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Municipal Solid Waste Management of Anand City Using Gis Technique

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ABSTRACT:- **India's population has tremendously increased and the current infrastructure in most cases is not only over stretched but also inadequate. The problem of Municipal Solid Waste Management has acquired alarming dimensions in India especially during the last decade. The per capita of Municipal Solid Waste generated daily in Class I cities ranges from about 150 gm/day to 900 gm/day, and for Class II cities ranges from about 100 gm/day to 700 gm/day. The Government of Gujarat has taken initiatives for addressing the challenges and providing improved infrastructure services and facilities.**
An attempt has been made in this study for understanding of various issues related to Municipal Solid Waste Management of Anand city, Gujarat and analyzing the same using Geographic Information System (GIS) and Global Positioning System (GPS) and implement an integrated Municipal Solid Waste Management approach for collection, transportation and disposal. GIS being useful for analysis of data collected and generation of map and GPS being useful in tracking of vehicles and route optimization.

Key words : municipal solid waste , Geographic Information System , Global Positioning System

I INTRODUCTION

The rapid increase in the population and economic development has led to severe environmental degradation that environmental resources base upon which sustainable developments depends. With growing population, urbanization and demand for consumer goods, both quantity and quality of urban solid waste has changed significantly. Urban solid waste is the major contributor to global warming; it leads to surface and ground water pollution through run – off from dump sites. Solid waste collection and disposal are an important part of environmental hygiene and need to be integrated with environmental planning and policies. Improper collection, storage, treatment and disposal can lead to massive environmental damages leading to serious health hazards. All human activities viz domestic, commercial industrial, health care and agriculture generate solid waste. The quantity and nature of the waste vary with the activity and with the level of technological development in country. Solid wastes are all the wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted. The Municipal solid waste includes commercial and residential wastes generated in municipal areas in either solid or semi solid form excluding industrial hazardous wastes but including treated bio – medical wastes.

Geographic information system (GIS) is computer system capable of assembling, storing, manipulating and displaying geographically referenced information i.e data identified according to their location. GIS being useful for analysis of data collected and generation of map. The aim of using GIS is to restructure the entire system of garbage collection, disposal and monitoring.

II OBJECTIVES OF STUDY:

- It extends to the study of existing MSWM practices of Anand city followed by ANP.
- It includes method of collection of waste, storage of waste, transportation and final disposal of MSW.
- Study of manpower involved in management of waste and the cost per ton of MSW disposed.
- The composition and characteristics of waste give a clear idea of possible alternatives for recycle and disposal of waste.
- The objective also includes finding the possibility of implementing Geographic Information System (GIS) in municipal solid waste management. GIS can be an effective tool for decision making and to prepare an overall plan that will increase the efficiency of whole management system.

III PRESENT SCENARIO OF MUNICIPAL SOLID WASTE MANAGEMENT SYSTEM AT ANAND CITY

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Anand city is located in central Gujarat. The limits of Anand taluka are enclosed between 22.37 to 22.43 latitude and 72.55 to 73.18 longitudes with area of 677 sq km. Anand city has an average rain fall of 473mm and the major crops are tobacco, ground nuts, wheat and rice. Population growth of the city is at an average of 13.22 % per decade in last two decades. The area, population and literacy rate of Anand city is shown in the table 1. The management of the municipal solid waste in Anand city is handled by Anand nagar palika (ANP). The silent feature of the city in the context to the no of houses, shops and commercial establishments, hospitals, hotels, markets are shown in table 3. The city of Anand is divided into four zones for the purpose of management of municipal solid waste. The representation of the limits of the various zones is also shown in table 4. The organizational structure of the existing municipal solid waste system in ANP is shown in figure 1. The collector is the chief head of ANP and chief officer is the key person involved with solid waste management. The sanitary inspector is the person involved in the management of the system at zone level. Every zone is allotted mukadam /supervisor and sweepers on the basis of the population distribution and /or solid waste generation in the zone.

Primary Collection of Wastes from Door-Steps:

Primary collection of waste is the one of the essential step in Solid waste management. An appropriate system of primary collection of waste is to be designed by the responsible wing that synchronizes with storage of the waste at source as well as waste storage depots facilities ensuring that the waste once collected.

Street cleansing

The task of street sweeping Anand is carried out by 97 sweepers, both departmental and contractual. The shift of sweeping are from 7:00 am to 11:00 am, 2:00pm to 6:00pm and 10:00 pm to 2:00 am. Each sweeper is provided with a brush, a broom, shovel and containerized hand cart. Presently there are 50 containerized hand carts with capacity of 0.075 m3. There are 100 wheel- barrows available with ANP. There are 4 mukadam and 3 supervisors with sweepers to ensure proper sweeping and cleaning of the roads.

Waste Storage

In Anand, the system providing waste storage is most inefficient, unhygienic and unscientific, posing a serious threat to the public health and environment. Waste stored is of the following types.

