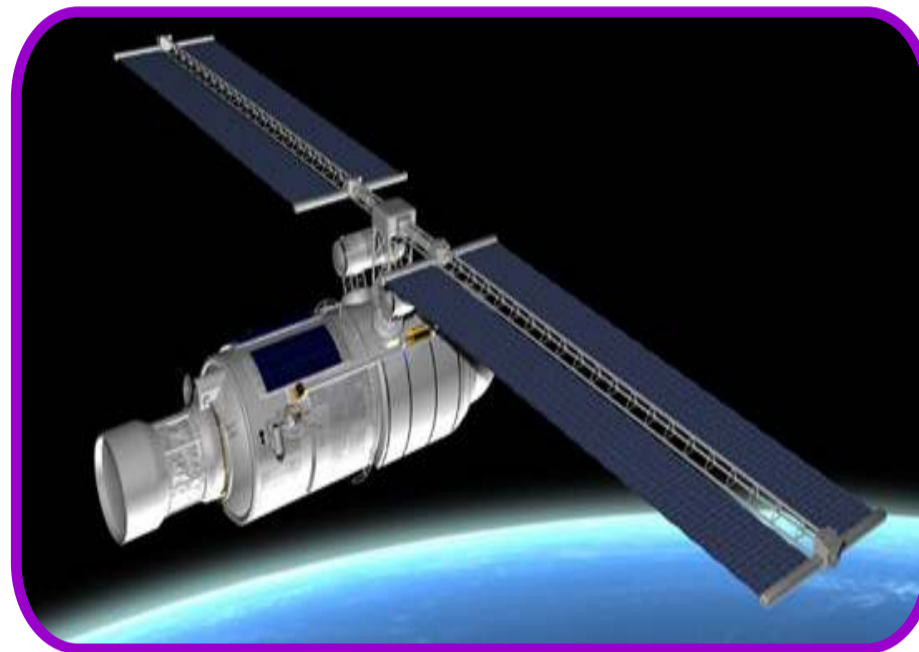# MONITORING LANDUSE CATEGORY ANDLANDCOVER CHANGE OVER TIME THROUGH APPLICATION OF RS AND GIS-A CASE STUDY OFSALT LAKE TOWN,WEST BENGAL

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Abstract:-Landuse changes, modifications in ecosystem structures and the loss ofbiodiversity affect the whole planet and have aroused worldwide public concern. Since the beginning of the 20th century, scientific and political debate on these issues, both nationally and internationally stated (Bolettaet. Al. 2000) have pointed towards land-use change, which is one of the most important human and nature induced environmental changes.Remote sensing is a suitable tool to measure the landuse changes specially through RS and GIS software.Here an attempt has been made to analyze the landuse category of Saltlake town in WestBengal,India in two different years and detect the changes occurred and explaining the reason behind it. As a planned town it experienced minor changes but important in respect of environmental factor.

Keywords: Remote sensing,supervisedclassification,master plan,landcover,satellite town.

INTRODUCTION :-

One of the main purposes of satellite remote sensing is to interpret the observed data and classify features. In addition to the approach of photointerpretation and quantitative analysis RS(Remote Sensing) and GIS(Geographical Information System) software are commonly used. Quantitative analysis can perform true multispectral analysis, make use of all the availablebrightness levels and obtain high quantitative accuracy. There are two broads of classificationprocedures to analyze landcover change in satellite images: supervised classification and unsupervised classification. The supervised classification is the essential tool usedfor extracting quantitative information from remotely sensed image data [Richards,1993].The most commonly used supervised classification is Maximum Likelihood Classification (MLC), which assumes that each spectral class can be described by a multivariate normal distribution. However, the effectiveness of maximum likelihood classification depends on reasonably accurate estimation of the mean vector and the covariance matrix for each spectral class data.

Land is most important and basic resource concerning the urban development. Improper land use practice results in an adverse impact on ecosystem. So the two words "Land cover" and "Land use" have important significance in regard to land. Thus urban development is strictly depends upon Land Use/ Land Cover (LULC) of that area. Several knowledge-based approaches were used by Anderson, 1971, Hutchinson, 1982, Jenssen et.al., 1992 for LULC classification by utilizing additional geographical data beside satellite images. The framework of a national land use and land cover classification system was presented by Anderson, et.al., 1976, for use with remote sensor data.

