

Logistics Management and Spatial Planning for Solid Waste Management System using Geographic Information System

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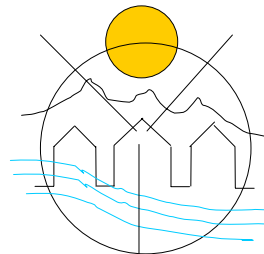
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**Logistics Management and Spatial Planning
for Solid Waste Management System using
Geographic Information System**

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Summary

The role of municipalities in the development of the cities and towns is very crucial and important in today's context when urbanisation is moving at a very rapid pace. The municipal bodies in spite of their efforts are unable to perform better in terms of financial management and efficient delivery of urban services. Therefore, the need of the hour is to strengthen and reengineer our urban local bodies which will perform better in terms of maximising the revenue generation and at the same time deliver the services in a better and efficient way. The only option which could bring such results can mainly be achieved through the introduction of innovative practices which directly targets these two issues, which mainly revolve around maximization of profits and better serviceability. This paper highlights certain areas where municipal GIS forms the core part in bringing reforms at the local bodies if planned and implemented in an efficient way by incorporating those actions which may realise a major improvement without much capital investment.

Introduction

There are various core areas where the municipal bodies are involved for providing their services for the betterment of the city. These services are often described as the obligatory and the mandatory functions. It is with these functions only where the municipal bodies have to perform in a way that they could maximize their revenue generation and perform and deliver the services in a better way. One of the important thing which is missing in the system is that data is not managed properly. Because of the improper management of the data and records, it often becomes difficult to know about the functioning of the system in an efficient way. The core solution to maximize the profit generation and efficient delivery of the urban services lies in the overall management of the data system of the organization. The data's are always linked to each other and often lies in an isolated form. It is very important to manage the data in an integrated way so that complexity of the various systems could be reduced to solve various issues related to the functions of the municipal bodies.

The project about the municipal applications of GIS involves various components which could enhance the revenue base of municipal systems. Some of the projects already exists in certain municipal bodies or are under process. The important issue is to see the sustainability of that project within the organization and how cost effective the project is for the organization. Often it is found that the project conceived is failed to meet the desired goals of the organization.

The project "Logistics Management and Spatial Planning for Solid Waste Management using Geographical Information System" is based mainly on the practical observations regarding the functions

and the city needs from time to time. The objective is simply to increase the revenue base of the local bodies and deliver the services in an efficient way by taking appropriate planning and management arrangements.

Need for Innovations

Solid waste management is one of the important areas where the problems arise from time to time. Municipal bodies are unable to provide a 100% efficient system and even are not able to reach to the efficiency of 60%. Solid waste management frequently suffers more than other municipal service when budget allocations and cuts are made. The provision of collection and disposal services for municipal refuse is not perceived as deserving higher priority. Efforts of people employed to collect, dispose and recycle wastes are rarely appreciated. The existing situation is not satisfactory and often there are complaints by the public which adds anxiety to the concerned officials involved in the management. The real problems are mainly of organization, management and planning, yet the favoured solutions involve more mechanization. One of the simplest way to bring innovations in any system is to document and study the existing system and bring the possible reforms by adopting appropriate measures at various levels through the introduction of innovative and cost effective solutions.

Present Status: Some Observations in Solid Waste Management

Solid Waste management is an obligatory function of the Urban Local Bodies. However if this service is poorly performed it results in problems of health, sanitation and environmental degradation. With over 3.6% annual growth in urban population and the rapid pace of urbanization, the situation is becoming more and more critical with the passage of time. There are various deficiencies related to SWM which are seen in the cities mainly no storage of waste at source, non-segregation at source, no system of primary collection of waste, use of inefficient tools, inefficient system of secondary storage of waste, inadequate transportation of waste, no processing of waste, disposal of waste, lack of institutional and administrative involvement. The infrastructural development is not in a position to keep pace with population growing owing to the inefficient resources in most of the local bodies.



