

TITLE: STUDY OF THE EFFECT OF CHANGE IN LANDUSE IN SEWAGE-FED AQUA CULTURE SYSTEM OF CALCUTTA USING REMOTE SENSING & GIS.

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Abstract

The Kolkata Municipal Corporation area generates roughly 600 million liters of sewage and wastewater and more than 3500 metric Tons of garbage every day and recycled at designated sites in the East Kolkata Wetlands. The garbages are used in 900 ha for Vegetable farming as fertiliser. The wastewater is used for aquaculture in around 254 fisheries and also for irrigation in vegetable cultivation. It constitutes a unique system of resource recovery, in which nutrients are extracted from the city's waste water through fish farming and agriculture for which East Kolkata Wetlands are designated as Ramsar site.. Changes in land use, changes in hydrological regimes, and stakeholder conflicts are rapidly degrading the system. So, Study of Land use change is the foremost requirement for system management.

This paper is aimed to detect the change in Land use of the East Kolkata Wetland Area using temporal data included ALOS AVNIR II data and Study the effect of change in land use in the existing sewage flow system, change in crop status in the sewage fed farms and condition of sewage fed fishery ponds. The study reflects that land use change is taking place which is alarming to the ecosystem. It also found that management failure and urban encroachments are other threats for the sustainability of the system.

1 INTRODUCTION:

The East Kolkata wetlands are the world's largest and oldest integrated resource recovery system based on a combination of agriculture and aquaculture, and provide livelihood support

to a large, economically underprivileged population of around 27,000 families which depend upon the various wetland products, primarily fish and vegetables for sustenance. In 2002, the East Kolkata Wetlands was declared a

Ramsar wetland site based upon the wise use of the wetland, in particular, sewage treatment, fishery production and agricultural irrigation. The Kolkata Municipal Corporation area generates roughly 600 million liters of sewage and wastewater every day and more than 3500 metric Tons of garbage which is collected daily and dumped at designated sites in the East Kolkata wetland. The wastewater is used for aquaculture in around 254 fisheries and also for irrigation in vegetable cultivation. It constitutes a unique system of resource recovery, in which nutrients are extracted from the city's waste water through fish farming and agriculture. Changes in land use, changes in hydrological regimes, and stakeholder conflicts are rapidly degrading the system. Located on the peri-urban interface of Kolkata City, the wetland has been under constant pressures for conversion for settlements and agriculture. The High Court of Kolkata passed an order in 1992 prohibiting changes in land use of the area and directed the state government to take remedy to statutory cover to stop any encroachment. Accordingly, in 2006 East Kolkata Wetland (Management & Conservation) Act was enacted. So, Study of Land use change is the foremost requirement for system management.

2 OBJECTIVES:

The objective of this paper is to detect the change in land use of the East Kolkata Wetland Area using satellite data of different time period. The effect of change in land use and threats in the existing sewage flow system will also be studied.

3 STUDY AREA:

The study area is located in the eastern fringe of city Kolkata lying in between 22°25' to 22°40'N and 88°20' to 88°35'E. The Kolkata Metropolis is one of the largest urban agglomerations in the country with a population of 14.72 million and a density of 7950 persons/sq.km. The East Kolkata Wetlands system is a part of Gangetic delta between river Hooghly on the west and Kulti on the east.

4 METHODOLOGY:

The land use zonation of the area is done based on satellite data of different time period. Time series data reflects the change pattern. SPOT data of 1989, IRS PAN data of 1999, IKONOS-2 data of 2002, Resourcesat-1 LISS IV of 2006 data were procured to show the spatial change of land use of the project area. The Survey of India topographical sheets of 79B/6, 79B/7, 79B/10 and 79B/11 of 1:50000 scale is

used for reference of change in land use. The EKW boundary is overlaid on all the images after geo-referencing. Then classification technique was used within the EKW area to classify the area. Two alternative approaches Supervised and Unsupervised classification techniques were used. After classification zoning of the major land use classes were done based on field information and classified classes. The Police Station maps, Toposheets and ground information were used to prepare the road network, canal network, settlements and other spatial and non-spatial inventory information. For the socio economic data a household survey was done within EKW area and database were prepared. All the database were kept in GIS environment to prepare different user level maps and also administrative and planning and policy level decisions are made based on these maps.

