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ORIGINAL ARTICLE

CHANGING LANDUSE OF EAST KOLKATA WETLAND, INDIA

SUBHADIP GUPTA

Lecturer in Geography in PCMM, Bonhoogly, Kolkata

Abstract:

Degradation of natural resources has been a global problem. Due to rapid urbanization and industrialization, over-exploitation, and other anthropogenic activities have resulted to changes in land-use and land cover pattern. Significant land-use/ land cover changes have been reported during the last century both on spatial and temporal scale, mainly due to economic development and population growth. Anthropogenic changes in land use and land cover being increasingly recognized as a critical factor influencing global change. Currently with the growing population pressure, changing human population-land ratio and increasing land degradation, the need for optimum utilization of land assumes much greater relevance. Remote sensing integrated with Geographic Information System (GIS), provides an effective tool for analysis of land use and land cover. The geospatial technology that combines the technology of remote sensing and GIS holds the potential for timely and accurate determination of pace of land degradation due to various anthropogenic and natural phenomena. These sorts of techniques have been used in the tropics

KEYWORDS:

Changing , Degradation , Land Use , Methodology , Analysis , Interpretation Technique.

INTRODUCTION

The transitional zones between permanently aquatic and dry terrestrial ecosystems are usually known as wetlands. It is an area of ground that is permanently or seasonally saturated with salt, fresh, or brackish water. The main functions of wetlands are as water purification systems, flood control, shoreline stability, and as reservoirs of biodiversity. East Kolkata Wetlands forms a part of the extensive inter distributory wetland regimes formed by the Gangetic delta. The dynamic siltation pattern in the delta resulting due to the interface between freshwater and coastal processes creates a distinct topographic pattern within the region. The presence of this depression along with changing silt distribution patterns due to shifting of river courses and clayey and calcareous substratum creates conducive environment for formation of marshes which have presence all along India and Bangladesh. The East Kolkata Wetlands (EKW), located on the eastern fringes of Kolkata city is one of the largest assemblages of sewage fed fish ponds spread over an area of 12,500 ha. These wetlands form a part of the extensive inter-distributory wetland regimes formed by the Gangetic Delta. EKW sustains the world's largest and perhaps oldest integrated resource recovery practice based on a combination of agriculture and aquaculture, and provides livelihood support to a large, economically underprivileged population of around 20,000 families which depend upon the various wetland products, primarily fish and vegetables for sustenance. Based on its

immense ecological and socio cultural importance, the Government of India declared EKW as a Wetland of International Importance under Ramsar Convention in 2003. The wetland system currently produces over 15,000 MT per annum from its 264 functioning aquaculture ponds, locally called bheries. Additionally, nearly 150 MT of vegetables are produced daily by subsistence farmers. Needless to say, EKW serves as the backbone of food security of Kolkata City.(www.ekwma.com)

PROBLEM OF THE STUDY AREA

Throughout the ages, urban wetlands, either natural or manmade, have been a part of many Indian cities, which were preserved by people as the main source of water supply for drinking and irrigation. But today, because of increasing pressure of urbanization, change in the quality and quantity of the solid waste and sewer, as also human neglect, this site, presently a Ramsar site is under threat from various directions. The two most important threats in these wetlands are that of encroachment due to urban development and siltation. The constant change of land use pattern has affected the ecology of these wetlands. Many large pisciculture ponds have been converted to paddy fields. The industries in the adjacent areas have made unauthorized connection to the sewers to empty their untreated wastewater. The sewers on the other hand empty the water into the channels that later on join the wetlands. This is causing a deposition of the heavy metals in the canals and ultimately the quality of fish and vegetables produced in the wetlands is far below the edible standard. Thus due to this rapid expanding human population, large scale changes in land use/land cover, improper use of watersheds have all caused a substantial decline of wetland resources of the country. (Mukherjee M and Chattopadhay K (2002): Kolkata, The city of wetland.