1. uisance points
2. arrier container
3. rolley container

There are around 107 nuisance points and 71 container points in Anand. The capacity of carrier container is 3.0 m3 and that of the trolley container is 3.5 m3 . A typical carrier container is shown in fig 3 and trolley container is shown in fig 4 . The container points and nuisance points are so arranged that the sweeper don't have to walk more than 250 mts. Deposition of waste at nuisance points sites is most unscientific and unhygienic. The waste is just dumped at such sites from wheel barrows / hand carts and wastes remain littered around such sites causing unsanitary conditions, foul smells , environmental pollutions besides giving unsightly appearance till it is removed. Similar is the position of container points where wastes overflows outsides the bin as these are poorly designed and not user friendly. Sweepers do not put the waste in such bins and but throw the waste outside the bin due to wrong design of the hand craft and inappropriate size of the bin.

Transportation of the Waste

In Anand waste stored in open space is loaded manually. Manual loading takes time and reduces the productivity of the vehicle and manpower deployed. Besides , manual handling of waste poses a threat to the health of the sanitation workers as the waste is highly contaminated , a typical manual loading is shown in the figure 5 . The schedule of collection of wastes from nuisance points and container points is as below.

Daily collected	55
Every two days collected	42
Every three days collected	31
Every four days collected	50

The total waste collected is transfer to the disposal site by 2 auto trippers , 4 tractors and 1 loader. All vehicle are manually loaded and the tractor which can take 300 kg of wastes in one trip , carry only 100 to 150 kg of the waste as strict monitoring system does not exist. This makes transportation operation very inefficient and uneconomical. The present scenario of the transportation of the waste is shown in table 5

Waste disposal

The municipal solid waste in Anand is dumped into low lying areas near the outskirt of the city. " Landfill " term can also be used for the disposal method as enough precautions are taken to ensure safe disposal of the wastes. There are two sites for disposal of the solid wastes in Anand , " Mangadpura site " and " Purshattom Nagar site "

Mangadpura Site

Mangadpura site is located in the residential area. The 70% site is filled. The general detail of the site is given below.

Land use pattern : lake
Surrounding area : residential and slums
Status : site is in operation since January 2004
Daily load : around 7 -8 tractor load is filled to this site
Surface water source nearby : No
Water supply well : No

Habitat area nearby : Yes . Residential area and slum contribute around 6000 population in the surrounding area.
Comments: 70 % of the site is filled. Combustion carried out by slums and ANP . Site is highly odorous. Pets and roddens are large in numbers.

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Purshattom Nagar site

The site is in outskirt of the city. It is low lying land of 5-6 feet from the road level.

Land use pattern : cultivation

Surrounding area : cultivation area

Status:site is in operation since August 2004

Daily load : around 6 -8 tractor load is filled to this site

Surface water source nearby : No

Water supply well : Yes. One 60m far and one 80 m far which is used for drinking and farming purpose.

Habitat area nearby : No

Comment: Combustion carried out by ANP

Identification and Prediction of impacts:

The major element in municipal solid waste management is the identification of impacts as it leads to other elements such as quantification. It is necessary to identify the critical impact on environment due to methods of collection and disposal of the municipal solid wastes. The network method was adopted to identify the potential impact to understand cost – condition – effect relationship between an activity and environmental parameters

Method for collection of samples of solid wastes

Major collection points were identified which are covering larger size of population.

Based on the type of area such as residential , commercial , industrial, markets, slums sampling points were distributed uniformly all over the study area. About 2kg of municipal solid waste was collected from 5 points , representing each as residential , commercial , markets, slums and street sweeping. The total quantity of the waste so collected was thoroughly mixed. The weight of components was expressed as the percentage of the original weight of the sample. Like wise 5 samples of 2 kg was collected from each zone in one month and analyzed.

	2001 census	1991 census
Area (sq km)	21.13	21.13
Population	130462	110266
Male	68032	57730
Female	62430	52536
Sex ratio	918	910
Density	6174	5218
Literacy %	78.18	74.95
Male	88.12	86.31
Female	67.29	62.53

Table 1 Area, Population and Literacy rate of Anand according to 1991 and 2001 consensus

Decadal Year	% Decadal Growth rate	Sex ratio
1901- 11	-2.0	865
1911- 21	+1.57	872
1921- 31	+8.79	875
1931- 41	+18.97	896
1941- 51	+20.66	906
1951 -61	+20.37	890
1961-71	+22.44	880
1971-81	+23.42	905
1981-91	+13.39	910
1991-2001	+13.03	918

Table 2 Population growth in Anand over century

Sr.No	Description	No's
1	Houses	37,534
2	Shops and commercial establishment	2,570
3	Markets	03
	Vegetable markets	02
	Meat markets	01
	Fish markets	00
4	Hospitals(Governments & Private)	48
5	Hotels	257
6	Halls	01

Table 3 Salient features of the city

Sr. no	Zone	Area (sq. km)	Name of the Zone
1	Zone 1	3.25	Municipal office compound
2	Zone 2	5.70	Town Hall compound
3	Zone 3	6.04	Bhalej water Tank
4	Zone 4	6.14	Shastri Madan

Table 4 Area Distribution in four zones

Vehicle	Total No	Trips per Day	Waste collected per trip	Total wastes collected in tons
Auto tripper	02	4 X 2 = 8	300 kg	2.4
Tractor	04	4 X 4 = 16	1.5 Ton	24.0
Loader	01	8 X 1 = 8	1.75 Ton	8.6