5 RESULTS AND DISCUSSION:

The plot level boundary of the project area is delineated using cadastral map and high resolution satellite data like IKONOS. The pattern of land use is studied from 1960 onwards. Though there are some technical limitations for exact comparison of different satellite data of different time period since the spectral and spatial resolutions are different. But the trend of land use change can be identified. SPOT data of 1989 (4th December), IRS 1D


PAN of 1997 (31st January), IKONOS of 2002 (November) , Resourcesat-1 LISS IV of 2006 (14th February) and AVNIR II of 2007 were used to find the spatial extent of different land use classes. The main land use classes of the project area are substantially water area which are mainly sewage fed and pisciculture is practiced widely, the next part is garbage farming area where farming is done using city sewage, agriculture using sewage and the settlement area.

The land use comparison is made regarding the basic trend of land use pattern in the EKW area over the years. The current land use pattern based on analysis of the high resolution IKONOS imagery, 2002 is indicated in the following table:

Land Use	Area (in ha)	% of total
Water bodies	5,852.14	47
Agriculture	4,718.56	38
Garbage Farming	602.78	5
Settlements	1,326.52	11
Total	12,500	100

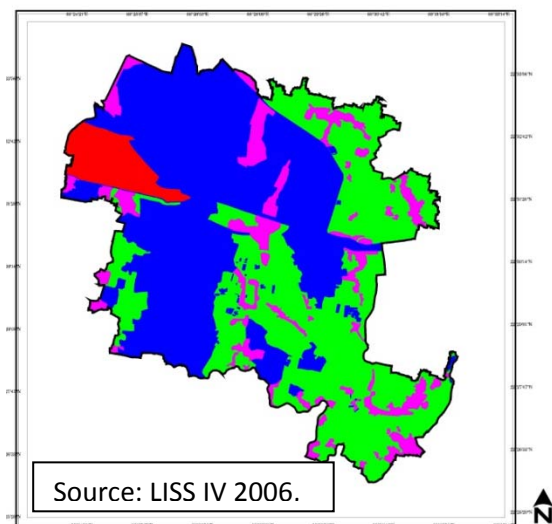
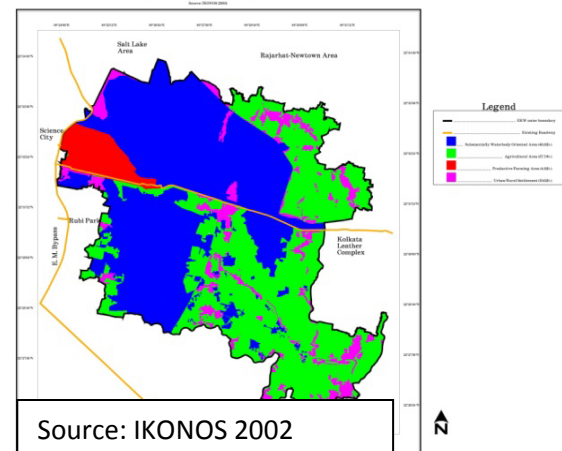
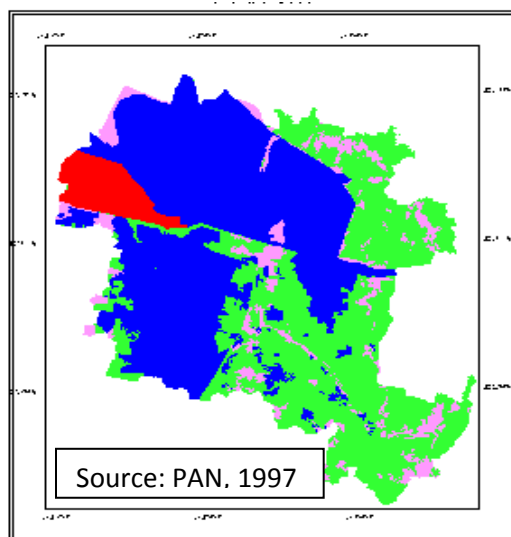
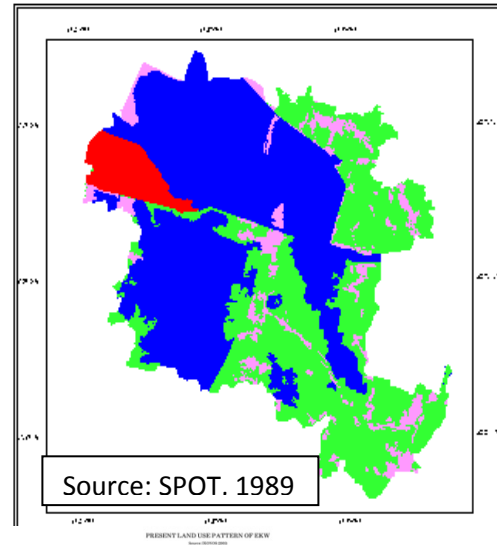
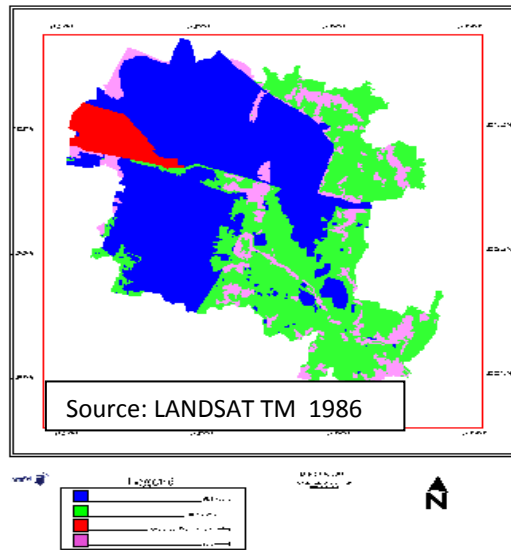
It is observed that there is certain trend of land use changes in East Kolkata Wetland Area. Two types of changes are seen. One is for natural reason and the other is for anthropogenic reasons. The broad trends emerging from the satellite data are presented below.