LAND USE

This region shares the delta region with Bangladesh. Presently, Land use of east Kolkata wetland is 3,898ha, or about two thirds of the 5,852ha of water area is used for 364 sewage-fed fisheries. The remaining one third of the water area, approximately 2,000ha or 20km2, supports a wide variety of agriculture including rice paddies, ornamental flowers and vegetables. The East Kolkata Wetlands describes the three major land uses as-substantially water body orientated area, productive farming area; and urban/rural settlement area

LOCATION OF STUDY AREA

The study area of our present paper is East Kolkata, which lies between Hugli River in the northwest and Bidyadhari River in the east. The area consisting of 133.50 km2 is bounded by latitude 22°25' to 22°40' N and Longitudes 88°20' to 88°35' E and adjacent to the eastern part of Kolkata bordering the Salt Lake township on the one hand and the upcoming new township at Rajarhat on the other. The multifunctional wetland ecosystem consists of an area of 12,500 hectares. This wetland acts as a sewage water treatment plant and treats about 800 million liters of wastewater flowing out daily from Kolkata. Wastewater of the city is a mixture of domestic and industrial effluent carrying high amounts of heavy metals. This wastewater is fed into the wetland locally known as "bheries". (East Kolkata Wetland by Bunting S Buy- Environmental Management Manual)

OBJECTIVE

The main objective of the present paper is to assess the temporal change of East Calcutta wetland area between the period from 1986 to 2011 by using remote sensing and GIS techniques.On the other hand the same objective is trying to be solved by using the Geographical Information System. The visual interpretation method is used to delineate the wet land area and also the other land use by the GIS platform.

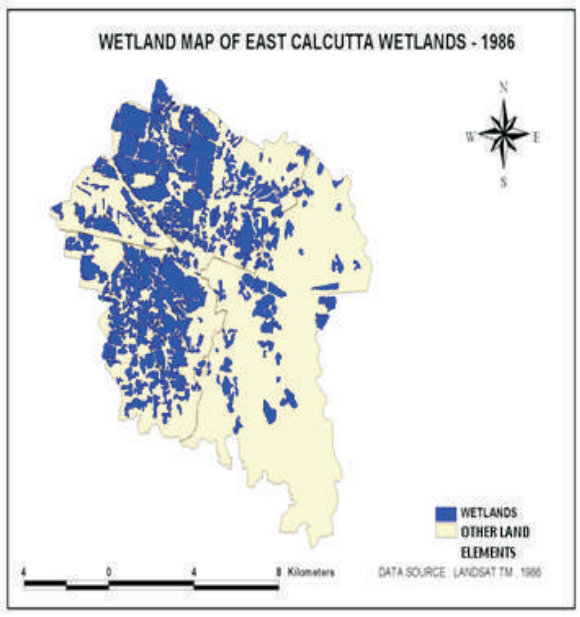
METHODOLOGY

Different types of images have been used to prepare the present paper. Such as -Google image (2011), LISS III image (2009), LANDSAT TM (1986, 1999, 2012). The software's which have been used are ARC VIEW and ERDAS. At the very early stage the Google images are downloaded (latitude and longitude specific) from the Google Earth. After that the downloaded images are imported and geo-referenced by using the ERDAS software. Those images are taken together to form a seamless mosaic map. By using this output the land use map of 2011 has been prepared.The Landsat TM images and the Google image are used for analyzing change using visual interpretation method. Landsat image is used for showing

the very recent condition of the selected study area.

ANALYSIS

Land use map of an area is nothing but a graphical representation of different physical, as well as cultural elements, which play an important role for the socio-economic development of a particular geographical area. So the socio-economic change of the study area , East Kolkata wetland can be easily identified by analyzing the temporal change of wetland area for last two decades. The most important physical element of this particular geographical area is water body or wetland and the ecological balance is very much depended on this particular landscape. As we know the east Kolkata wetland is called the green heart of the city due to its greenery and rich wetland resource. So it is our duty to keep a close look on the ecological interpretation of the changing land use of east Kolkata wetland. Landuse changes in east Kolkata wetland over a period of years from 1986 to 2011 have resembled a distinct change of a more to less severe pattern. We have taken four satellite images of the chosen time period. The images of 1986, 1999 and 2012 are Landsat TM data, and the 2009 image is Liss 3 data. To prepare recent land use map we have used the Google image of 2011. After vectorisation by visual interpretation of the images we have got the areas of different land cover features. Using Excel sheet we derived the percentage values.