Plate 1



Plate 2

The following are some of the observations seen in cities:

1. The citizens often complain that solid waste is never lifted from its place, it is observed that the bins are full and the waste is lying for days without being lifted it to the landfill site.
2. The municipal authorities say that citizens often do not throw the garbage in the bins and it usually lies there outside the bins.
3. The other reason for which is claimed by the authorities is that, there is shortage of manpower and equipments and machines which could do the needful.
4. The current lifting capacity is much less as compared to the waste generated per day.
5. The complete inventory of the bins and its locations etc ward wise and sector wise, on major roads is often not available with the authorities.



Plate 3

6. The number of sweepers on a stretch of major and minor roads, in different wards is also missing. They may tell some figure but if some analysis is to be done on map, it is not available with the authorities.
7. The data about the most waste generating areas and along roads is not available to them.
8. Bins of different types are unnecessarily been provided on a stretch of various roads, which basically accounts to additional cost of diesel, manpower, equipment etc.
9. The route planning is never prepared and is currently done as and when need arises.
10. The redressal system is not existing, its just by a system on demand by the community.



Plate 4



Plate 5



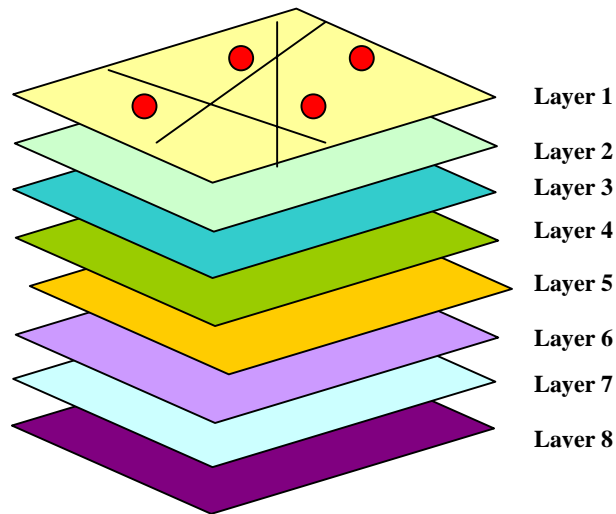
Plate 6

How Municipalities can go forward

Create a Phased Action Plan

Based on specific objectives to provide acceptable solid waste management service, and on existing financial constraints, a phased action plan may have two basic elements. One element of the plan being the creation of an efficient MIS and GIS system. Another element of the plan being provisions of planning and management arrangement as well as the improvement of the financial and institutional base upon which the solid waste service relies.

The plan should try to readily incorporate those actions which may realize a major improvement without major capital investment. Therefore, initial emphasis may be placed on actions such as the following:



Creation of MIS & GIS Information

It is often seen in most of the local bodies that data lies in an isolated form. The availability of SWM data is often not available at one place for arriving at proper decisions regarding the planning and management arrangements. Most solid waste planning efforts emphasize technology with such engineering activities as determining the number of trucks and the siting of landfills. In the existing system there is inadequate supervision of workers, inadequate logistics management, and spatial planning. Through continuous planning and dynamic management these systems can be designed to have capacity meet demand on a continuous basis.

The following are some of the important points which should be considered as an important exercise to begin with:

1. Identify and prepare the layer on the GIS platform about the exact location of the dustbins in the city. This can be done by using GPS or by a survey and marking on the base map of the city.
2. Ward wise inventory of the bins should be made.
3. Current waste generation map showing the waste generated along the main roads, streets and wards of the city.
4. The existing minimum distance between the bins.
5. Identification and inventory of the existing sanitary inspectors, sweepers ward wise. This will help to optimize the ratio of supervisory personnel, inspection personnel, maintenance personnel to direct labour and provide equipment and facilities to facilitate their work.
6. Current lifting cycle pattern identification based on the waste generated along the main roads, streets, and wards.
7. Existing hourly cycle pattern of the vehicles for different wards and main roads.
8. Presence of NGOs, Community Groups, Resident Welfare Associations, Mohalla Sanitation Committees active in SWM issues in various wards of the city.
9. Existing location of the landfill sites.
10. Existing inventory of the tools, equipments, trailers, tippers, dumper placers etc available with the authorities.
11. Identification of the areas where hoardings can be provided for the bins to increase the aesthetic value and maximize the revenue generation of the municipality.
12. Allocation of unique number to each bin based on the area code should be prepared by which bins can be located easily for the complaint redressal system. This will give a complete idea about the wards of the municipal area, by this the authorities will be able to know that how many