Table 5 Details of transportation of waste

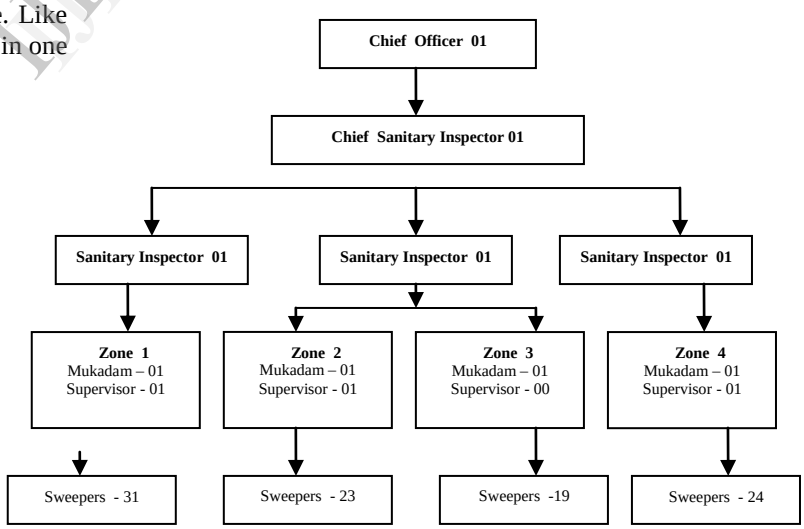

Figure 1: Organizational structure

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IV PRESENT INFORMATION ON SOURCES AND COMPOSITION OF MUNICIPAL SOLID WASTE OF ANAND CITY:

SOURCES:

- Residential/Domestic Waste: Anand Nagar Palika (ANP) is having a population of about 1,30,462 and the total number of houses in four zones are 37,453 which shows average population per house varying between 3 to 4.
- Commercial Waste: There are about 2570 shops and commercial establishments and 3 markets out of which 2 are vegetable market hotels in ANP limit are 257 and 1 public hall.
- Municipal Waste: It includes wastes from municipal activities and services such as street waste, dead animals, and market wastes. The street waste and market waste is collected by the people of ANP and the dead animals are disposed by private agency which is employed by ANP.
- Institutional Waste: There are about 48 private and government hospitals in ANP limits and the waste arising from the hospitals is collected by private agency and incinerated at a private instate in Ahmedabad.
- Agricultural / Horticulture Waste: In this category are included the waste arising from agricultural processes and also tree trimmings, leaves, wastes from parks and gardens, road side trees, etc.
- Construction and Demolition Waste: These wastes in Anand is collected by Public Works Department and is used for filling low lying areas plays an important role after putting up the compost plant. The values were provided by ANP as a compost plant is under set-up in Lambhvel. The table 7 shows some of the parameters of chemical analysis.

V CHARACTERISTICS:

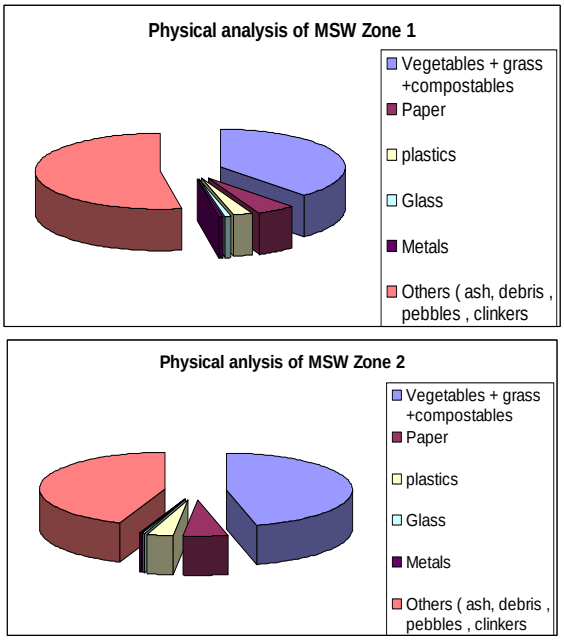
Physical Composition of MSW: The physical analysis for all the zones is shown in table 6. The physical composition of MSW is graphically represented in figure 4.1 to 4.5. It is evident from the results that the compostable matter in the Anand city is very high as much as 42%, and it also contains large amount of inert materials, ash & debris.

Chemical Analysis of MSW: Before putting up a compost plant, chemical analysis of solid waste is very important, since the capacity of plant will depend upon total amount of biodegradables and its chemical composition. NPK, moisture content, pH, C/N ratio etc.