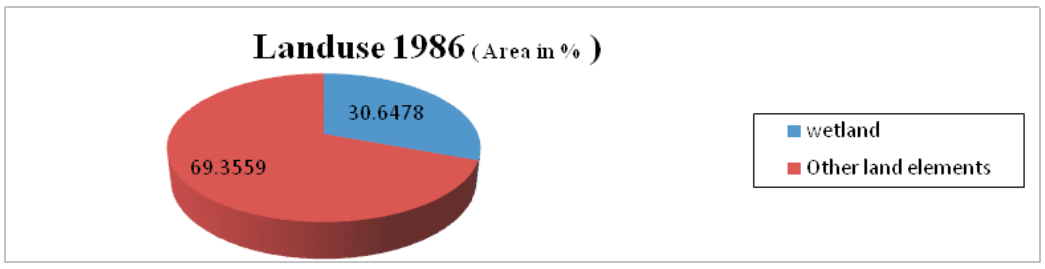


USING VISUAL INTERPRETATION TECHNIQUE

Year	Wet land area(in sq km)	Other land elements(in sq Km)	Total area(in sq km)	% of wetland
1986	41.065	92.925	133.99	30.64
1999	35.279	98.711	133.99	26.32
2011	33.082	100.908	133.99	24.68

The above diagram represents the areal change of wetland area in the year of 1986, 1999 and 2011.The statistical figure shows the wetland area as 41.06 sq km, 35.28sq km and 33.08 sq km. which on the percentage value are 30.64, 26.32 and 24.69 percent respectively. The above map is showing the wetland pattern of 1986 of Ramsar site ,Kolkata which is based on landsat TM data of the same year. Out of the total 133.99 sq km, 41.065 sq km is wetland which is approximately 30%.

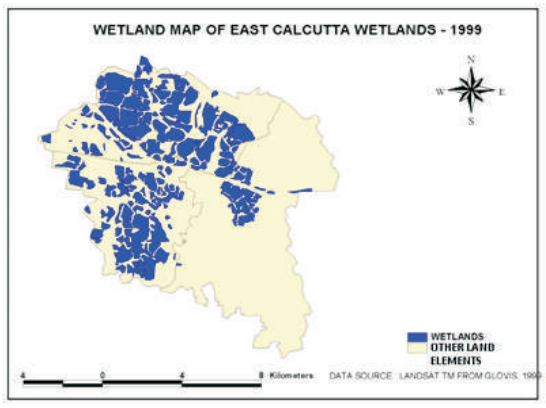
Year	Wetland Area(in sq km)	Unclassified area (in Sq Km)	Total area(in sq Km)	Wetland(in%)
1986	41.065	92.930	133.99	30.6478

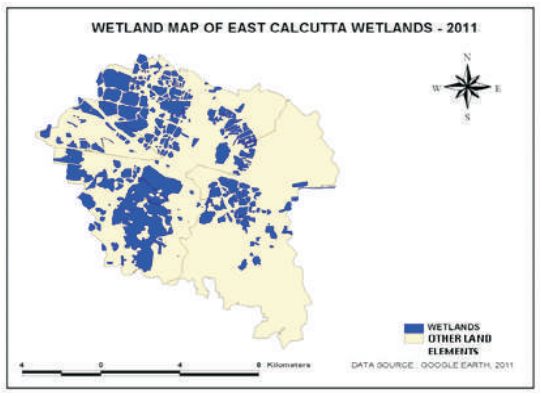


The above rea table specifies the wetland area of 1986 which is approximatley 41.065 sq km. out of the total wetland awhich is 133.99 sq km, app 92.930 sq km falls under unclassified areas ensemble all other landuse and landcover attributes. The percentage values of wetland in 1986 was 30.6478. The pie chart is the graphical representation of the above table.