Figure 1 Creation of different GIS Maps

- wards are there which produces more waste daily and how many produce waste in more than two or more days. With this exercise even the exact position and location of the bins accumulating waste could be known for the planning purpose.
13. Adopt a system of record keeping at main yard and at landfill site to know about the daily collection of waste generated and logistics information about the transportation issues.
 14. Clarify responsibilities by such actions as making specific collection crews responsible for specific routes or areas of service, and similarly assigning equipment to individual drivers or operators.
 15. Also, clearly designate the chain of communication and coordination for workers to utilize in reporting problems and issues in service provision, and for citizens to utilize in making complaints or commendations.

Creation of Planning and Management Arrangements

It is found that in various cities where all or a portion of the cleaning service is contracted out to the private sector, it is the municipal responsibility to hire the contractor and monitor the service provided. In many cities, the municipality remains the agent to handle complaints and provide transportation and disposal systems, therefore it becomes essential to make planning and management arrangements by which the departments and the staff associated with it become responsible for the effective service delivery. In this context, it is essential that the capacity building measures be taken as apart of the over all logistics management and spatial planning process for SWM. The initial exercise involved should talk about the training, data components and analysis using the platform of GIS. The following are some of the important phases in which Innovations in the Solid Waste Management system can be brought at the municipal department level:

Phase I

Phase I of the project component should involve training workshops for the various user end departments of the local bodies. The objective of such an exercise is to get user departments familiar with the concept and technology of Geographic Information Systems. This can be started in the form of trainings and workshops related to the various applications and benefits of the system. Various components involved in the GIS system and the requirements for the same can be showcased.

Phase II

Phase II should give training on the concept of database management and documentation of various attributes which are essential for the SWM analysis in the GIS platform. The components involved in the data attribute should be discussed and demonstrated. User end departments should be encouraged to start and initiate a live project where the application will be implemented. Project formulation and preparation of the respective areas should be taken and evaluated. Through this phase a system should be designed for a GIS enabled integrated planning.

Phase III

Phase III should comprise selection of the software and hardware parameters for the user departments and the actual implementation of GIS system. The new system should have Phase I and Phase II as the base platform which will highlight the uniqueness of the new system in terms of its data attributes and various analysis heads. The new system should comprise a total integrated system which will talk about city level SWM issues. The user end department training and post implementation evaluation of the new system should be another addition in the Phase III schedule of the GIS component.

End Results

After implementing all the phases, this innovative system is expected to bring reforms in terms of clarity on the concepts of the data management & analysis using the uniquely designed innovative GIS platform. The municipal officers involved in the solid waste management will be clear about the functions and their role in terms of managing the cities efficiently with the help of GIS system. There will be complete inventory of the things associated with SWM and a proper logistics management and spatial planning can

be done using the help of GIS analysis based on various generated layers about the SWM issues for implementing and managing the system at field level.

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Index of Figure 1:

The layers shown in the Figure 1 are some of the maps which should be created as part of the logistics management and spatial planning exercise by the urban local bodies for the effective planning and management of solid waste management issues. The more the layers in terms of information, the more will be better decision analysis.

Layer 1	Ward map of the city.
Layer 2	Ward wise population distribution.
Layer 3	Existing waste generation map as per the population structure and waste producing areas.
Layer 4	Existing lifting cycle pattern of the waste bins of city.
Layer 5	Existing density of sweepers, sanitary inspectors, etc in various wards.
Layer 6	Presence of NGOs, Community Groups, RWA's, Mohalla Sanitation Committees etc.
Layer 7	Existing route planning for lifting of waste.
Layer 8	Proposed logistics and spatial plan based on the analysis derived from the above layers/ maps.

Index of Plates:

The photographs shown in the paper shows the actual condition of SWM in Dehradun city.

Plate 1	Existing condition of some of the waste bins, the waste lies outside the bins.
Plate 2	Women sweeper carrying waste to the open storage bin in the heart of the city.
Plate 3	Existing condition of the open collection points in some city areas.
Plate 4	Waste collection system in vegetable market of city.
Plate 5	Transportation system for the waste disposal.
Plate 6	Landfill site for dumping of waste produced in the city.