International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2763
Issue 04, Volume 3 (April 2016) www.ijirae.com

A study Report on Implementation of GIS in Solid Waste Management

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Abstract - Increasing human population and economic development and urbanization has resulted in generation of huge quantities of municipal solid waste (MSW). It involves many activities like collection, transportation and disposal of wastes. There is tremendous amount of loss in terms of environment degradation, health hazards and economic descend, due to direct disposal of waste. It is better to segregate waste at initial stages where it is generated. Planners are thus forced to consider alternate and available means of disposal, especially by minimizing damage to the ecosystem and human population. GIS has proved to be boon to such planners by visualizing the real solid waste situations and facilitating route analysis through mapping. A Geographic Information System (GIS) is a computer system for capturing, storing, checking and displaying data related to positions on Earth's surface.

Keywords- MSW, Environmental degradation, GIS, segregate, route analysis

I. INTRODUCTION

Solid Waste is unwanted or useless solid materials generated from combined, residential, industrial and commercial activities in a given area. It may be categorized according to its origin such domestic, institution, industrial and commercial activities in a given area. It may be categorized according to its origin such as domestic, institution, industrial commercial activities in a given area. It may be categorized according to its origin such as domestic, institution, industrial and commercial activities in a given area. It may be categorized according to its origin such as domestic, institution, industrial, commercial, construction etc. according to its contents like organic materials , glass, metal, plastic paper etc. or according to hazardous materials such as toxic,flammable,infectious or radioactive substances. A number of processes are involved in effectively managing waste for a municipality. These include monitoring, collecting, transport, processing, recycling and disposal.

The most common problems associated with improper management of solid waste include diseases transmission, fire hazards, odor nuisance, atmospheric and water pollution, aesthetic nuisance and economic losses [1]. In general a 1% increase in population is associated with 1.04% increase in solid waste generation and 1% increase in capita income is associated with 0.34% increase in total solid waste generation) [21]. It is estimated that about 10% of each person's production life is lost as a result of waste related disease. [3]. GIS can recognize, analyze and correlate the spatial relationship between mapped phenomenon the software also has provision for querying thereby enabling policy makes to link disparate sources of information, perform sophisticated analysis, visualize trends, project outcomes and strategize long term planning goals[4].

II. REVIEW OF LITERATURE

1. Estimation of waste generation – Shoba and Rasappan (2013) took study area of Coimbatore. Population distribution map is prepared thematically to identify area based on population and Natural break classifier is used to classify the population into six classes, to classify the waste generation and distribution of ward workers. Inventory questionnaire is used for data on solid waste generation, collection, treatment and disposal. ARCGIS is used for analysis of data. Katpal and Rao (2012) [6] developed a computer based information systems which offers decision making capabilities with geographic parameters. Satellite data and linear regression analysis technique was used to generate indices for computing physical and chemical characteristics of solid waste for residential land use classes.
2. Waste Temporary Storage Bin Placement- Senthi (2012) reports the present scenario of inconvenient bin placements in ward (number 45) in Kumbakonam town, Tamil Nadu. India dust bins were not used by all households due to lack of accessibility and inconvenience as the location of bins is not found in optimum location. (Centroid analysis with help of GPS survey and ARCGIS were used which shows the centroid settlement pattern of the ward.
3. Waste collection Route optimization Collection and transportation is responsible for 70-80% of total waste management cost [7], [8] have proposed a GIS based collection and transportation model for MSMW and test checked it for Pallavapurum municipality.
4. A GIS based routing model was used to develop an optimal route map for efficient transport system. The parameters considered included population density, waste generation, capacity, road network, storage bins and collection vehicles.

The developed route map could be used to trace the minimum distance as well as efficient collection paths for transporting solid waste from collection points to final disposal site trough transfer stations. The proposed model can be used as a decision support tool by municipal authority for efficient management of daily operations for moving solid waste , load balancing within vehicles, managing fuel consumptions and generating work schedules for workers and vehicles.