Year	Wetland Area(in sq km)	Unclassified area (in Sq Km)	Total area(in sq Km)	Wetland (in %)
1999	35.279	98.72	133.99	26.3295

The above table specifies the wetland area of 1999 which is approximatley 35.279 sq km. Out of the total wetland area which is 133.99 sq km, app 98.72 sq km falls under unclassified areas which ensemble all other landuse and landcover attributes. The percentage values of wetland in 1999 was 26.3295. If we

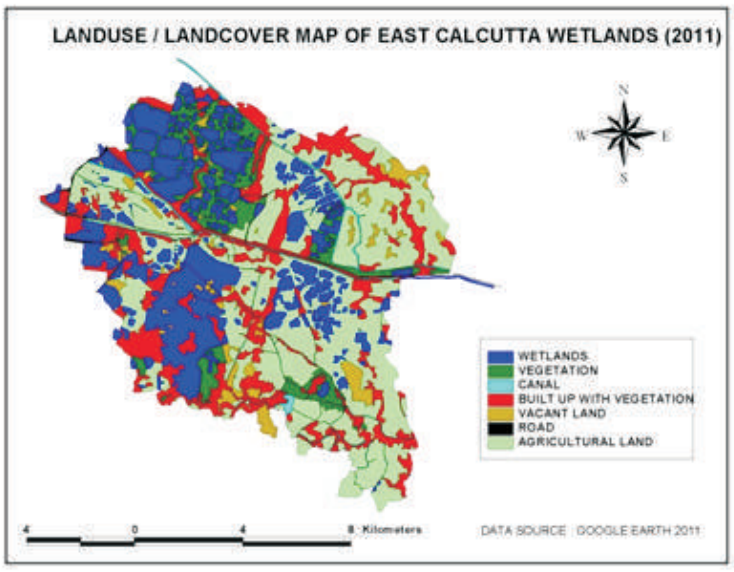




compare it from 1986, we can analyse that the concentration of wetland has gradually shrinked to about 4%(30.6478 to 26.3295). The pie diagram is the graphical representation of the above table. In this map, the above mentioned table provide a cogent evidence that the pace of decreasing wetland has lessened to some extent. Based on the analysis of 24 years the changes replicate a slight 4% decrease between 1986 to 1999 and near about 2% decrease between 1999 to 2011.

Year	Wetland Area(in sq km)	Unclassified area (in Sq Km)	Total area(in sq Km)	Wetland (in %)
2011	33.082	100.908	133.99	24.6899

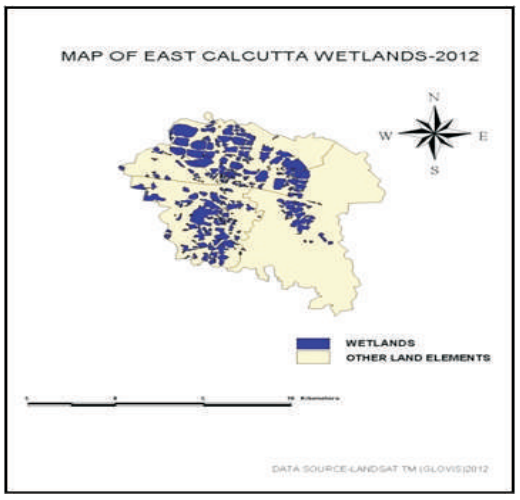
The above table specifies the wetland area of 2011 which is approximatley 33.082 sq km. Out of the total wetland area which is 133.99 sq km, app 100 sq km falls under unclassified areas which ensemble all other landuse and landcover attributes. The concentration of wetland as usual getting decrease and the area under unclassified is resembling a persisting increment. The percentage values of wetland in 2011was 24.6899. If we compare it from 1999, we can analyse that the intensity of shrinkage has decreased to a lesser extent ie from 26.3295 to 24.6899(near about 1.6% reduction). The pie diagram is the graphical representation of the above table.

