Aarhat Multidisciplinary International Education Research Journal (AMIERJ)

(UGC Approved Journal No 48178, 48818)

ISSN 2278-5655

WETLANDS & ENVIRONMENTAL SUSTAINABILITY: A CASE STUDY

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Abstract

Wetlands are ecosystems or habitats for specific plants and animals that are saturated with water. The presence or absence of water determines their formation, processes and characteristics. Wetlands are of great importance to man and nature as it purifies water, reduces flood, stores water, prevents soil erosion, supports varied biodiversities etc. Starting about thousands of years in urban areas of the world and typically a few hundred years ago in most other coastal areas, humanity has profoundly impacted, degraded or destroyed many coastal wetlands worldwide by direct physical degradation and pollution. Ironically, reduced coastal wetland increases threat to human safety at the same time, shoreline development exposes populations to coastal hazards such as tsunamis, erosion, flooding, storm waves and surges. This paper tries to evaluate the importance of Wetlands and the present scenario of wetlands and the steps taken by the world community to protect and preserve it. This paper illustrates the present scenario of wetlands by The Case study of Pallikaranai Wetlands of Chennai which presents the best example of the dismal state of wetlands in-spite of numerous efforts taken by academicians, environmentalists and the local community to protect it.

Aim

1. To bring out the importance of Wetlands and the need to preserve and protect it.
2. Illustrate the present scenario of Wetlands based on a case study of "Pallikaranai Wetlands Ecosystems in Chennai" and the present scenario of Wetlands around the world.

Methodology

The methodology is based on the review of present and past work done on the subject and a case study of Pallikaranai wetlands ecosystem. The study

has used satellite imageries to classify land use data. Level-I classification listed devised by James Anderson (1976) has been used for the detection of land use. The land use changes and the change detection were determined using Thematic Mapper (TM) Image with 80m resolution, Enhanced Thematic Mapper (ETM) Image with 30m resolution and Linear Imaging Self Scanning Sensor (LISS III) Imageries from Indian Institute of Remote Sensing (IRS) having 24m resolution. Supervised Classification was done with reference to ground truth verification. Zhao Hui et al., (2010), Ester et al., (2012), Zhang et al., (2007), Tahir et al., (2013), Manju et al.,(2005), Kuwari and Kaiser (2011), have used similar technique for land use analysis and change detection.

Satellite imageries of the years 1991, 2001, 2006, and 2011 were used for the present study to find out land use and change detection in the study area. The year 1991 imagery was taken from LandSat 5 (L5) satellite with Thematic Mapper (TM) sensor of path 142 and row 51. The year 2001 data was taken from LandSat 7 (L7) satellite with Enhanced Thematic Mapper (ETM +) sensor of path 142 and row 51. The data for the year 2006 and 2011 were taken from Indian Remote Sensing Satellite (IRS P-6), Linear Image Scanning Sensor (LISS -3) having path 102 and row 64. The Satellite Imageries were Georeferenced using ERDAS IMAGING 9.8 version. The Imageries were processed and classified into 500 classes, using unsupervised classification these classes were re-coded after field verification. The coded unsupervised classified Images were digitized in the ARC GIS 9.3.1.

Introduction

Climate change, Global Warming, Sea level rice, Melting of Polar Ice caps all are some of the well discussed and familiar Environmental Problems and the nations of the world seems to be concerned to address these problems. At most times there are debates at reducing the emission of Green House Gases and at most times we fail to come to the conclusion, since the economic growth of a country mainly the

developed and the developing nations are at stake as they are highly dependent on industries for the growth of the economy. Along with the reduction in the emission of Green House Gases if alternative methods are adopted we can be in a better position to save the Environment from Degradation. Of the many methods one most important is plantation of more and more trees and protection of the present forest cover, as plants are one of the important sources which can convert Carbon-di-Oxide (CO_2) into Oxygen. An another alternative or similar to a forestation which can help to reduce the Green House Gases and other pollutants and argument water supply and other economic benefits are the Wet Lands. The rapid growth of population and the subsequent pressure on land for agriculture, housing and industries has alarmingly reduced the area under wetlands, to address the continuous dwindling of the wetlands and protect, preserve and sustainable utilization of the resource from the wetlands an International Convention on Wetlands or Waterfowl Habitats was held in Ramsar (Iran) on 2nd February 1971 and came into existence on 21st December 1975. According to the Ramsar Convention :*"Wetlands are areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters."* Presently there are 1,888 Ramsar Sites covering area around 1,853,000 sq.km in 159 countries of the world. The Headquarters is located in Gland Switzerland. With the help of Ramsar Convention many well renowned and important Wetlands are protected around the world, but there are numerous wetlands which are continuously filled and reclaimed for various uses. The paper tries to compile the work done by various scholars on wetlands around the world, about the importance, use and misuse of wetlands and the diminishing area and its consequences.

