR sensors is integrated with attribute and layers of prerequisite information which could make it easy to understand the area's waste generation nature and trend. These trends are useful during planning waste management and disposal. These provide remedies while dealing with such severe environmental issue.

Conflict of interest

The authors declare no conflict of interests.

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