SOI toposheet of 1959-60 of the project area was referred and it was seen that there is a



Source: TOPOSHEET 1959

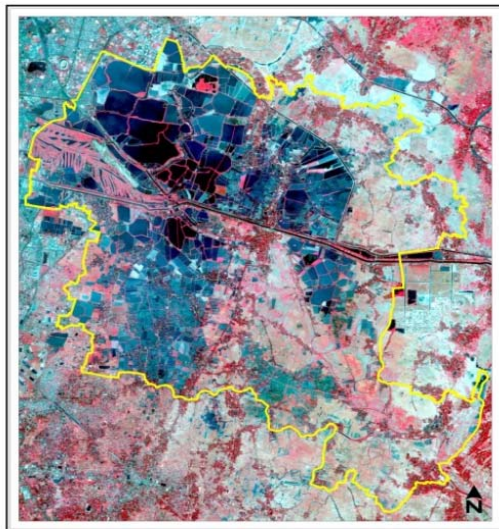
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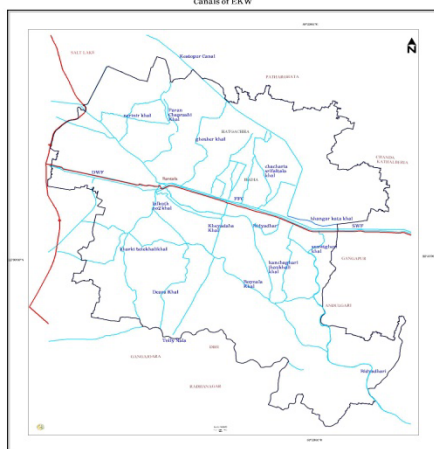
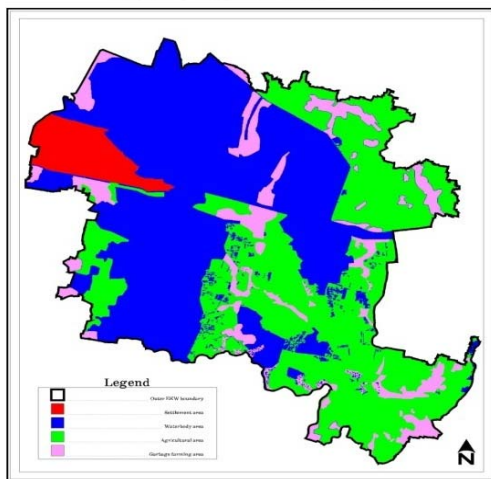
ecosystem services and over all environmental balance is getting disturbed. Located on the periurban interface of Kolkata city, the wetlands have been under constant pressure for conversion for settlement and agriculture. Thus this change in land use is actually threatening the system ecologically endangering the overall sustainability of the resource recovery practices which forms the base of existence of the entire Kolkata city and of the livelihoods of 0.2 million poor who depend on its resources for sustenance. Realizing this truth and to combat the system from encroachment and other degradation activities the act was enacted in

