

CHANGES IN LAND USE DUE ENVIRONMENTAL DEGRADATION IN PALLIKARANAI MARSH, AN URBAN WETLANDS IN CHENNAI PRIME SUBURBS, TAMILNADU, INDIA

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Abstract— Wetlands are one of the most threatened habitats in the world. According to the UN Millennium Ecosystem Assessment, 2005 environmental degradation is more prominent within wetland systems when compared to other natural systems of earth. The degradation is due to factors such as the process of ill planned urbanization, industrialization and encroachments. Wetlands in India, as elsewhere, are increasingly facing several anthropogenic pressures. These have led to hydrological perturbations, pollution and their effects. Unsustainable levels of grazing and fishing activities have also resulted in degradation of wetlands. The State of Tamil Nadu has a number of water bodies and wetlands and several of these are facing serious threats or are increasingly disappearing due to multifarious pressures. This is especially true for those wetlands located close to growing urban centers or bustling metropolises. Pallikaranai Marsh is one of the last few remaining natural ecosystems in the city of Chennai in the outskirts of Chennai. About 30 years ago, the Pallikaranai Wetland was spread over an area of more than 5000ha (50 km²). The present study has used Geographical Information Systems (GIS) and Remote Sensing (RS) tools to study these changes between year 1990 and 2010. The classification of land use into seven categories is based on multi-spectral or multi-temporal remote sensing images has been the main approach for detecting wetland change. The Land use pattern for the year 1991 and 2010 respectively shows that there is significant increase in settlements and the Marsh (in Perungudi dump , K. K. Sharma, Professor and

Head, Department of Applied Geology and Centre for Environmental Sciences, University of Madras, Chennai, India yard) has clearly witnessed an increase in dump area. A rapid decrease in the area of grass land indicated that human activities strengthened the disturbance of wetland. It was seen that the wetland area and grasslands decreased and the area under settlements and dump yard increased between the year 1990 to 2010 contributing to water pollution in the Marshland leading to deterioration of water quality.

Index Terms— wetland, Pallikaranai marsh, landuse, dumpyard, pollution, environmental degradation, Geographical Information Systems, grasslands

I. INTRODUCTION

Wetlands in India, as elsewhere are increasingly facing several anthropogenic pressures. Significant losses have resulted from its conversion threats from industrial, agricultural and various urban developments. These have led to hydrological perturbations, pollution and their effects. Unsustainable levels of grazing and fishing activities have also resulted in degradation of wetlands (Prasad et al, 2002).

The State of Tamil Nadu, India, has a number of water bodies and wetlands. Several of these are facing serious threats or are increasingly disappearing due to multifarious pressures. This is especially true for those wetlands located close to growing urban centers or bustling metropolises. Due to migrants the population growth is intense so as to affect , pressure on the local infrastructure, ecological fragmentation, poverty, air pollution, waste and sewage management, improper drainage systems and inadequate water supply leading to disastrous seasonal floods, diseases, ground water lowering, pollution and environmental destruction (Drescher et al. 2007).

Pallikaranai Marsh is one of the last few remaining natural ecosystems in the city of Chennai. This wetland is located in the outskirts of Chennai. It is one such wetland that is very likely to disappear in near future, if active appropriate interventions are not made now

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(Glaser et al, 2006). Out of 566.59 ha. of Pallikaranai Marsh, an area of 317.00 ha. of Marsh has been declared as Pallikaranai Marsh Reserved Land under Tamil Nadu Forest Act 1882 with effect from 18.04.2007

II. Material and Methodology

The present study has used Geographical Information Systems (GIS) and Remote Sensing (RS) tools to study these changes between year 1990 and 2010. The technical assistance for the present study was from Centre for Climate Change & Adaptation Research, Anna University, Chennai. Landsat Thematic Mapper (TM) of 1991 and 2010 images covering Pallikaranai wetlands were acquired which in turn had been obtained from National Remote Sensing Centre, Hyderabad. The Landsat Thematic Mapper data are processed using ERDAS IMAGINE 9.3 image processing software. The images are imported into ERDAS layer stack module to form a floating scene and to group the bands together. Initially, the image of 1991 is geometrically corrected and geo-referenced by using the topography at the scale of 1:50,000. Then the geometrically corrected 1991 image is used as a master image to register other image. This is followed by performing further geometric corrections of the 2010 image to remove few scattered clouds in the image. The images are projected to the Universal Traverse Mercator (UTM) coordinates Zone 44. The spheroid and datum is also referenced to WGS 84. Accurate geometric registration of an image set with RMSE of <1 is necessary for accurate land use change analysis. After the rectification processes, datasets are cropped based on the detailed polygon area in the study area.