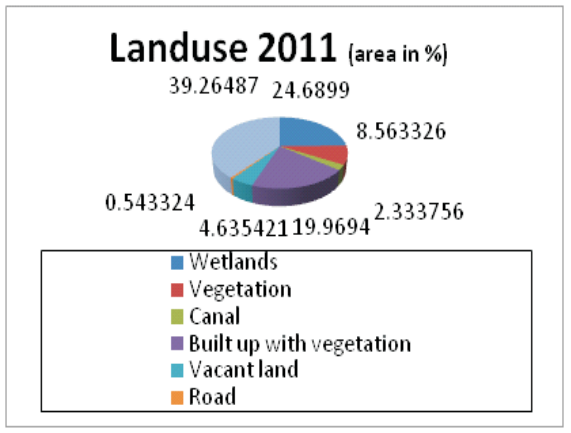


LANDUSE SCENARIO OF YEAR 2011

The present landuse map is prepared on the basis of Google image 2011. The broad landuse catagories which are taken into consideration are wetland, vegetation, canal, built up area with vegetation, vacant land, road and agricultural land. If we give stress on the areal distribution of the said different landuse category, we can notice that a maximum portion of the total area is covered by the wetland.

Sl. No	Landuse	Area in Sq Km	Area in %
1	Wetlands	33.082	24.68
2	Vegetation	11.474	8.56
3	Canal	3.127	2.33
4	Built up with vegetation	26.757	19.96
5	Vacant land	6.211	4.63
6	Road	0.728	0.54
7	Agricultural land	52.611	39.26





The present land use table of east Kolkata wetland represents the different types of entities which surrounds this wetland around its nearby ambit. The important categories of land use pertaining here are wetlands, vegetation, vacant land, agricultural land, build up with vegetation and roads. This table provides a clear evidence of the decreasing of wetland area has been mechanized primarily because of increasing concentration of agricultural area whereby villagers are utilizing this very wetland area for crop cultivation.

In 2011, the areal coverage of agricultural land is about 52.611 sq km which accounts 39.26487 %. With the proliferations of suburb area, the nexus of periphery are increasing at an alarming rate which is also indicated in the table, whereby the areal coverage of built area is around 26.757 sq km, which in percentage stands about 19.9694. A map has been generated from the Land sat TM image of 4th February 2012, downloaded from Glovis. This map presents the recent spatial scenario of the study area.

CONCLUSION

East Kolkata Wetlands have witnessed many conversions in the following manners-Over time from 1986 to 2011 the areal concentration of this wetland is decreasing. Out of the total wetland area in 1986 to 2011 the percentage of decreasing wetland is equivalent with the percentages of increasing unclassified areas. The area where wetlands over time shrunk has engendered mainly built up areas because of suburbanization, construction of new built up areas and to some extent the emergence of agricultural land. Degradation of wetland has a great impact on environment. This can lead to change of biodiversity of the area and its surrounding largely. The East Kolkata wetland is called the green heart of the city, thus any disturbance in the area can cause total environmental imbalance for the metropolitan zone. In the time period of two decades from 1986 to 2011 the main wetland area has shrunken a lot and it is still tending to shrink. There is an noticeable point that the East Kolkata Wetland has announced as an Ramsar site in the year 2002, and after that the rapidity of converting wetlands to agricultural lands and buildup areas has reduced to near about half of the before. Though in the first decade the rate of disappearance was much than the second but the process is still running. It may be an indicator of occurrence of any big calamities in near future. To stop further deterioration of the system as also to protect and develop its original character, the East Kolkata Wetlands Management Authority, Department of Environment, Govt. of West Bengal has prepared a comprehensive and integrated Management Plan in keeping with basic guidelines of the Ramsar Protocol, and started implementing it.

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