Network Analysis of Solid Waste Management System In Dalanwala Ward (Dehradun)

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Abstract

In recent decades process of urbanization in India is significantly faster than before. It is result of rapid industrialization and the liberalization policies adopted in the new free market economy. It has positive as well as negative consequences. Increase in GDP, rising standards of living of urban population in one hand on the other hand degradation of environment, pollution, social degradation, slums and solid waste disposal becomes major problems. Dehardun is one of the important metabolites of Uttarakhand state. Solid waste management in this city is also a major concern. Hence study is carried out for suggesting some measures to solve the problem of solid waste disposal. Network analysis has become inevitable for determining appropriate routes for collection of wastes and determining shortest routes for disposal of it at dumping site. Network analysis is the method of understanding and analyzing existing network system qualities for a particular developmental initiative. (Liberalization, GDP, Multi Factor Evaluation)

1. INTRODUCTION:

In recent decade urbanization is increasing significantly. Indian cities are one of the fastest growing in terms of population and in geographical area among most of the cities outside India. More than forty five percent of the total population in India is living in urban areas. Thus, post independence, while the population of Indian has grown three times, the urban population has grown five times. The urban population in the country is expected to rise India’s population is likely to reach around 1.50 billion (50%) by 2030. Migration flows from rural to urban area and even from small urban centers to metabolites is increasing.

Rapid urbanization has variety of consequences. They are positive as well as negative. Multifaceted economy grows in the metabolites and even in the small cities. Lots of negative impacts include increase in slums, unemployment, pollutions and the most important aspect is of solid waste generation. Solid waste management in the cities hampered lot because of lack of co-ordination and planning. Solid waste management is an activity, where public participation holds the key to its success. The local body can never be successful in solid waste management without active community participation. Awareness and education campaigns need to target municipal authorities, the elected representatives, schools, NGOs, media, traders associations, the family and the public at large.

Identification of optimal path along a linear network for urban solid waste management is one of the critical issues of urban planning. Network analysis has become inevitable for determining appropriate routes for collection of wastes and determining shortest routes for disposal of it at dumping site. Network analysis is the method of
understanding and analyzing existing network system qualities for a particular developmental initiative.

Various analytical tools available under Geographic Information System (GIS) environment help in processing the data as also in studying geographical distribution and variance of different parameters so as to assess different services providing by the Municipal Corporation. A network is linear features that are inter connected in GIS. Common examples of network includes highways, major roads, minor roads, city streets, transportation routes, drinking water supply, transit, school and educational institutes routes, tourist interest sights routes and solid waste collection routes etc.

Geographic information system based approaches have often been used to optimize the use of public resources for planning the collection of solid waste and location of waste disposal site. It is universally established that remote sensing and GIS tools play a major role in various infrastructure development initiatives. Several decisions taken by different planning agencies require spatial analysis of maps involving many parameters.

2. LITERATURE REVIEW:

There is significant amount of literature dealing with Network analysis. According to M.K. Ghosh, Uncontrolled growth of the urban population in developing countries in recent years has made solid waste management an important issue. Very often, a substantial amount of total expenditures is spent on the collection of solid waste by city authorities. Optimization of the routing system for collection and transport of solid waste thus constitutes an important component of an effective solid waste management system.

Carver (1991) illustrated that identification of waste disposal sites is a complex spatial problem involving multiple criteria and objectives that require the use of spatial analysis models for its solution. He has used multi-criteria evaluation (MCE) and multi-factor evaluation (MFE) under GIS environment to assess the probability of occurrence of illegal landfills.

3. AIM AND OBJECTIVE:

The prime focus of the present study is to undertake Network Analysis for urban solid waste management in Dalanwala ward No.25, 26 and 27 of Dehradun by using GIS.

Objective:

- To prepare network database for Dalanwala ward and road network map of Dalanwala by using GIS.
- To identify the shortest path by distance and by time from solid waste dust bins to disposal site.
- To suggest certain remedies about keeping dustbins at suitable site.

4. STUDY AREA:

Location:

The study area covers three exemplary wards Dalanwala North, Dalanwala South and Dalnawala East “30°18’9’’ N to 30°19’30” N and 78°03’00” E to 78°03’33” E”, of Dehradun city, located in the Uttarakhand. City has well developed road network. Population of the city is moderately distributed.
5. DATA:

5.1. Primary Data: Primary data is collected through Extensive field work and interviewing of workers and supervisors involved in Ward No.25, 26, and 27.

5.2. Toposheet:
Survey of India (SOI) Topographic Map
Dehradun and Tehri – Garhwal Districts No.: 53 J/3, Scale: 1:50,000
Dehradun Guide Map, Scale: 1:20,000

5.3. Satellite Data
IKONOS:
The IKONOS Satellite is a high-resolution satellite operated by GeoEye. Its capabilities include capturing a 4m multispectral, 1m panchromatic resolution. Its applications include both urban and rural mapping of natural resources and of natural disasters, tax mapping, agriculture and forestry analysis, mining, engineering, construction and change detection. It can yield relevant data for nearly all aspects of environmental study.

