Original Research Paper

Environmental Science

APPROACH OF BEST SOLID WASTE MANAGEMENT BY GEOINFORMATICS TECHNOLOGY

Dr.Uma Devi Randhi*	Assistant Professor, GITAM University, Hyderabad *Corresponding author
Dr. K.Santosh Kumar	Assistant Professor, H&S, Methodist college of Engineering and Technology, Abids, Hyderabad

ABSTRACT System appears to be a major problem due to the complication and the wide nature of waste production. Different criteria are working in determination of an appropriate place for disposal; each of them is of high importance and may cause specific restrictions as to the selection of the location. The ultimate aim of these criteria is the selection of a site that is likely to have at least possible detrimental environmental effect on the nearby area. The pollution of underground water and soil of surrounding area can be considered as some of these bad effects. In this study, it is proved that geospatial system can serve as an efficient way of employing and managing various data in locating more appropriate places for the disposal of solid waste.

1. INTRODUCTION

Solid waste generation is a continually growing problem at global, regional and local levels. Solid wastes are those organic and inorganic waste materials produced by various activities of the society, which have lost their value to the first user. Improper disposal of solid wastes pollutes all the vital components of the living environment (i.e., air, land and water) at local and global levels. Urban society rejects and generates solid material regularly due to rapid increase in production and consumption. The problem is more acute in developing nations than in developed nations, as their economic growth as well as urbanisation is more rapid. This necessitates management of solid waste at generation, storage, collection, transfer and transport, processing, and disposal stages in an environmentally sound manner in accordance with the best principles of public health, economics, engineering, conservation, aesthetics and environmental considerations (Burrough and Rachael, 998).

Increasing population, the rapid economic growth and the rise in community living standards accelerate municipal solid waste (MSW) generation in developing cities. Municipal solid waste management (MSWM) is one of the critical environmental challenges of rapid urban development facing the developing countries.

Composition of Municipal Solid Waste in India

In India the biodegradable portion dominates the bulk of Municipal Solid Waste. Generally the biodegradable portion is mainly due to food and yard waste. With rising urbanization and change in lifestyle and food habits, the amount of municipal solid waste has been increasing rapidly and its composition changing.

Adverse Effect of open dump

Open dumping can include solid waste disposal facilities or practices that pose a reasonable probability of adverse effects on health or the environment.

- The health risks associated with illegal dumping are significant. Areas used for open dumping may be easily accessible to people, especially children, who are vulnerable to the physical and chemical hazards posed by wastes.
- Rodents, insects, and other vermin attracted to open dump sites may also pose health risks. Dump sites with scrap tires provide an ideal breeding ground for mosquitoes, which can multiply 100 times faster than normal in the warm stagnant water standing in scrap tire causing several illnesses.
- Burns and other injuries can occur resulting from occupational accidents and methane gas exposure at waste disposal sites.
- Air pollution: Dust generated from on-site vehicle movements, and placement of waste and materials.

- Water pollution Runoff from open dump sites containing chemicals may contaminate wells and surface water used as sources of drinking water open dumping can also impact proper drainage of runoff, making areas more susceptible to flooding when wastes block ravines, creeks, culverts, and drainage basins & also contamination of groundwater resources and surface water from leachate emissions.

2. INTEGRATED STUDY FOR SITE SELECTION

The spatial and attribute digital database generated are further integrated for subsequent data analysis in GIS. Buffers are generated for the exclusionary screening criteria e.g. 100m buffer around tanks and other water bodies, 200m buffer around major roads etc. and the area lying within the buffers are excluded for landfill siting. All the non-exclusionary data layers are integrated and overlay analysis performed. All the non-exclusionary criteria considered for site selection are ranked and weighted using Analytic Hierarchy Process (AHP) after the development of decision hierarchy for preparation of a final suitability map for selection of disposal site (Mather, 1998).

3. OPTIMUM ROUTE ANALYSIS FOR TRANSPORTATION OF SOLID WASTE

In early times, the transportation and disposal of human and other wastes produced in the city did not pose significant problem as the amount of waste generated and the distance between the point of generation and disposal was less. But, as the population increased, more land was occupied for residential and commercial purposes. As a result, the dumpsites had to be relocated to far off places in order to reduce its impact on the public health, which in turn requires provision of better transportation facilities for the transfer of wastes to the dumpsites. Therefore optimization of the route or selection of the shortest route to the dumpsite considering the transportation costs including the fuel efficiency is very much essential.