The landuse of Salt lake(a satellite town of Kolkata) has changed with time but not majorly because it is a planned township. After independence in the late sixties decade it was developed as the most important planned residential town to support the increasing population of Kolkata. It was set up by filling up the wetlands of the moribund river Bidyadhariwhich was connected to Sundarban region in Ganga Delta.Supervised classification has been done showing landuse and landcoverclassification in two different years(9 years duration) to detect the changing scenario of landuse.

AREA OF STUDY:

Salt lake(map 1)or Bidhannagaris a planned satellite town of Kolkata(8 km away from CBD), situated at the northeastern part of the metropolis. From 1967 after completing the filling of wetlands, works on sewerage,drainage,water supply and roads were taken up to develop the necessary infrastructure. Thus the landuse changed drastically from marshy salt water to an almost polygonal shaped planned town with an area of 12.5 sq km (excluding added area) and population 2,15,091(2011 census).The present administrative body is Bidhannagar Municipality.The town is divided into four sectors , 25 wards and 74 blocks.The another sector i.e sector V marked for IT industry is presently under a separate municipality (Nabadiganta Industrial Township Authority) .It is well connected with the main city.It has important govt offices,institutions,several hospitals, schools, colleges, university ,markets,shopping malls which make the town self-sufficient in all aspects. It has newly built up Rajarhat-Newtown on the north and Eastern Bypass road at South.

OBJECTIVES OF STUDY:

To identify the landuse and landcover of the satellite town from 2004 to 2013
To mark the changes in land use in 9 years span and identify the reasons behind this changes
To analyze the landuse pattern in the master plan prepared before setting up the town
To find out the problems occurred due to land use changes
To discuss the environmental impact of this land use changes
To suggest proper land use strategies within the planned area

DATABASE AND METHODOLOGY:

RS and GIS have been applied through satellite image and software like ERDAS IMAGINE 8.4 And ARC VIEW 3.2 to create the classification and land use maps.Referenced map of Bidhannagar municipality which divides the area in 25 wards is used but out of total 33.5sqkm only 12.5 sqkm planned area is considered in this study. At first the LISS IV P6 satellite images of 2004 and 2013 have been collected and after sub setting the study area supervised classification by maximum likelihood method is run to classify the land use into built up, green area, water body, vacant land etc and area of each category is also determined to compare the change in two years. Then statistical techniques are applied to show the land

cover change and for comparison.

Ward map is collected ⟶ map georeferenced ⟶ only planned area is digitiesd for further subsetting.Satellite image of 2004 and 2013 are collected ⟶ image to image referencing done AOI is created through referenced ward map ⟶ supervised classification is done ⟶ Lay out is prepared

**Location of the study area:Map 1**
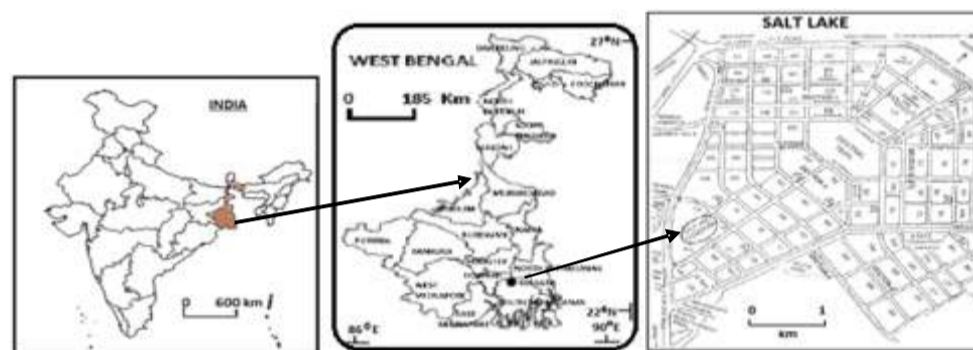
LANDUSE IN THE MASTER PLAN:

Before setting up the town in late sixtiesYugoslavian architectsprepared a master plan of the town where provision for all urban facilities were made about 50 years ago.Planners gave thrust on environmental protection,hence created parks,open grounds etc along with Central Park(100 acre)- the lung of the town.This total township was built on a high slope so that water logging problem can be avoided.It has an average height of 12 ft(more than 4-5 ft of Kolkata). Roads of different widths and types were constructed in the town.It was mainly built for residential purpose of the lower and middle income group people.Sectors were divided into wards,then blocks and plots of 2.5-6kotha.Upto three storied was permitted but now multistoried are being constructed.The landuse plan(fig 1)in the master plan is given in table no 1.

It is clear that in the master plan percentage of road is higher than metropolis Kolkata and other cities so abundant of open space, provision for health care, education, commerce were considered.50% was allotted for residential purpose where mostly one to three storied house and some co-operative houses were set up.There are about 40 different size parks and grounds seen in three sectors (sector IV and V are out of the planned area)where each block has one to three parks or playground.One of the drawbacks of the master plan is that there is no provision for wetland or waterbodies to maintain the ecological balance in the township.Only a lake can be found in the middle of the central park and some ponds (part of the wetlands) in western fringing area within slum which werealready there before the township was set up.

Table 1- Land use pattern in Master plan of Salt lake

Land use Category	Area in %
RESIDENTIAL	50
COMMERCIAL	4.6
ADMINISTRATIVE	1.3
HEALTH	1.5
GREENARIES	12.1
EDUCATIONAL	2.4
ROADS	23
CO-OPERARIVE	3.2

Source: BDP,KMDA

LAND USE PLAN(in %) OF SALT LAKE(MASTER PLAN 1966)
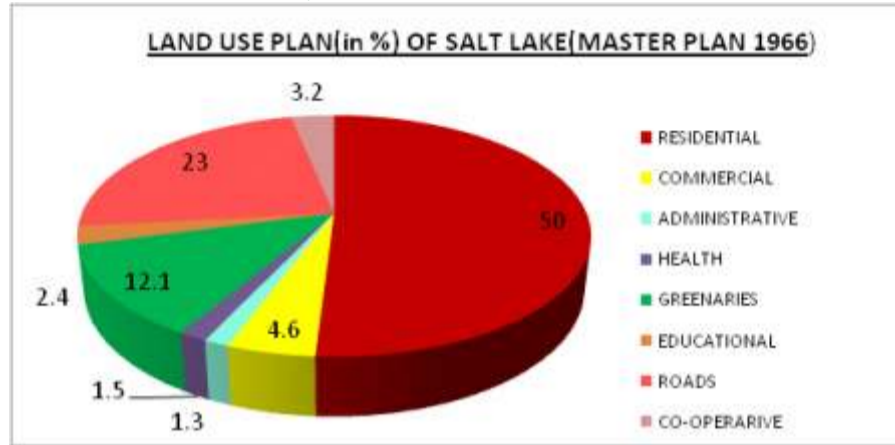
Identification of landuse pattern in the town:

7.1After running the supervised classification(Maximum Likelihood Classification) in 2004 and 2013satellite image it is found that sevenbroad landuse-landcover classes can be identified in the town.Areas of human habitation developed due to non-agricultural use and thathas a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands are classified into the following categories-

1.Vacant land2.Greenary3.Waterbody4. Densely built up area5. Medium built up area6. Open ground7. Road

Table 2(Land use of 2004)

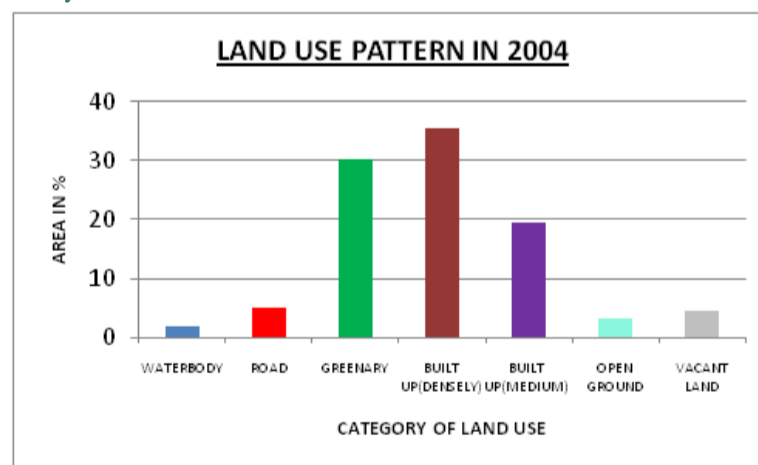| LAND USE CATEGORY	AREA(HECTARES)	IN %
WATERBODY	24.08	1.97
ROA	60.83	4.98
GREENARY	367.65	30.14
BUILT UP(DENSELY)	432.27	35.44
BUILT UP(MEDIUM)	238.95	19.59
OPEN GROUND	39.08	3.23
VACANT LAND	56.77	4.65
TOTAL	1219.63	100

Source:Computed by author

LAND USE PATTERN IN 2004

Fig 2

The map and diagram shows (image 1,map 2,fig 2) that out of the total area in the town,built up area is about 55% covering settlement,commercial,institutional and administrative area.The built up area is also divided into densely and medium built up zones.Then greenery covers about 30% indicating plenty space for parks,green verge,roadside trees, settlements with trees etc.It has a rich biodiversity too.The whole town is considered to be clean and green and well maintained.There are about 40 parks in the town and bare open grounds and vacant plots also along with road(major roads are identified only).But very few ponds are found in the north-western fringe area and a lake in the middle of central park(only 1.97%) as there was no provision for waterbody in the plan.

7.2After this 2013 image is classified andanalyzed through supervised classification(image 2 and map 3)i.e editing pixels by known identity.Here after 9 years some changes in landuse pattern has been observed. (fig 3)Area under waterbody is reduced to 1.08% as well as greenery from 30% to 24.88%.Built up area increased to 59.13% as new structures has come up in the form of shopping mall,schools etc. Vacant land and open ground remain almost same,so change in landuse pattern is limited. Road has increased to 7% indicating new road constructions especially in slum areas and concretizing kutchcha roads in slums.

Table 3(Land use of 2013)

LAND USE CATEGORY	AREA(IN HECTARES)	IN %
WATERBODY	13.22	1.08
ROAD	85.85	7.03
GREENERY	303.46	24.88
BUILT UP(DENSELY)	433	35.5
BUILT UP(MEDIUM)	288.1	23.63
OPEN GROUND	39.59	3.25
VACANT LAND	56.41	4.63
TOTAL	1219.63	100

SOURCE:computed by Author
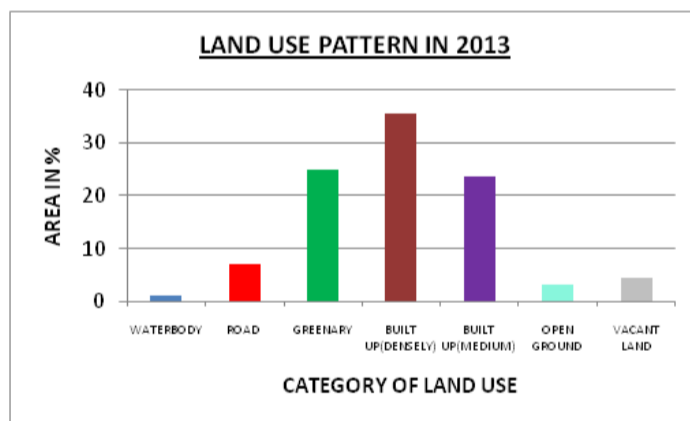
8.RESULTS AND DISCUSSION:

A minute comparison between land use in 2004 and 2013 can be précised through the table (no 4) and following diagrams (fig 4 and 5). The comparison of land use between 2004 and 2013 shows several changes in the township especially in terms of loss of water bodies and greenery.

1.Area underWaterbody reduced 0.89% in this 9 years because of the increased pollution of ponds in ward no 23 and 24.Moreover the encroachment of ponds by the slum dwellers to build kutchcha houses on it has filled up the ponds.All these leads to the reduction of waterbody from 24.08 to 13.22 hectares in the planned area causing environmental imbalance.
2.Green area has also reduced to 367.65 hec from 303.46 hec. as hundreds of trees had been cut for the construction of metro railway and other high rises and specially in the central park area for setting up sports complex, permanent fairground etc.

3.Area under open ground, vacant land and densely built up remain almost unchanged. The areas for these are specified in the master plan and no construction can be done on the ground and very few vacant land has been covered with structures till now.