Table 1. Showing the IKONOS satellite data and their characteristics

<table>
<thead>
<tr>
<th>Launch Date</th>
<th>24 September 1999 at Vandenberg Air Force Base, California, USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbit</td>
<td>98.1 degree, sun synchronous</td>
</tr>
<tr>
<td>Speed on Orbit</td>
<td>7.5 kilometers per second</td>
</tr>
<tr>
<td>Altitude</td>
<td>681 kilometers</td>
</tr>
<tr>
<td>Resolution</td>
<td>1 meters panchromatic; 4 meters multispectral</td>
</tr>
<tr>
<td>Resolution</td>
<td>26° Off-Nadir</td>
</tr>
<tr>
<td>Image Swath</td>
<td>1.0 meter panchromatic; 4.0 meters multispectral</td>
</tr>
<tr>
<td></td>
<td>11.3 kilometers at nadir; 13.8 kilometers at 26° off-nadir</td>
</tr>
</tbody>
</table>
Equator Crossing Time | Nominally 10:30 AM solar time
Revisit Time | Approximately 3 days at 40° latitude
Image Bands | Panchromatic, blue, green, red, near IR

5.4. Software:
The following software has been used in order to obtain objective of study.
**ArcGIS 10** - Pioneer software in GIS field developed by ESRI.
**MS-OFFICE** - This software used for making a report and generation of Bar, Pie chart (I), MS-WORD (II) MS-Excel

5.6. Secondary Data: Secondary data is collected from the various sources including Records of DVSWM, Dehradun

6. METHODOLOGY:

7. ANALYSIS
Integrated Solid Waste Management project is sanctioned by GOI under JNNURM programme for solid waste management of Dehradun city by Ministry of Urban Development, Government of India. A The Operation & Maintenance (O&M) of assets and facilities created under ISWM as well as that to be created under ISWM will be vested with the respective Dehradun Nagar Nigam (DNN) will be the ultimate custodians of the assets and facilities so created. With the increasing responsibilities of the DNN with regard to sustainable O&M of these assets, an overall capacity building programme has been envisaged under ISWM for development and upgrading of managerial, technical and financial capacity of DNN through Implementation of IMSWM project.
A GIS optimal routing model is proposed to determine the minimum cost/distance efficient collection paths for transporting the solid wastes to the landfill. The model uses information on population density, waste generation capacity, road network and the types of road, storage bins and collection vehicles, etc. The proposed model can be used as a decision support tool by municipal authorities for efficient management of the daily operations for transporting solid wastes, load balancing within vehicles, managing fuel consumption and generating work schedules for the workers and vehicles.

After identification of problem data base was awarded for the Dlanwala ward. The Network Analysis process for Dalawala ward of Dehradun city includes four steps: analysis of existing routing of collection of solid waste, determining the optimal path by distance and by time, determining the service area of each of the waste collection site, develop and an integrated system for solid waste collection to disposal. Initially road network of Dalanwala ward and selected the exact location of the eight number of dustbins in ward; were mapped, Network analysis was carried out the shortest path for dustbins to disposal site regarding to distance and by time.

![Fig. No. III](image)

There are three vehicles allocated in this ward by DVSWM. Vehicles are generally started every day at 6.00 a.m. in the morning from Municipal Transportation Depot, of Eastern Canal Road and finish their picking of solid waste work by 1.00 p.m. It was found that vehicle -1 covers 04 dustbins , vehicle-2 cover 03dustbins and vehicle -3 cover 01 dustbin regarding shortest distance which save the time and fuel.
Shortest path by length – When network analysis is carried out by taking path by length, shortest distance from dustbins to disposal site. It gives a shortest route from each dustbin to disposal site.

Shortest path by time – When network analysis is carried out by taking shortest path by time, shortest and optimal route from each dustbin to disposal site was identified and shows the different route. Taking into consideration carrying capacities of the vehicles and availability of time this network is useful. It suggests at what speed and in how much time one can travel from each of the dustbin to the disposal site. It is helpful in attaining maximum turns by each vehicle in a given schedule of time.

It means that if vehicles follow the network analysis suggested route it will benefited by saving time and distance. It further leads to save fuel and increase efficiency of the vehicles.
8. CONCLUSION:

By network analysis for two dimension [length, time] different routes for each bin to disposal site was found which have their own significance in relation to efficiency and cost. Shortest path by time suggests at what speed and in how much time one can travel from each of the dustbin to the disposal site. It will be helpful in attaining maximum turns by each vehicle in a given schedule of time. Shortest path by length gives a shortest route from each dustbin to disposal site.

The important aspect found is that, the dustbins are not uniformly located and not optimal. It may effects the collection of the solid waste. At majority location of dustbins are of smaller in size. They are over flooded by garbage.

The system integrates major tool of GIS in a manner that reach the correct solution to assist the decision maker in determining appropriate solid waste management. The system was successfully tested in determining the optimum path for the Dalanwala ward.

Fig. No. V
9. RECOMMENDATIONS:

In order to find solutions to the efficient and effective solid waste management for Dalanwala ward of Dehradun some recommendations can be suggested on the basis of Network Analysis carried out using GIS.

1. They have to adopt applications of network analysis for management of transportation system.
2. Dustbin locations should change in a manner that all the residential areas should be covered.
3. The size of the dustbins should be bigger. Small dustbins should be kept at proper locations in the wards.
4. To increase the efficiency of cycle rickshaws monitoring system should be adopt.

10. REFERENCES: