SWM of Kolar Municipality Using Remote Sensing and GIS Techniques

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Abstract:-Urban solid waste management needs careful considerations. This problem has become as one of the most serious environmental problems in municipal authorities in developing countries like India. This research paper marks out the selection of best alternative site for municipal solid waste land filling, using inputs from Remote Sensing & Global positioning system (GPS) and analysis using GIS tools. Various parameters involved in the selection of SW (solid waste) disposal site like *geology, land use, water table*, *economy* and *government rules* have been stored in the form of GIS data base. Overlay & buffer analysis have been performed in Arc GIS 9.1. The most common problems associated with improper management of solid waste includes transmission of diseases, fire hazards, odor nuisance, atmospheric and water pollution, aesthetic nuisance and economic losses.

Key words:-Solid waste, Geology, Buffer analysis, Remote sensing, GIS.

Introduction:-

With increase in growth rate in all field the solid waste accumulation also increases. High population levels, rapid economic growth and rise in community living standard accelerate the generation rate of municipal solid waste (MSW) in Indian cities. Improper management of MSW causes hazards to inhabitants. A balanced development has always remained the main objective of any development strategy. Satellite remote sensing images can provide information about the wasteland and other associated features, which help in the selection of sites. Coupled with GIS it can provide an opportunity to integrate field parameters with population and other relevant data. Solid waste management rules are in role since 2000, but their implementation is difficult due to lack of reliable data related to land use, its activities and environmental awareness among the people. Kolar area is a developing area, located in Bhopal, hence providing opportunity for investigations regarding waste disposal management. This study aims to demonstrate the utility of remote sensing technology in **identification** of waste land and asses the capability of GIS in **determining** an ecologically sound waste management program. IRS-1C-PAN and LISSIII pan merged data S.O.I. Topo sheet 55E/8 of KOLAR municipal area ward map using Arc GIS Arc info, GIS software.

This study is carried out to meet the following general objectives:-

- Mapping the different wasteland categories using LISS-III merge imagery by visual interpretation techniques.
- Mapping of Kolar municipal area with different land categories and attribute data attachment.
- Selection of wastelands to dispose Municipal waste.
- Creation of a GIS database for decision support system.
- Study of existing solid waste management practices at Kolar municipality Bhopal Madhya Pradesh.

Keeping these objectives in view the present study has been undertaken to extract information from LISS III and high resolution PAN imagery regarding identification of wasteland to select it as a waste disposal site. The job is crucial because it involves study of number of parameters.

2. Study Area:-

In the present study we have selected Kolar (Bhopal Madhya Pradesh India.) urban complex. Population of Kolar is increasing day by day due to its position, availability of resources and job opportunities. At present there is no declared waste disposal site in kolar municipality. Kolar municipality is disposing Municipal waste in the low-lying area in general and in drainage in particular causing nuisance. Kolar is among most rapidly developing suburban area of Bhopal M. P., According to 2001 the population was 31, 161 (Kolar Municipality) but in 2010 estimated population is about 1, 50,000 (MPEB), Kolar Municipality was established on 11 Nov. 2006, merging 9 village Panchayats.

Some general details of Kolar (Bhopal Madhya Pradesh India) municipality:-

Latitude 23˚12’19”E to 23˚1’1” E, Longitude 77˚25’11”N to 77˚25’1” N, Mean sea level (MSL in meter) 470-600, Rainfall Average (1244 ml), Temperature range (8˚c to 44˚c), Moisture (Humidity) at morning Average56 and In evening Average 40,Population-31,161 (As per census 2001), No. of Wards - 21, Wards area-171.663 k.m.²,

3. Methodology for site selection:-

the methodology is developed based on the following steps:-
Step1 Collection of data about Kolar municipality.
Step2 Characterization of solid waste.
Step3 Study the existing system of SWM.

Step4 Identification of possible sites for solid waste using remote sensing techniques.
Step5 selection of best site for solid waste using GIS techniques.
Step6 GIS data base creation.
Generation of thematic maps including following steps-

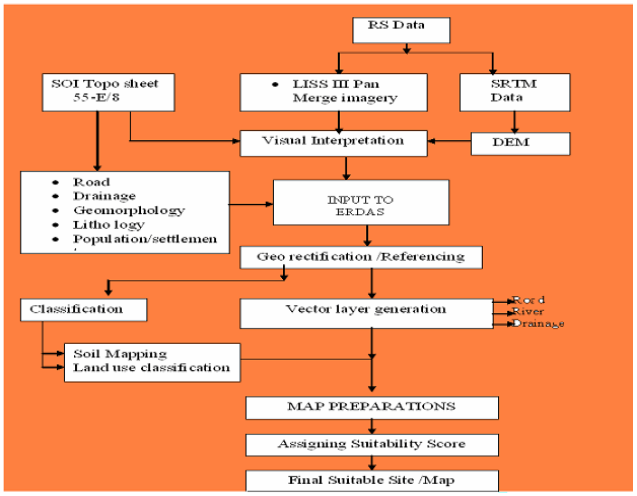
- Geo-referencing:-Geo-referencing is the process of aligning spatial data (layers that are shape files: polygons, points, etc.) to an image file such as an historical map, satellite image, or aerial photograph. This document describes the basic steps for Geo-referencing an image using Arc GIS.
- Creation of AOI:-In order to achieve the objective sets for the cross parameter relationship method has been adopted in which weightage of different parameters were assigned on the basis of their importance. The methodology comprises the following steps-
- Selecting criteria for evaluation of sites.
- Apportioning a total score of 1000 among the assessment criteria based on the importance
- Developing site sensitivity index (SSI)
- Estimating score for each parameter for various sites alternatives using SSI.
- Adding the score of individual site alternatives based on total score.

Based on extensive study, following parameters were used for the selection of solid waste disposal sites:

- Slope of the ground.
- Distance of surface drainage in meter.
- Soil type.
- Distance of the sites from the waste producing units.
- Present transport route.
- Type of waste.

The methodology developed, based on the site visit and detailed survey carries out in the Kolar municipality. In the present study GIS has played a very important task. With the help of Network analysis in ARC/Map software most economical route for transportation has been computed.

Work flow chart:-work has been accomplished as described below:-



Criteria adopted for site selection:-Score of respective site with sensitivity index Criteria have been Chosen very carefully and in planned manner with respect to the study area.

Table 1: Waitage index

S.N.	CRITERIA CLASS	Waitage	SUB CRITERIA	SENSITIVITY INDEX 10	20	30
1.	GEOLOGICAL (120)	2	Bedrock depth	Shallow	Moderate	Deep
			Slope of ground	Steep	Medium	Minimum
			Rocktype	Poor	Wethered	Compact
			Structural features	Extensive	Moderate	Less
2.	HYDROLOGICAL (90)	1.5	Water table depth	Shallow	Medium	Very low
			Drainage density	Few	Low	Very low
			Ground water yield	Average	Low	Poor
3.	GEOTECHNICAL (60)	1.5	Soil type	Black soil	Alluvium	Rocky stony
			Permeability	Well	Low	Poor
4.	SOCIO-ECONOMICAL (150)	4	Population density	Medium	Low	Sparse
			Land use	Built up	Agriculture	Wasteland
			Distance from waste producing site	Away	Far	Very far
			Transport route	Unmettl	Unmettle	Mettle

Score table:-score for the sites are given on the basis of sensitivity index. Dhuankhera site got 830 points out of 1035, from score table, and other one got 398 points so, analyzing these score it's found that Dhuankhera site is suitable for waste dumping. It's also fond that Dhuankhera site got maximum points in socioeconomic aspects which plays vital roll in any developing country.

Table2: sensitivity score

no.	Ward/Site	Geological	Sensitivity score: Geohydrological	geotechnical	Socio-economic	Overall score
1.	Dhuankheda	200/240	40/105	30/90	560/600	830/1035
2	Amra vihar	80/240	10/105	8/90	300/600	398/1035

4. Results:-

Results of the present study are summarized below:-Figure1, shows the Kolar administrative map which has been used for base map preparation and extraction of administrative boundaries. This map was obtained from municipal authorities and geo-referenced with the help of SOI Toposheet no.55E/8. After Georeferencing the area of interest (AOI) has been extracted in ERDAS IMAGINE software.

Fig.1 Koar administrative map (Cmo Kolar Municipality)

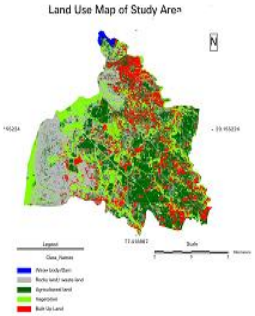


Fig.2 shows the landuse of the kolar

Next

In fig.2 the supervised classification has been presented there are five land use classes namely built-up, stony, waste, agricultural and vegetation cover. Then the contour map has been generated and process carried out in Arc GIS software. This map provides the elevation profile of study area at 20 meter contour interval. The northern boundary is surrounded by hilly region and highly elevated portions situated here. Shown in Figures

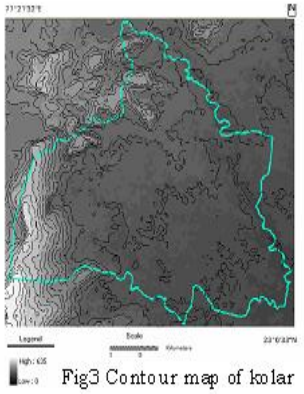


Fig3 Contour map of kolar

Fig.4 slope map, 3% slope

And the slope map extracted from this data after that, two slop maps have been generated to study is shown in fig4, this study is relevant from geological aspects as runoff direction. The respective slop maps are generated in Arc Map. Lighter area shows more elevated and steeper portion while darker portion is less steep and darkest portion is almost flat terrain. Fig.5 shows the road network extracted from satellite image for the study area. The drainage map extracted from satellite image is shown in fig 6.