Classification of land use based on multi-spectral or multi-temporal remote sensing images has been the main approach for detecting wetland change. In order to obtain high quality land use change, ArcGIS software is used for digitization. Supervised classification with a maximum likelihood algorithm was used in this study, because this classification algorithm produces consistently good results for most habitat types. The training polygons are digitized on screen based on terrain knowledge acquired during field work and was distributed throughout the study area. Seven land cover categories are digitized in GIS polygons incorporating

(1) Water body and vegetation (2) Settlements (3) Dump yard (4) Sewage treatment plant (5) Grassland. In order to evaluate the accuracy of the land use maps derived from remote sensing images covering the Pallikaranai wetland, a field survey was conducted covering the entire study area using GPS facility.

After the accuracy assessment, the classified images were exported to the ARC GIS to generate the land cover and land use map. Post classification comparison proved to be an effective technique because data from different dates were separately classified, thereby minimizing the problem of normalizing for atmosphere and sensor differences among dates. Once maps had exactly the same number of feature pixels they were subjected to a cross tabular comparison. This indicates the differences in extent of each class and the transitions that had taken place between dates.

Results and Discussion: Changes in Land Use/Land Cover in Pallikaranai Marsh between 1991 And 2010

About 30 years ago, the Pallikaranai Wetland was spread over an area of more than 5000ha (50 km²). The area of the wetland has been decreasing rapidly. Urban development has taken place in ecologically very sensitive zones. The environmental changes taken place in Pallikaranai Marsh till the year 2001 are the extreme progression of urbanisation dynamics around Pallikaranai Marsh has a dramatic influence on the ecosystem marshland. Fragmentation, decrease of water spread, introduction of invasive plants and intense pollution gravely alter water ecology and dynamics. The consequence is the initiation of a change from a mainly saltwater marshland to a terrestrial land. Further, gross fragmentation, pollution and degradation processes are very close to destroying the marshland ecosystem including important ecosystem services.

As mentioned above, the land use/land cover changes are seen for past 30 years and hence the present study has used Geographical Information Systems (GIS) and Remote Sensing (RS) tools to study these changes between year 1990 and 2010.

In the Table.1, it is seen that the area under the wetland and grass land has decreased where as the area under the settlements and dump yard area has increased tremendously between 1991 and 2010.

Table.1
Land use/Land Cover Changes in Year 1991 And 2010

Class	1991 (ha)	2010 (ha)
Wetland (open water, floating vegetation and emerging vegetation) this is the area with deep water (core area of the Marsh)	592.17	523.33
Settlements	138	1146.28
Dump yard	5.81	66.18
Sewerage Treatment Plant	0	23.52
Grassland	1424.02	401.38