5. Dumpsite selection –Natesan and Suresh (2002) [9] developed a GIS based decision support system for sanitary landfill site selection. The themes identified for purpose included land use, geology, geomorphology, drainage density, slope, soil and runoff. The factors considered for selecting themes were permeability characteristics, Susceptibility to erosion, runoff, settlement and load carrying capacity of strata, absence of faults and joints, slope of ground and ground water potential.
6. GIS (GEOGRPHIC INFORMATION SYSTEM) -It is a computer tool used for capturing storing querying analyzing and displaying spatial data from real world for a particular set of purposes. This technique is used to generate optimal route for collecting solid wastes. GIS is a tool that not only reduces time and cost of site selection, but also provide a digital data bank for future monitoring program of site. B. Shobha and DR.K Rasappan October 2013 [10] showcased application of GIS in solid waste management for Coimbatore city.

III. METHODOLOGY

A) Data Entry – ArcView GIS 3.2a software is used to create maps and for analysis of data base.
B) Mapping Technique –The images are converted into raster forms and then the image was projected using Geographic latitude and longitude over raster level, new layer is digitized with special points. The entire layer was saved as shape file.
C) Thematic Mapping – For the present study natural break classification techniques were used to classify waste generation for thematic mapping

IV. SOLID WASTE MANAGEMENT PLANNING AND APPLICATION OF GIS IN SOLID WASTE MANAGEMENT

In India the systems of Urban Solid Waste Management are coming progressively costly and complex. To comprehend solid waste management challenges and issues information was accumulated from diverse sources to achieve goals of study. Accessibility of area for transfer of metropolitan waste is getting rare. Landfills have made different issues like ground water sullying and the uncontrolled emanation of gases initiating irruptions. Solid waste management, i.e. SWM has three fundamental segments accumulation, transportation and transfer. It was discovered handy to look into execution of waste and ecological information about accumulation and transfer stations and available landfill areas through ARCGIS ESRI programming.

Planning is the first step in solid waste management. A solid waste management plan will help your tribe to take institutional, social, budgetary, investment, specialized and ecological elements into attention as it administrates its waste stream. A waste management plan is a report that can help, guide your neighborhood's SWM endeavors.

It can help you in the following way-

1. Define and comprehend current waste management practices and the system set up
2. Identify issues and insufficiencies with present system.
3. Identify chances for development of the present system.
4. Set necessities for activity to address issues and influence change.
5. Measure advance to actualize the measures.
6. Identify the assets required and advance plans.
7. Revisit and change necessities as plan improves.

Key choices your tribe can address in planning includes

1. How important is waste reduction as a priority compared with other SWM priorities?
2. What opportunities exist for waste reduction?
3. Which material can be recycled?
4. What type of waste and recyclable collection system can tribe use?
5. What type of disposal system can the tribe use?
6. What will the present and future costs of the waste management program be?

7. What resources does the tribe need to implement its solid waste management plan?
8. What resources are available in tribe?

Solid waste management plan steps –
SWM planning is particular to every tribe. The accompanying steps plot general process needed to improve your solid waste management plan.

Step 1.Develop a profile of planning area. Order information on the populace, number of families and assessed development rate of your tribe. This can incorporate information on any planned financial advancement.

Step 2.Define solid waste generators within the planning area. Analyze sum of private, business, metropolitan solid waste generators in your planning region.

Step 3.Identify existing waste management practices within plan area. Where is waste going now? Are people of same area or neighborhood are reusing materials?

Step 4.Conduct a waste assessment audit

Step 5.Estimate future waste generation quantities

Step 6.Develop waste handling options

Step 7.Identify existing regional programs or infrastructure that the planning area might use.

Step 8.Develop costs for waste handling options.

Step 9Compare options based on criteria defined by tribe. Look to your objectives to help you to improve the criteria for looking for choices and prioritize the criteria.