Fig.5&6 showing major roads and drainage respectively of kolar area.

The road and drainage map layers have been superimposed in Arc GIS software. The GIS buffering tool has been used for the creation of buffer zone of 30m width for main roads and 60m for drainage and these results are given in the fig. 7 Combined buffer zones of roads and drainage are also shown in fig.7

3D view of study area by superimposing image on the DEM are shown in fig 11. To prepare various land categories, the supervised classification has been accomplished for preparing the soil map in four different classes and the same is shown in fig.12, namely black cotton soil,sandy soil, sandy loam, clay loam.

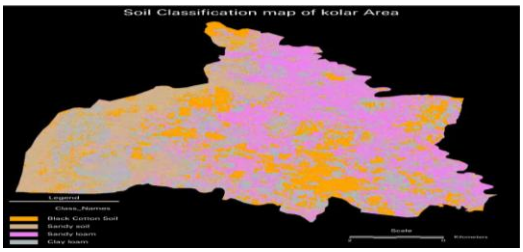


Fig.12 , soil classification of Kolar area

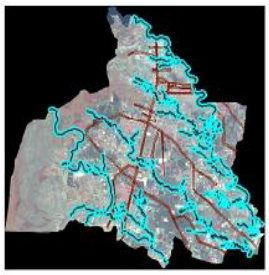


Fig.7An overlay map of buffer layers of R[30m]D[60m],

Fig.8 showing DEM of study area

Proposed dust bin:- ward wise dust bin has been shown in fig.9 and 10, these Fig. has been generated in ArcGis and shows the collection points in kolar area. The satellite image of CARTOSAT has been used to indicate more clear dust bin location in the study area.

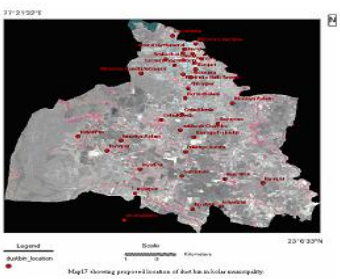


Fig.9. location of dust bin in kolar municipality

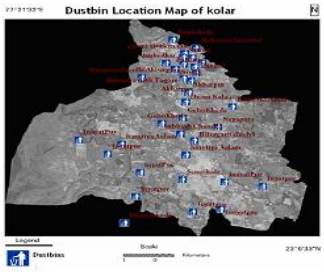
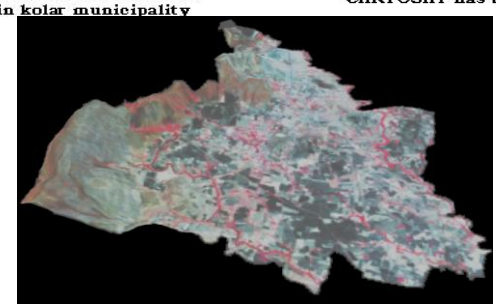


Fig.10 satellite image of CARTOSAT has been used



Map.11 , 3D View of Kolar area,

5. Conclusion and discussion:-Geographical Information System have been expanding across the Country and becoming integral parts of information systems. Several reasons for this are presented below:-

- Most municipal and county information relates back to Area ID. This information can be associated with map locations which can be efficiently and easily accessed by staff or the public using graphics-based computer programs rather than traditional paper filling systems.
- A GIS allows a community to produce custom map representations upon demand. The capabilities of which are limited only by the content of the database. These capabilities are simply not feasible with manual mapping techniques.
- GIS techniques can be very helpful in the management of waste collection and vehicle routing, and disposal site selection.
- In Present investigation Dhuankhera site found appropriate for the waste disposal and the methodology can be implemented.
- Safe disposal of municipal solid waste being generated in cities is growing concern for environmental manages.

- Municipal solid waste although can be used as a resource for energy recovery, if not managed properly may create havoc in cities.
- Only inert portion of MSW may be landfilled in properly designed engineered landfill site at Kajrikheda (Dhuakhera chichali) Kolar Bopal Madhya Pradesh India.

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