Source: Based on the data compiled by Author

Figure .1 Land use /land cover map for Pallikarana marsh area in year 1991

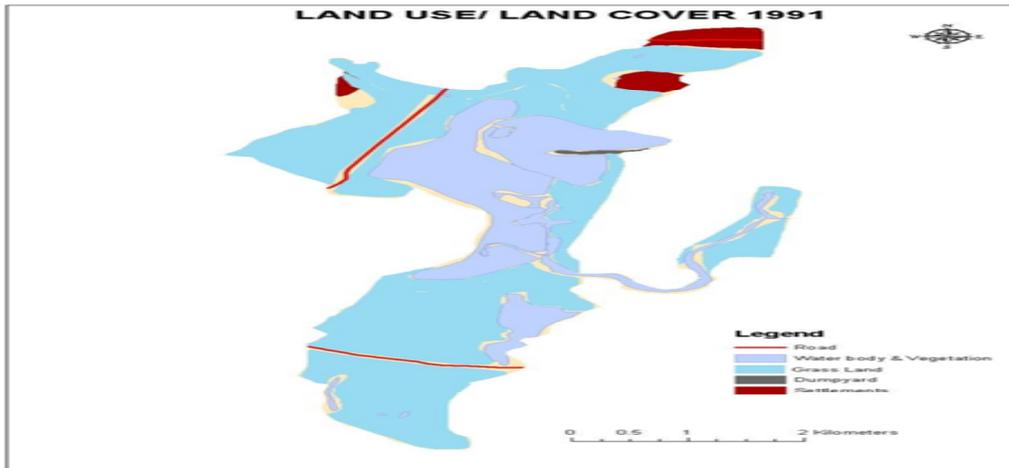
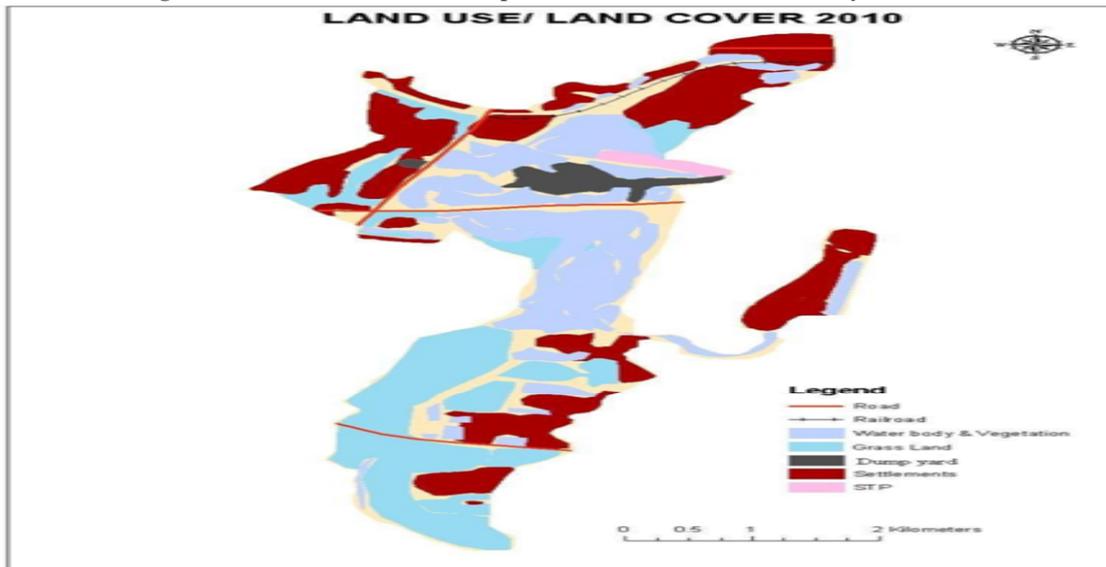


Table.2
 Percentage of Land use /Land Cover Changes between year 1991 and 2010

Class	1991 -2010(ha)	Change (%)
Wetland (open water, floating vegetation and emerging vegetation) this is the area with deep water (core area of the Marsh)	-68.84	-11.6
Settlements	1008.28	87.96
Dump yard	60.37	91.22
Sewerage Treatment Plant	23.52	1
Grassland	-1022.64	-71.81

Source: Based on the data compiled by Author

Figure .2 Land use /land cover map for Pallikaranai marsh area in year 2010



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In the Table.1, it is seen that the increase in the settlements is from 138ha in 1991 to 1146 ha in 2010, that is, % change by 87.96%. Due to the rapid urbanization, the wastes generated in the major part of Chennai City are being dumped in the Marsh as a result the Marsh has witnessed an increase in dump area by 60.37 ha and % change by 91.22%. The Sewerage Treatment Plant (STP) in the Marsh area was under operation from 2006 under CCRCP scheme, hence in the year 2010, 23.52 ha was under the STP. There was a rapid decrease in grass land from 1424.02 ha in 1991 to 401.38 ha in the year 2010 and % change by -71.81% is shown in Table.2.

The Wetland is being eaten up by the rampant urban sprawl and unscientific solid waste disposal. From the previous studies conducted by Patnaik and Srihari (2004), Chandramohan and Bharathi(2009) and Jaykumar et al (2009), it was seen that there was tremendous reduction in area of the Marsh.

Jaykumar et al (2009), opine that the satellite based study on the wetland shows that 45.54% wetland area has been converted into various land use between 1991 and 2001. Encroachment is the major threat, which is responsible for 83% of land conversion. The garbage dump and road construction are responsible for remaining 17% of conversion. The rate of conversion of wetland to other land use is at the rate of 97.37 ha per year. Moreover, between 1991 and 2001, a bye-pass road was constructed dividing the Marsh into two halves arresting the water movements, which occupied 46.39 ha.

Similarly, in the present study on Pallikaranai Marsh, on comparing the land use /land cover maps in the year 1991 and 2010, (Figures.1 and 2), the reduction in the area of Pallikaranai Marsh is seen distinctly and the magnitude of reduction is also alarming.

The Land use pattern for the year 1991 and 2010 respectively shows that there is significant increase in settlements, which increased from 138ha in 1991 to 1146.28 ha in 2010 which is 87.96 % increase. Due to rapid urbanization in the Velachery area and also due to the waste generated in the major part of the Chennai city being dumped inside the Marsh (in Perungudi dump yard) has clearly witnessed an increase in dump area by 91.22 % between years 1990 to 2010. A rapid decrease in the area of grass land from 1424.02 to 401.38 ha in 2010 indicated that human activities strengthened the disturbance of wetland.

Conclusion

Pallikaranai Marsh, is one of the important urban wetland in India, which acts as a giant water aquifer, safe guarding the city against floods in southern part of Chennai. But this has now been seriously compromised due to the garbage dumping and rampant development along the fringes of the Marsh. It was seen that the

wetland area and grasslands decreased and the area under settlements and dump yard increased between the year 1990 to 2010. This contributes to water pollution in the Marshland leading to deterioration of water quality.

References

1. Chandramohan BP, Bharathi D (2009) Role of Public Governance in the Conservation of Urban Wetland System: A Study of Pallikaranai Marsh. The Indian Society for Ecological Economics (INSEE): 5th Biennial Conference, **Technical Session-III, pp1-22.**
2. Drescher Axel, Rüdiger Glaser, Constanze Pfeiffer, Jayshree Vencatesan, Elke Schliermann-Kraus, Stephanie Glaser, Marco Lechner, Paul Dostal (2007) Risk assessment of extreme precipitation in the coastal areas of Chennai as an element of catastrophe prevention. Forum DKKV/CEDIM: Disaster Reduction in Climate Change, Karlsruhe University, Germany.
3. Glaser, S, R.Glaser, A.Drescher, C.Pfeiffer, E.Schliermann-Kraus, M.Lechner, J. Vencatesan (2008) Geo-communication for risk assessment and catastrophe prevention of flood events in the coastal areas of Chennai . International Congress on Environmental Modelling and Software Integrating Sciences and Information Technology for Environmental Assessment and Decision Making, 4th Biennial Meeting, IEMSS, 2008.
4. Jayakumar, S, Joon Heo, Il-Hong Seo, Hyung Sig Cho (2009) Rapid assessment of influential factors on Pallikaranai wetland of Tamil Nadu, India. In Proceeding of Conference of The Korean Society for Geo Spatial Information System, April 24, 2009, Seoul, Korea. pp 329-331.
5. Patnaik, Dipankar.C, Srihari Priya (2004) Wetlands - A development paradox: The dilemma of South Chennai, India. Social Science Research Network (SSRN) . September 19, 2004.
6. Prasad, S.N, T.V. Ramachandra, N. Ahalya, T.Sengupta, Alok kumar, A.K.Tiwari V.S. Vijayan Lalitha Vijayan (2002) Conservation of wetlands of India – a review Tropical Ecology, Vol .43:No.1. pp 173-186.