Importance of Wetlands

Wetlands act as a natural filter that traps pollutants and purify water, the

vegetation in wetlands slows water down and helps reduce floods, it plays an important role in protecting coastal areas from cyclones and reducing the effect of Tsunami and plays in preventing many natural disasters (Smith et al., 1994; Massel et al., 1999 Katharesan and Rajendran, 2005). Wetlands are great source of water as it functions like a sponge and release water throughout the year continuously recharging the ground water supply and it also plays a vital role in regulation of stream flow in its area of influence. The vegetation cover plays an important role in soil erosion. Wetlands are the habitat of numerous species and are a store house of varied bio-diversities (Neill,1958); they are one of the most biologically productive regions of the world and plays a vital role in nutrient recycling. Wetlands are worlds most important Carbon Sinks. Wetlands are of great benefit to people, as they provide fish, different types of reeds for building and other commercial activities mainly handicrafts, provides land for agriculture mainly paddy and fodder for livestock. Wetlands can be source of energy mainly methane can be extracted from wetlands (van der Nat and Middelburg, 2000; Bridgham et al., 2006); they can be developed into recreation and tourist spots. Wetlands are true paradise for bird lovers as they are the habitat of wide variety of birds (Goss-Custard et al., 1977; Erwin, 1996). Many wetlands add to the aesthetic beauty of the landscape (Dorst, 1965).

Disease and other problems associated with Wetlands

Wetlands are perceived as a breeding ground for mosquitoes that transmits disease to humans (Dale and Knight, 2008). Some disease can be life threatening such as malaria, yellow fever, dengue, and forms of encephalitis. Wetlands have often been blamed by the public for the proliferation of Vibrio cholera, the etiological agent of cholera that, despite progress in medicine, still exists in over 90 countries (WHO, 1998). Cholera epidemics can also be linked to plankton booms, rise in temperature, and El Nino southern oscillation. Outbreaks can occur after natural disasters (Colwell, 1996).Wetlands are major source of Methane one of the major

gases which contribute to Global Warming (Van der Nat and Middelburg, 2000; Bridgham et al., 2006).

Dwindling wetlands

With the passage of time the area under marshland has been declining and the marshlands which exist have been degraded due to human activities. Human has degraded and reduced the area of marshland by dredging, filling, urban and agricultural development, dike and levee construction, drainage, oil and gas exploration, construction of port facilities, highways, bridges, airports, use as aquaculture, and conversation as lakes and huge water bodies etc.

Wetlands have been targeted by Humans from the past. Starting about, 7,760 years ago in China (Zong et all., 2007) and a few hundred year ago in most coastal areas, many coastal wetlands had been profoundly impacted, degraded, or destroyed by humans. Nearly all salt marshes have been destroyed by land reclamation in several highly populated temperate countries, including Japan, China and the Netherlands (Wolanski, 2007a). Recent wetland destruction has been phenomenal in the United States where over 9 million hectares of wetlands of the Gulf of Mexico (Frayer et all., 1983). Despite the "swampbuster" 1985 Food Securities Act and the "no net loss" of wetlands policy that emerged in 1989, wetland loss along that coast continues, though at a slower rate (Streever, 2001). The remaining wetlands are sinking as they are not replenished by sediment because rivers are diverted elsewhere and this exacerbates flooding by river floods and storm surges (Streever, 2001). This march of humanity now threatens also tropical coastal wetlands; indeed we face prospect of a world without mangroves this century (Diop, 2003; Duke et al; 2007). The effects of sediment starvation have been well documented as the cause of tidal marsh losses (Streever, 2001; Bernier et al; 2006). Climatic change and Sea level rise poses a concern about the long term sustainability of coastal wetlands (Reeds, 1995), though wetlands keep evolving with the sea level rise but the greatest question is can wetland elevation keep pace

with the sea level rise. Though wetlands keep upward transition but in much case where coastal wetlands are surrounded by steep habitats, such migration would not be possible and will lead to total loss of wetlands (Titus, 1991). In many parts of north western parts of Europe and the Atlantic coast of the United States Tidal Fresh Water Wetlands have been destroyed with the development of cities and port facility (Barendregt et al., 2006). Many former perimarine wetlands are largely absent from Europe lowlands is primarily due to land claim. Earlier marshlands in northern Europe have been extensively diked over the past 2,000 years and the surviving ones have been is reduced in size and have been modified to a large extent. On the German coast of the near the Wadden Sea, about 1000 sq. km of coastal marshland have been diked over the last thousand years. In northern Netherlands due to anthropological activity all tidal wetland have been lost (Lotze, 2004). Though the importance of wetland has been well recognized, there will be continuous loss of wetland sites where the social and economic benefits of development are deemed to outweigh those of conservation.

The Indian Scenario

The Wildlife Institute of India's survey reveals that 70-80% of individual freshwater marshes and lakes in the Gangetic flood plains have been lost in the last five decades. At present, only 50 percent of India's wetlands remain. They are disappearing at a rate of 2% to 3% every year. Indian mangrove areas have been halved almost from 700,000 hectares in 1987 to 453,000 hectares in 1995 (Sustainable Wetlands, Environmental Governance-2, 1999). A recent estimate based on remote sensing shows only 4000 sq. km area of mangrove resource in India.