is also increasing which is alarming to the

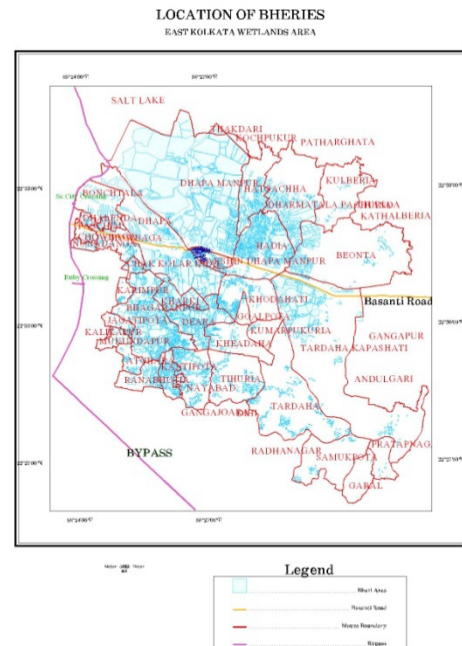
EKW area to protect conversion of character of land



Source: AVNIR II 2007.

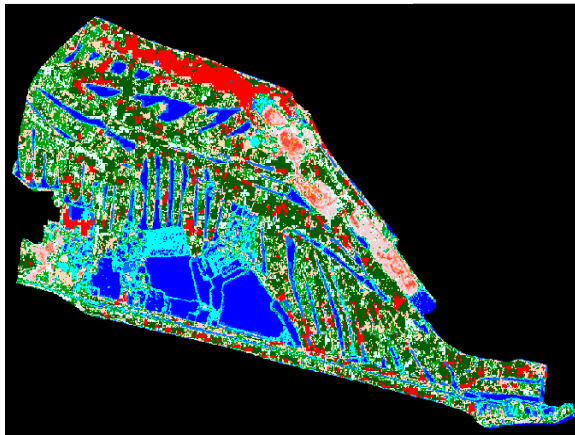


within EKW area. The plot level land use delineated using IKONOS imagery is considered as the final land use which is scheduled in the Act, 2006 and change of this scheduled land use is prohibited as per Act. For the study of



compatibility of AVNIR II data with respect to LISS IV in terms of classification of land use, unsupervised classification was applied within EKW area. It was observed that though the spatial resolution of AVNIR II (10m) is coarser than that of LISS IV (5.8m) the classification outcome doesn't show any significant difference except for the settlement class when compared to IKONOS (4 m) data of the same area which has better resolution. The difference may be due to variation in spectral resolution and time of data acquisition. Another important point to mention is that Rapid siltation due to changes in hydrological regimes, pollution and stakeholder conflicts are also greatly hampering the wetland

functioning. To analyse these changes different spatial database of EKW area is prepared using these satellite data. A separate study was made to find out the ecological impact of sewage irrigated vegetable farming in the productive farming area of EKW. For this purpose high resolution satellite data like IKONOS



multispectral is used for classification and vegetable segregation is the next stage. The socio-economic survey reflects that access to social amenities within the wetland communities is insufficient. Scarcity of drinking water, inadequate sanitation and health care are common problem suffered by the people here.

6 CONCLUSION

East Kolkata Wetlands have a long history of conversions for settlements, aquaculture development and industrialization. The combined outcome of these activities have evolved problems like area reduction, siltation, infectivity due to toxic wastes, loss of biodiversity and overall ecological loss of multiple benefits generally served by wetlands. The conversion threat is now well addressed by exercising the power of EKW(C&M) Act, 2006. The inputs of the study are incorporated while preparing management plan and action plans are suggested accordingly to make the system sustainable. Land use monitoring of EKW area using satellite data from time to time is already initiated. For this purpose high resolution satellite data is required. The usefulness of AVNIR II data is quite satisfactory in respect of land use classification and change detection can be done by acquiring time series data of EKW area which will give a broad overview of the changes taking place in and around EKW area. Since the land use of EKW area while delineating the settlement is complex one since they are very scattered in nature and mostly mixes up with water area since they are located adjacent to the wetlands. ALOS PALSAR imagery can be acquired each year to map the dynamics of wetlands in EKW area. This will help out in mapping seasonal sewage channel network mapping also. For de-siltation purpose different canal de-siltation within EKW area is in progress. The satellite imagery in this purpose is also very helpful. The output maps are very

useful for planning and implementing stages of the action plans recommended in the integrated management plan of East Kolkata Wetland Area.

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