Constituents	Zone 1	Zone 2	Zone 3	Zone 4	Mean
Moisture %	25.05	32.60	21.15	30.00	27.2
Carbon	12.67	10.78	10.06	10.03	10.9
Nitrogen	0.41	0.41	0.94	0.58	0.58
Hydrogen	1.17	0.89	1.28	1.39	1.19
Oxygen	3.78	4.43	4.01	3.32	3.9
Phosphorous	0.4	0.38	0.38	0.5	0.41
Potassium	0.52	0.46	0.38	0.44	0.45
Calorific value , kcal/kg	800.90	1020.98	925.71	850.65	899.56

Table 6 **Physical composition of MSW of all Zones**

Constituents	Zone 1	Zone 2	Zone 3	Zone 4	Mean
Vegetables + grass +composTables	38.33	46	44	39.4	42
Paper	5.0	6.0	5.0	6.0	5.50
plastics	2.58	3.34	3.5	3.7	3.20
Glass	0.74	0.27	0.3	0.54	0.46
Metals	0.47	0.34	0.2	0.33	0.34
Others (ash, debris , pebbles , clinkers	52.88	44.05	47.0	50.1	48.5



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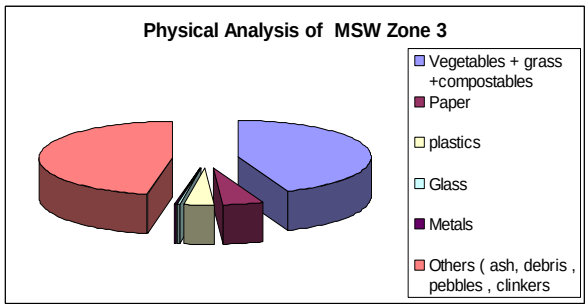

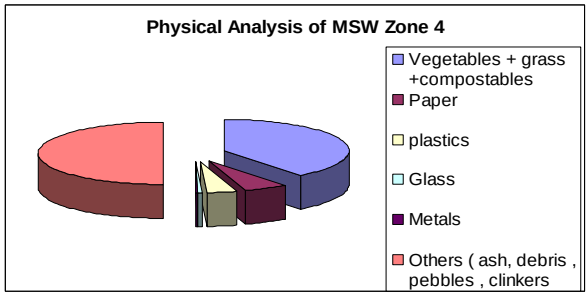

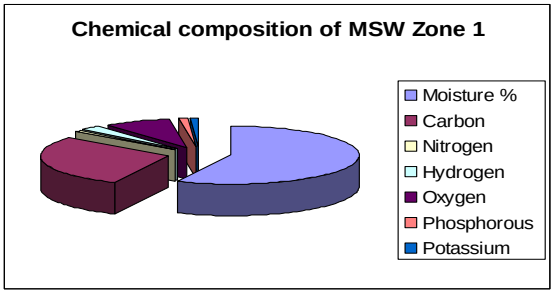

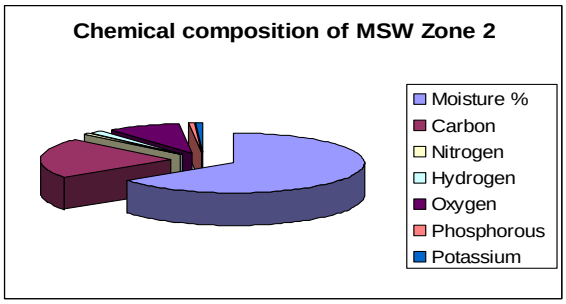

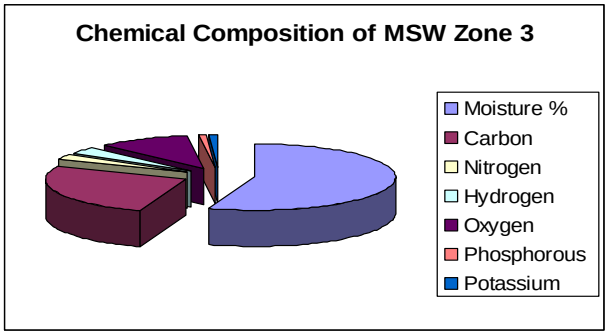

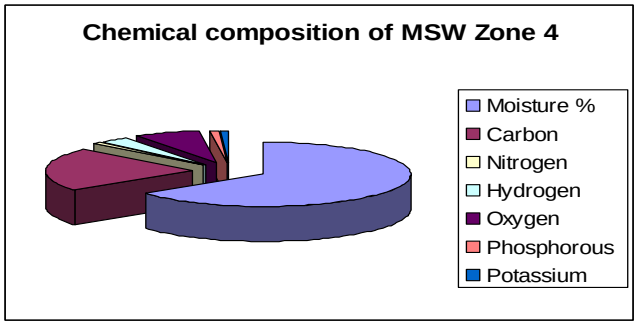

VI GEOGRAPHIC INFORMATION SYSTEM FOR MUNICIPAL SOLID WASTE MANAGEMENT IN ANAND

Geographic Information System (GIS) is a computer based tool used for mapping and analysing events that happen on earth by integrating common database operations such as query and statistical analysis with visualisation and geographic analysis of maps.

Global Positioning System (GPS) is a location system based on a constellation of 24 satellites orbiting the earth at altitudes of approximately 7000 kilometers

A GIS is a descriptive database of the earth whereas a GPS provides location of a point (X, Y, Z).

Objectives of using GIS for MSWM:

The aim of using GIS is to restructure the entire system of garbage collection, disposal and monitoring. Good municipal solid waste management practices requires collection of critical information for keeping records upto date but also for taking effective corrective measures as well as of proper planning for future. Therefore, some information is required to be collected for having an overall idea of the prevalent situation; deficiency in the system and likely require requirements of the further information, which could highlight deficiencies in the system on day to day basis and could be used for taking corrective measures has to be collected at regular intervals to monitor the services. Computerization of such information helps at all the levels of administration to work not harder but smarter, increases the level of job satisfaction, and also to establish strong and reliable information data base necessary to facilitate the decision making and monitoring process for management. GIS could be introduced in large cities and integrated with Management Information System (MIS). The main objectives of using GIS are:

- Use GIS for making decisions on investment in infrastructure facilities.

- Use GIS as an efficient mechanism for managing the garbage.
- Route optimization - shortest path from the collection point to the dumping yard and for maximum collection coverage and optimizing fuel efficiency.
- Making decisions for the sorting area, disposal area, truck routes and optimizing the number of collection points and transport of garbage.

VII METHODOLOGY

Selection of software: The software selected for using GIS as an effective decision making tool for MSWM in Anand was ESRI's ArcInfo and ArcView (Version 3.X) as a part of this work.

Creation of Baseline Database: For this, a proper study of the existing infrastructure with respect to the needs was carried out. It basically included the study and analysis of the existing conditions – maps, attribute data, reports, the monitoring mechanism, etc. It was found that all the maps and database were in the disorganized way. A feeling for organized system like GIS was felt among the management, since most data they use has spatial components. Also, the data used were not regularly updated.
A baseline data was created with respect to the city level and zone level. It included creation of database containing information on the area of zone, waste generation per day per zone, number of nuisance points, number of container points, collection people, number of vehicles for transportation of waste, collection route of vehicles, etc. These data were collected by general survey of whole city within a time period of one month so that the actual present condition of the city can be revealed. And then this data were incorporated with the data provided by the management i.e ANP and an overall view of the existing condition and ideal condition were developed. This data can be classified at the city level and zone levels. The data collected are represented in table 8.1 , 8.2,8.3,8.4,8.5. This database is important from the management point of view of MSW as it gives an overall picture of the existing management practices involved and the flaws present.

Digitizing the maps: The next step included the digitizing of the existing boundary map of Anand city and the existing zone boundaries with reference to proper scale. This helps to better understand the existing conditions of MSWM. The identification of major and minor road networks, water bodies, public parks, major locations, etc. was done on the digitized map at city and zone level. Also, identification of nuisance points, trolley container points, carrier container points on the map were useful in identifying the distribution of the waste collection and storage system. Data entry at zone level was done on the basis of container type, collection capacity, utilization factor, solid waste collected, etc. This was done as a part of identifying the containers that needed attendance at a period of one, two, three or four days. The trasport route to disposal site was identified and the collection efficiency was studied. Also, the scaling of the map is done in such a way that the distance between any two or more points in the map can be calculated in km. This helps in finding the shortest route of transportation vehicles to the disposal site.

Using GIS as a tool for decision making: A complete management information system was formed for effective management of MSW for Anand city. It incorporated every detail that was useful for effective decision making. Here, it was found that utilization factor of containers and the collection efficiency of the transport vehicles can be improved with the help of using GIS. Also, the shortest route of the transportation vehicles to the disposal site can be identified.

GIS is also useful in effective monitoring of the management of MSW. A complete schedule was developed for daily monitoring of waste collection from waste storage depots which is attached as Annexure- VI (a). This helps in easy understanding of the efficiency of waste collection. The total quantity of waste collected per zone can be found. This is a part of data up-gradation module of the software.

A daily monitoring of disposal site operations entry record sheet is attached as Annexure – VI (b). This helps in easy identification and understanding of the daily solid waste disposed its source in terms of the zone. Also vehicle identification in terms of registration number, time of entry, time of leaving the disposal site can be monitored. This helps in easy understanding of the collection efficiency of the vehicles. This data then can be entered in the software on daily basis and a complete check can be made in respect of disposal site.

Also, a monitoring on the cost of operations can be made as per the Annexure – VI (c). This helps in identifying of the number of vehicle trips made, the total distance travelled, cost of labour, total quantity of waste transported, cost of transportation, cost of repair and maintenance, total cost of operation, and cost of operation per tonne can be calculated. This data sheet can be used for comparing the operating cost with the previous year's cost and hence is helpful in effective management of municipal solid waste.

A format of labour utility report is also attached as Annexure – VI (d). This data sheet can be useful in terms of understanding the economic efficiency of the drivers, sanitary workers, mechanics, supervisor, assistant engineer, etc.

These all sheets are a part of montoring and data up-gradation module of the software for effective and efficient management of MSW. Use of GIS can be an important tool for decision making, efficient removal of waste, minimizing the cost, monitoring and tracking the transport

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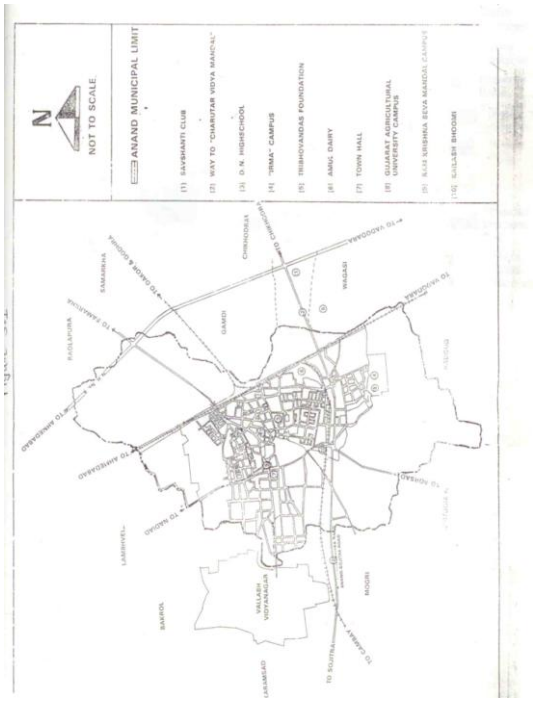
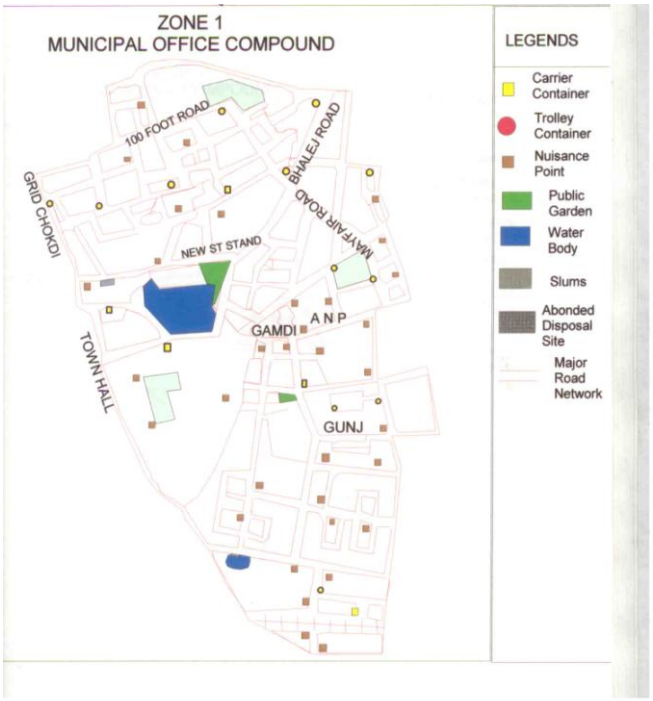
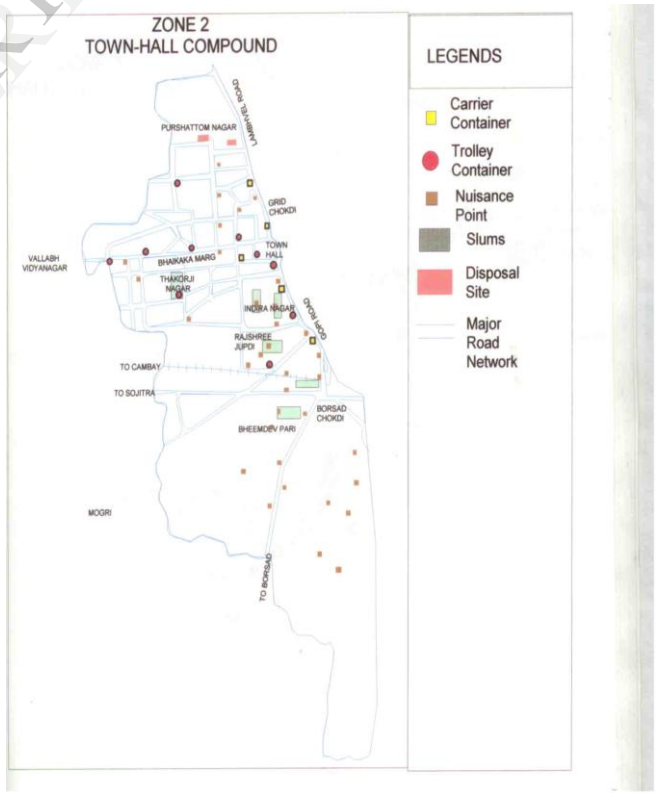
vehicles, optimize the transport vehicle routes, identifying the deviations in operations, identifying the vehicle during the operation, etc.







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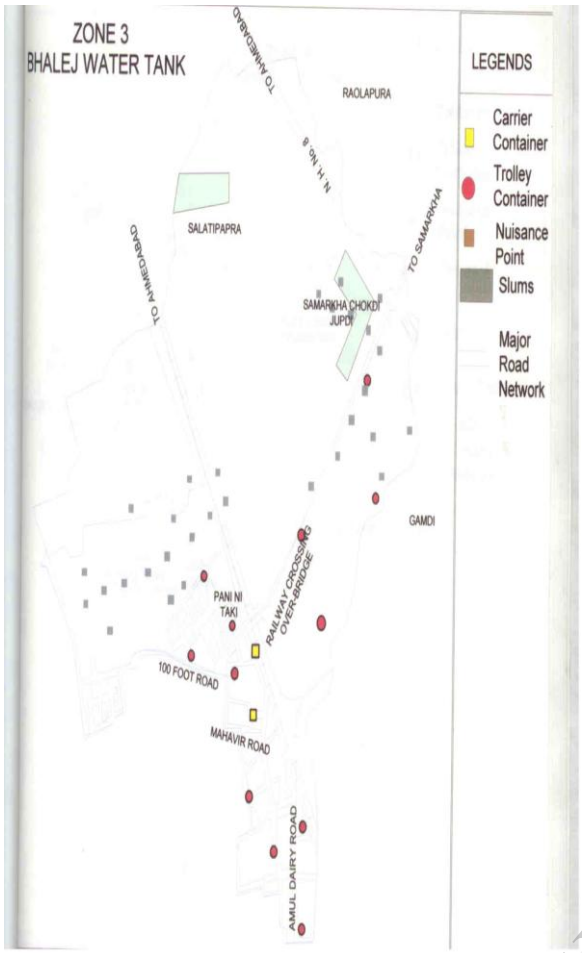