CHANGING PATTERN FROM 2004 TO 2013: (Table 4)

LAND USE CATEGORY	2004 (area in hec)	2013 (area in hec)	% of change
WATERBODY	24.08	13.22	-0.89
ROAD	60.83	85.85	2.05
GREENARY	367.65	303.46	-5.26
BUILT UP(DENSE)	432.27	433.33	0.06
BUILT UP(MEDIUM)	238.95	288.1	4.04
OPEN GROUND	39.08	39.59	0.02
VACANT LAND	56.77	56.41	-0.02

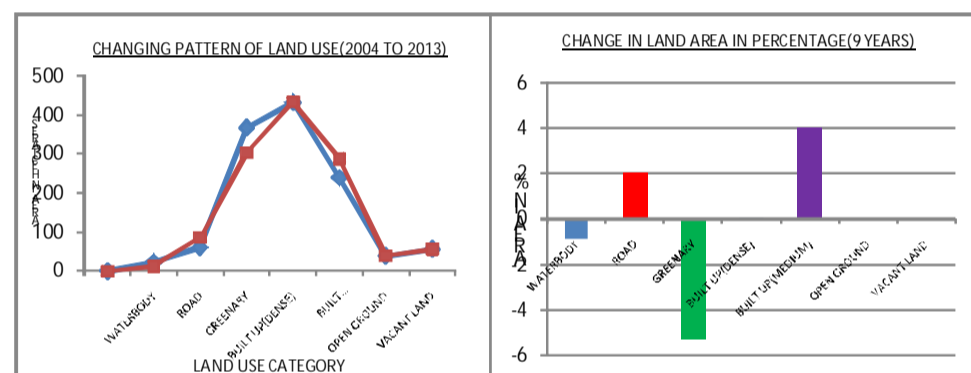Fig 4   Fig 5

1.Percentage of Road has 2.05% increased in 9 years. New roads are being constructed in   the slum areas and previous kutchcha roads are concretized through different government schemes by the municipality. The total length of roads has also increased.
2.Built up area (medium) has also increased to 4.04% as new houses , markets, shopping malls ,hospital, office, institutions are being constructed in different parts and the town is becoming important for administrative purpose than only residential like before.

SUGGESTIONS FOR BETTER MANAGEMENT OF LAND:

·   The municipality has no authority over land(as it is under the Urban Development Department.So illegal encroachment can not be checked until it comes under the jurisdiction of the municipality.By this direct control over land the transfer can be legalized and rules can be implemented.
Building up new hutments in slum area can be checked by controlling the in migration in the town.The waterbodies must be cleared once in a month by the local inhabitants to stop eutrophication and pollution.
Parks and gardens are ill maintained which needs attention of the local stakeholders(block secretary or ward counselor) to plant more trees and keep the surrounding healthy.
New construction work at central park and some places should not be encouraged as it is against the master plan and the ecological ethics of the township.
Lakes can be used for amusement purpose and increasing water bodies in the town.
Eco tourism spots can be developed at Nicco park, Central park where amusement fee can be an extra source of income of municipality

Rehabilitation of the slums within the planned area along the bypass road is the need of the hour to maintain the sustainable environment
Renovation of the ponds in ward no 22,23 and 24 can save the ecological balance of the area as these are the lifeline of the slumdwellers.

CONCLUSION:

In metropolitan and urban areas the problems related to rapid transformationthat take place in terms of land-use are now very pronounced. As a result, theavailability of detailed, timely information on urban areas is of considerable importance to both the management of urban activities and to forward planning.Satellite remote sensing has the potential to provide some necessary information.
It can be concluded from the study that being a planned town landuse category for each sector was preplanned and construction followed the master plan.But over time due to the demand of people and pressure for an alternative administrative area of Kolkata, Salt lake has become an important place where all the administrative office and institutions are set up and specially sector V,the IT industrial area (now outside the municipality) has created demand for market,stalls, hotels,amusement etc.There are four slums in the planned area where hutments are still increasing everyday inviting migration from outside.This leads to filling up wetlands and developmental works like construction of metro railway also reduced the no of trees and create other environmental concern.Though no provision for tram,metro or ropeway was there in the master plan ,but even that plan is being changed with time which may lead to different problems and threat to the town in future.

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