The data required for carrying out the optimal route analysis include ward details of study area, solid waste collection points, transfer stations, disposal sites and detailed road network of study area that include road length and type of roads (Anji, 2001). The road network map is prepares from the Survey of India (SOI) toposheets in 1:50,000 scale and by updating using satellite imagery. These paper can drawn maps are converted into digital maps through digitization using AutoCAD and editing process available in ARC/INFO. Software used in finding the optimal route for transportation of solid waste from the existing transfer stations to the final disposal sites is ArcView GIS. This software is a desktop GIS with an easy-to-use, point-and-click graphical user interface (GUI) that easily load spatial and tabular data. ArcView provides the tools needed to query and analyze the data and present results as presentation-quality maps. Network Analyst is an extension

product of ArcView designed to use networks more efficiently (Mishra, 1998) . It can solve common network problems on any theme containing lines that connect. The ArcView Network Analyst (AVNA) extension module allows the user to solve three categories of network analysis problems; Find Best Route, Find Closest Facility and Find Service Area . Find Best Route problems involve finding the "least cost impedance" path on the network between two or more stops. Find Closest Facility pertains to finding the distances from an event to the nearest facilities, or vice versa, finding the distance from a facility to one or more events. Find Service Area determines the area that a particular facility can serve within a given time or cost frame.

4. Finding Best Route

A variety of route optimization criteria or planning criteria may be used in route planning. The quality of a route depends on many factors such as distance, travel time, travel speed and number of turns. Some prefer the shortest path based on distance and some prefer based on travel time (Lillesand and Ralph, 2000). The route selection criteria can be either fixed by a design or implemented via a selectable user interface. In the current project route selection is via user interface. In the optimization of the travel distance (road segment length), distance was stored in digital database and the route planning algorithm was used.

After adding the road network theme, there are two options to add the stops for which a route should be calculated i.e. either by interactively selecting stops graphically from the view, or by loading a point theme that holds the stops (Freeman et al., 2004). In the present study, the location of transfer stations and collection points are added and overlaid onto road network as a point theme and final disposal site locations are added as a separate theme on the road network. These locations are selected graphically from the view during route analysis. The steps involved in finding the best path with user given origin and destination are described as follows:

- Open ArcView
- Add the road network theme in a view
- Keep the roads theme active
- Go to Network > Find Best Route
- AVNA now adds a route theme to the view and presents a new dialog box.

There are two options to add the stops for which we want to calculate a route, either by interactively selecting stops graphically from the view, or by loading a point theme that holds the stops (Nathanson, 2003).

Selecting Stops Interactively

- Click the Add Location icon in the menu bar:
- Then click in the view to select stops (transfer station and final disposal points).

These are added to the dialog box as we click them. The order of stops can be changed by highlighting (clicking) them. Stops can also be deleted by clicking the delete "X" button. In addition we can use the check boxes to choose whether we want AVNA to find the best order of stops, and/or whether you want to return to the origin (the first stop in the list). Properties allow us to choose the shortest path based on shortest distance.

- Just add a couple of stops, then click the Solve icon.
- AVNA will now build the topology and run the analysis. When done, AVNA will add a display route in the window.
- Click Directions.
- This gives you turn-by-turn directions for the entire route.
- Click Done.
- If there are a number of stops, check the Find best order box, and then click the Solve icon again to get a different route.
- We can save the different alternatives as different routes separately:
- Make the calculated route active in the View window.

- Theme > Convert to Shape file > Select a name and a folder > Accept to add the theme to the view.
- When done running and saving the different alternatives we want to display, delete the default route theme.

The graphical output in the form of a map indicates the route to be traversed along with the distances and directions to be traversed along each road segment gives complete description of the route with least impedance.

REFERENCES

1. Anji Reddy.M, textbook of RS and GIS, second edition, B.Spublications, Hyderabad, 2001
2. Burrough Peter A and Rachael A Mc Donnell, Principles of GIS, Oxford University press, New York, 1998.
3. Freeman and Koushik P.A, U.Al-Duaij and W.Al-Ghimlas Collection and transportation cost of household solid waste in Kuwait Waste Management, Volume 24, Issue 9, 2004, pages 957-964.
4. Lillesand M Thomas and Ralph w keiferi, remote sensing and image interpretation, John wiley and sons, Newyork, 2000.
5. Mather. M Paul, Computer Processing of Remotesensing images, an introduction
a. Second edition, JOHN WILEY &SONS, newyork,1998.
6. Mishra H.C,"Introduction To Satellite Remote Sensing", GIS India,1998. Nathanson Jerry. A,"basic environmental technology"prentice hall of India; 2003.