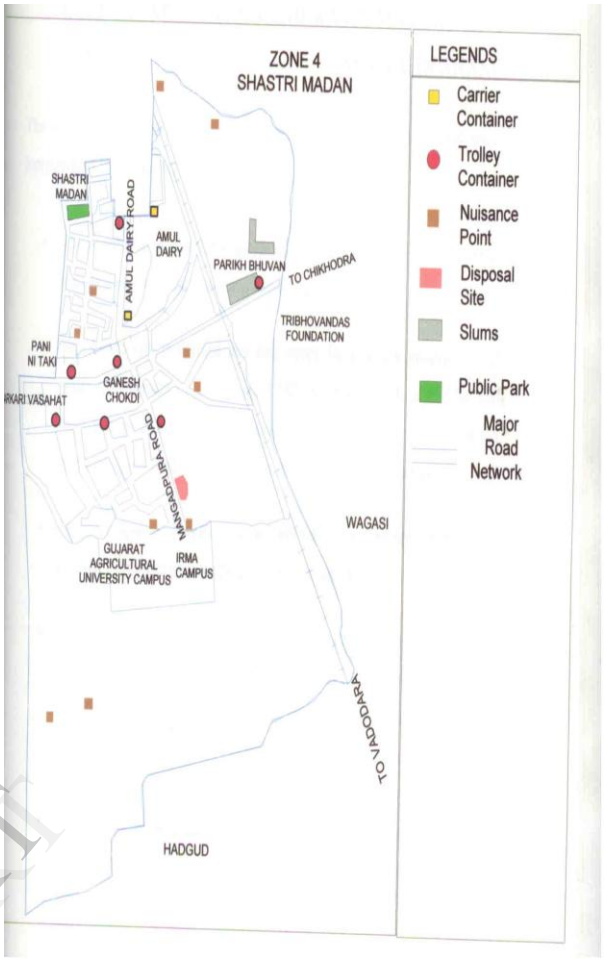

VIII RESULT OF ANALYSIS & SUGGESTIONS TO IMPROVE CURRENT MSWM SYSTEM IN ANAND:

The key analysis of and suggestions to, improve current MSWM in Anand city is:

The population of Anand has increased to 18.03% and 18.31% in last two decade with the municipal limits remaining constant.

The Anand city is divided into four zones for effective MSWM of an average 5.2825 sq. km. area. It is felt that still there is need to divide it further into more zones as zone no. 3 and 4 has more area, so it is advisable to divide it for solid waste collection.

The MSW collected from all zones amounts to 35 tonnes per day. This value gives average of 268 gms/capita/day.

There are 97 employees working for SWM in Anand city. Each sweeper is provided with a a brush, a broom, shovel,

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and containerized hand-cart. A total number of 50 containerised hand-carts and 100 wheel barrow are available with ANP. Primary collection of waste at door-steps can be employed in whole Anand city through NGO and its own resources. At present, there are around 37,534 number of houses and 2570 number of shops. A provision of one worker for every 150-200 houses and / or shops will lead to a demand of total 130 workers. That means that ANP needs only 33 number of human resources more to do the better and total collection of MSW.

The total length of roads swept everyday is 95,638 rmt. For effective sweeping one sweeper can be provided for every 300 – 350 rmt road in densely populated area, 500 – 600 rnt for medium populated area, and 750 – 1000 rmt for sparsely populated area. Average value in Anand for one sweeper is more than 900 rmt.

There are around 107 nuisance points, and 71 container points for storage of waste in Anand. For effective waste management the abolition of open waste storage points is necessary by replacing with a provision of 4 containers per sq. km area or 1 container per 5000 people.

The fleet of vehicles employed in MSWM in Anand comprises of 2 Auto-trippers, 4 tractors and 1 loader. This leads to ineffective collection and transportation of MSW. Additional requirement of 2 tractors and 3 loaders is suggested.

All the 35 MT of waste generated per day is disposed in landfill sites without any segregation except that is being done by Pickers. The waste in Anand is high in compostable matter and hence, for effective and economical management of waste, the waste should be segregated by methods like Composting (Bacterial or Vermi-composting may be used for manufacturing manure).

Incorporating GIS, MIS & GPS as a part of Management System: Implementation of GIS, MIS and GPS as a part of decision making can modify the whole system for MSWM system. It is one of the most critical use of these system though it can be an integral and indispensable tool for civic management and serving the integrating information needs of the citizens. This study is only a starting journey of implementation of GIS, MIS & GPS in MSWM system are listed below:

It invariably becomes the monitoring system for MSWM.

GIS, MIS & GPS serves as a tool for decision making on investment in infrastructure facilities and acts as an effective and efficient mechanism for managing, handling and disposing of MSW.