Some normal criteria incorporates

1. Environmental effects
2. Relative expenses
3. Potential to make occupations in the tribe
4. Operation and support challenges
5. Regulatory prerequisites
6. Degree of tribal control

V. COMPONENTS AND MEASURABLE AND TANGIBLE BENEFITS OF GIS

A geographic information system (GIS) is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. GIS can show many different kinds of data on one map. This enables people to more easily see, analyze, and understand patterns and relationships. With GIS technology, people can compare the locations of different things in order to discover how they relate to each other. For example, using GIS, the same map could include sites that produce pollution, such as gas stations, and sites that are sensitive to pollution, such as wetlands. Such a map would help people determine which wetlands are most at risk.

GIS can use any information that includes location. The location can be expressed in many different ways, such as latitude and longitude, address, or ZIP code. Many different types of information can be compared and contrasted using GIS. The system can include data about people, such as population, income, or education level. It can include information about the land, such as the location of streams, different kinds of vegetation, and different kinds of soil. It can include information about the sites of factories, farms, and schools, or storm drains, roads, and electric power lines.

Data in many different forms can be entered into GIS. Data that are already in map form can be included in GIS. This includes such information as the location of rivers and roads, hills and valleys. Digital, or computerized, data can also be entered into GIS. An example of this kind of information is data collected by satellites that show land use—the location of farms, towns, or forests. GIS can also include data in table form, such as population information. GIS technology allows all these different types of information, no matter their source or original format, to be overlaid on top of one another on a single map.
GIS maps can be used to show information about number and density. For example, GIS can be used to show how many doctors there are in different areas compared with the population. They can also show what is near what, such as which homes and businesses are in areas prone to flooding.

With GIS technology, researchers can also look at change over time. They can use satellite data to study topics such as how much of the Polar Regions are covered in ice. A police department can study changes in crime data to help determine where to assign officers. GIS systems are often used to produce three-dimensional images. This is useful, for example, to geologists studying faults. GIS technology makes updating maps much easier.

Updated data can simply be added to the existing GIS program. A new map can then be printed or displayed on screen. This skips the traditional process of drawing a map, which can be time-consuming and expensive. There is no limit to the kind of information that can be analyzed using GIS technology.

VI. IMPLEMENTATION OF GEOGRAPHIC INFORMATION SYSTEM (GIS)

The second part of the system comprises of a geo database holding all the districts in the Mexican Republic. It likewise incorporates the base maps (for a chose study zone) and shape files that might permit the system to do the spatial dissection to find potential places for sterile landfills inside a chose district. The Table demonstrates to a portion of the limitations that are to be taken consistent with NOM-083- SEMARNAT-2003.

TABLE 1: DISTANCES AND RESTRICTIONS TO INFRASTRUCTURE TO BE PRESERVED WHEN SELECTING LANDFILL SITES

Attribute	Distance to
Airports	> 2 Km
Towns and cities (with more than 2500 inhabitants)	> 0.5Km
Lakes, rivers, water courses	> 2 Km
Natural protected areas (ANPs)	out
Water wells	> 1.6 Km

Not all the confinements said in NOM-083-SEMARNAT-2003 are suitable to be put forth in the GIS. Thus, the limitations were decreased to those that might be spoken to in manifestations of vector or raster information in the GIS. Then again, different characteristics which are not pondered in the standard were chosen to be included for instance, soil sort, land utilize, presence of ways, and so on.) to supplement the information given to the client. These characteristics may not be that discriminating for landfill choice, however might be suitable in choice making. The system then performs an arrangement of spatial examinations (cushion creation essentially) to find potential suitable destinations for landfills. Figure shows how the effects of the spatial breakdowns part look like:

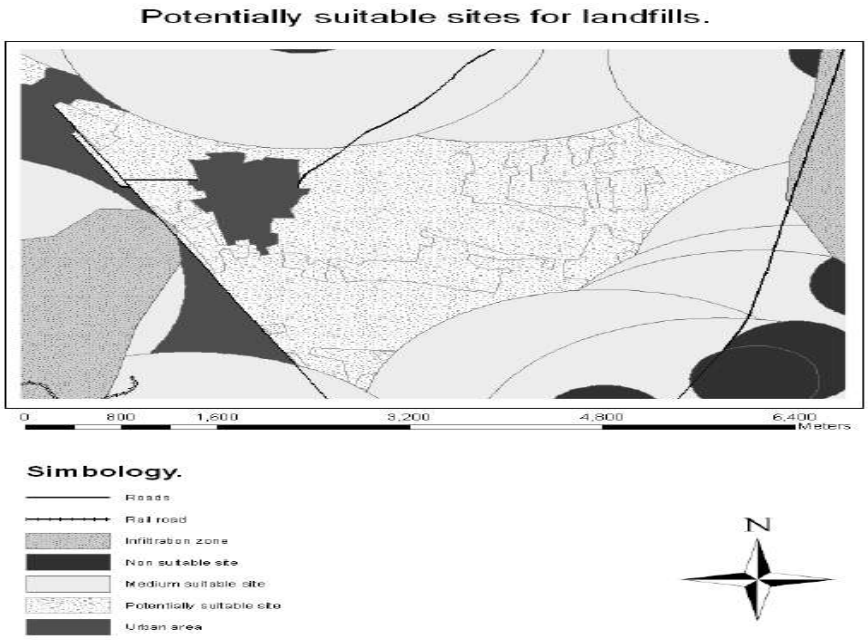

Fig 1: Layout with results of potential sites for landfills (in the municipality of San Luis Potosí, SLP, Mexico).

VII. CONCLUSION

The municipal officers and local workers involved in solid waste management should be clear about the function and their role in terms of managing cities effectively with help of GIS system. Thematic maps will help to identify and monitor more generated waste. The assignment of waste management comes to be more unpredictable as the populace increments. The moving capability of GIS in taking care of extensive volume of geospatial information requires its inclination to the utilization of accepted technique for waste management. In this study GIS innovation was utilized for the advancement of a strategy for the optimization of blended MSW gathering. The system employments different geographical information (way organize, area of waste canisters, arrive utilizes and so on) in co-operation with progressed spatial dissection GIS instruments.There is need to improve data system of solid waste for monitoring and management to support environment reports. GIS can be used at various levels in MSW management in India.

REFERENCES

[1] Jilani T ;(2002) State of solid waste management in Khulna City. Environment science Discipline, Khulna University Khulna, Bangladesh 25-85
[2] Wang, Hi, He, J., Kim, Y. And Kamatta, T., (2011). Municipal Solid Waste management. In small Towns: An economic Analysis conducted in China. Policy Research paper, 57-67
[3] Al-Ansari N.K.Hanbali, A.Al and Knutssoon S. (2012) locating solid waste landfills in Mafraq City, Jordan. Advance Science and Engineering Research, 2(1) 40-51
[4] Malczewski, J., 1996 A GIS based land use suitability analysis, a critical overview, Progr. Plan. 62(1) 3-65
[5] Shoba, B., and Rasappan, K ;(2013) Application of GIS in solid waste management for Coimbatore City. International Journal of scientific and Research Publications, 3(10)
[6] Katpatal, Y.B and Rama Rao, B.V.S, (2010) urban spatial decision support system for municipal solid waste management in Nagpur urban area using high resolution satellite data and GIS. Journal of urban planning and Development.
[7] Karadimas N.V and Loumous V.G (2008) GIS based modeling for estimation of municipal solid waste generation and collection. Waste management and research, 26,337-346
[8] Kanchanabhan, T.E., Mohaideen, J.A, Shrinivasan, S., and Sundaram, V.L.K (2010).Optimum municipal solid waste collection using GIS and vehicle tracking for Pallavapuram municipality. Journal of waste management and research.
[9] Nateshan. U and Suresh, ESM (2002), Site suitability evaluation for locating sanitary landfills using GIS , Journal of Indian Society of Remote Sensing , 30(4)
[10] Shoba, Dr.K. Rasappan; Application of GIS in solid waste management for Coimbatore City. International Journal of Scientific and Research Publications, Volume (3), Issue 10, October 2013.