GIS & GPS system is extremely helpful in monitoring and tracking the vehicles every moment, identifying the deviations in operations, computing the kilometers travelled by each vehicle etc. It also helps in route optimizing i.e finding shortest path from the collection point to the dumping yard and indirectly saving the fuel cost, time and man-power. In short, it maximises the use of all infrastructure facilities.

GIS leads to updating and maintaining the data easier. It is a form of organised data collection which in turn assist in providing the technical information and support. It helps in making decisions about the sorting area, disposal area, routing analysis and transfer station justification. It helps in maintaining proper map and data sets which indirectly increases the efficiency of whole management system.

Some of the intangible benefits of this system are :
Government database becomes asset in information structure and thereby helping to meet demands of business sector and citizens.

Helpful in providing timely response to public.

It becomes an effective tool in better decision making.

Management of data on timely basis becomes easier i.e data up gradation becomes easier.

Helps in improving the data accuracy and consistency.

Enhances data sharing and data accessibility & compatibility.

Zone ID	**Zone 1**	**Zone 2**	**Zone 3**	**Zone 4**
Name	**Municipal office**	**Town –hall**	**Bhalej water tank**	**Shastri maidan**
Area (sq mt)	**3.75**	**5.70**	**6.04**	**6.14**
No.of Employees	**31**	**23**	**19**	**24**
No .of nuisance points	**34**	**12**	**31**	**30**
No of carrier containers	**02**	**05**	**02**	**05**
No of trolley containers	**14**	**10**	**12**	**21**
Total no of containers	**16**	**15**	**14**	**21**
Fleet vehicles	1 tractor 1auto tripper	1 tractor	1 tractor	1 tractor 1 auto tripper
No of disposal sites	00	02	00	01

Table .8.1 Data at city and zone level

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Container location	Capacity m^3	Frequency of collection (d/wk)	UF (%)	Total waste collected (m^3/wk)
Bh D.N high school	3.5	3.0	80	8.4
Bh community hall, Moraraji ground	3.5	3.0	80	8.4
Krishna hall	3.0	2.0	80	4.8
C.K hall	3.0	3.0	70	6.3
Guru Nanak Soc	3.0	2.0	70	4.2
Patel soc. Pioneer High school	3.0	2.0	80	4.8
Ambika chowk	3.0	2.0	80	4.8
Water supply tank	3.0	2.0	70	4.2
Prajapati soc	3.0	2.0	80	4.8
Red cross blood bank	3.0	2.0	70	4.2
Opp Mahendra shah hospital	3.0	2.0	80	4.8
Raj mahel bunglow	3.0	2.0	90	5.4
Kalakruti flats	3.0	2.0	70	4.2
Bh kalpna tokies	3.0	2.0	90	5.4
Bh Sardar Bagh	3.0	2.0	80	4.8
Bh C.P college	3.0	2.0	90	5.4

Table 8.2 Details of container Zone 1

Container location	Capacity m^3	Frequency of collection (d/wk)	UF (%)	Total waste collected (m^3/wk)
Khatki Vad	3.5	3.0	85	8.9
Doshi & sons Khacha	3.5	3.0	85	8.9
Abrar colony	3.0	2.0	80	4.8
Dipawali soc	3.0	2.0	80	4.8
Drainage pumping st	3.0	2.0	80	4.8
Vora soc	3.0	2.0	70	4.2
Bhatia Dharmasala	3.0	2.0	70	4.2
Nr Sarvaya mazid	3.0	2.0	90	5.4
Opp Sagar Soc	3.0	2.0	85	5.1
Ismil Nagar naka	3.0	2.0	80	4.8
Gamdi jakat nakat	3.0	2.0	90	5.4
Nutum nagar	3.0	2.0	70	4.2
Nr.Mahavir jupadpatti	3.0	2.0	80	4.8
Old vegetable market	3.0	3.0	80	7.2

Table 8.3 Details of container Zone 2

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Container location	Capacity m^3	Frequency of collection (d/wk)	UF (%)	Total waste collected (m^3/wk)
Inside municipality hospital	3.5	2.0	80	5.6
Navarang society	3.5	2.0	75	5.25
Sarvoday soc	3.5	2.0	70	4.9
Citi bus stand	3.5	2.0	70	4.9
Opp jawahar Sindhi soc	3.0	2.0	80	5.6
Kalgighar soc	3.0	2.0	80	4.8
Amul park	3.0	2.0	80	4.8
Nr Hero Honda show room	3.0	2.0	70	4.2
Parikh bhuvan	3.0	2.0	75	4.5
Anupam Park	3.0	2.0	80	4.8
Jalaram soc	3.0	2.0	75	4.5
Ganesh crossing	3.0	2.0	75	4.5
Opp Gaytri soc	3.0	2.0	90	4.4
Purnima soc	3.0	2.0	70	4.2
Gita Park	3.0	2.0	80	4.8
Opp Radha Krishna Park	3.0	2.0	80	4.8
Urvashi Appt.	3.0	2.0	80	4.8
Bh. Anupam flats	3.0	2.0	70	4.2
Panchsheel soc	3.0	2.0	80	4.8
Municipal quarters	3.0	2.0	80	4.8

Table 8.4 Details of container Zone 3

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