Wetland Scenario in Chennai

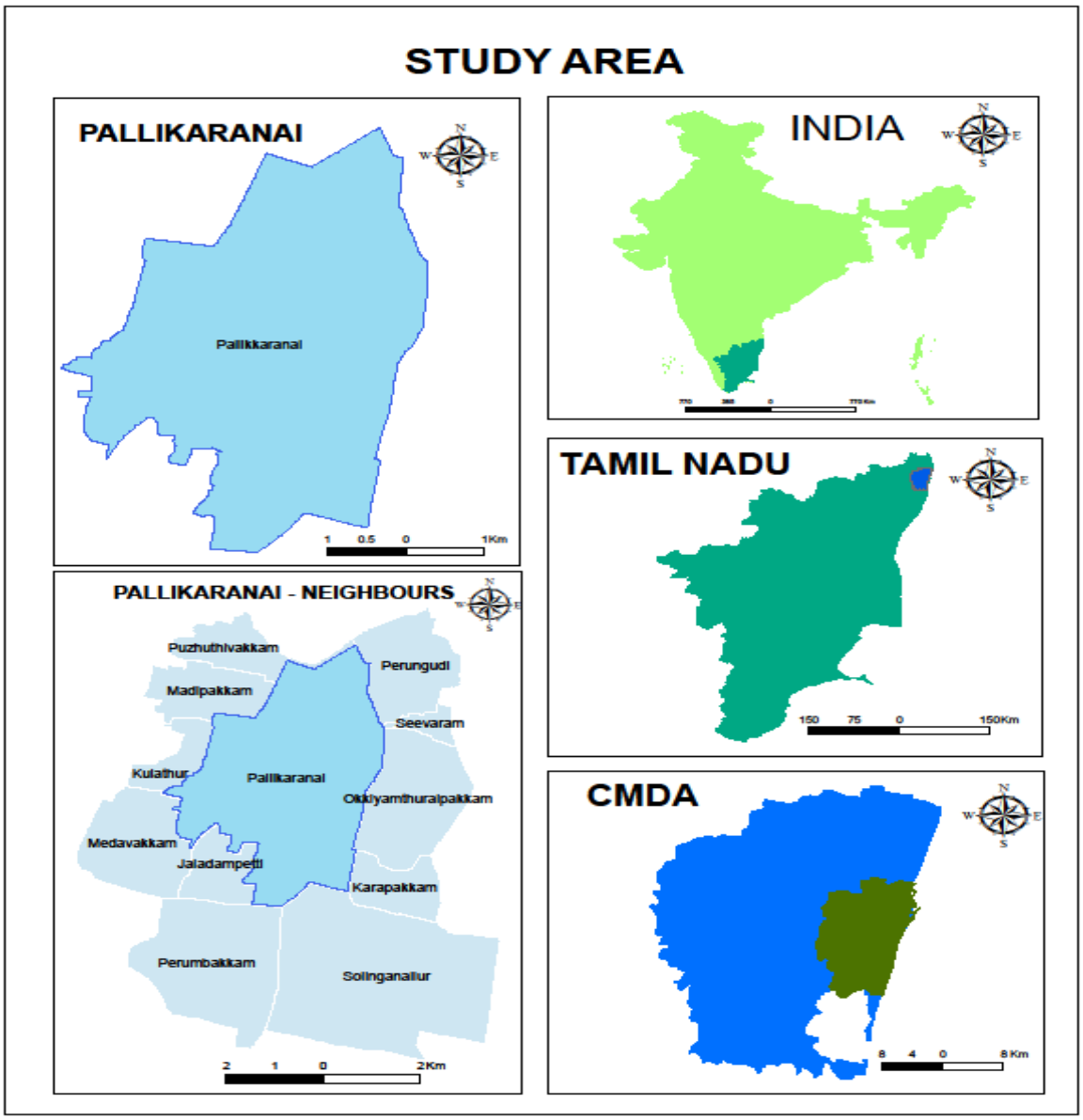
Chennai used to have about 150 small and big water bodies in and around it, but today, the number has been reduced to 27. According to Dr. Sanjeeva Raj (2002), Adambakkam Lake, Mugappair Lake, Red Hills, Manali jheel, Madhavaram jheel,

Korattur Lake, Ambattur Lake, Pulicat Lake, Pallikaranai, Velachery and Chembarambakkam Lake are a few of them. Rettai eri, Porur Lake, Sunnampu Kolathur Lake, Chetpet Lake, Vyasarpadi Lake and Chitlapakkam Lake are some of the other water bodies that still exist today.

Pallikaranai Wetlands

Pallikaranai wetland is one of the unique wetlands. It is located in one of the most urbanized area with thick population, just south of Chennai City, and now it has become a part of the Chennai Municipality. The Wetlands is freshwater wetlands and is rich in bio-diversity. The elevation of the wetlands is at base level and at some place below the base level. The area of the Pallikaranai wetland at present is 5.95 sq.km and of this 3.17 sq.km is conserved as reserved forest to protect the unique and abundant bio-diversity of this wetlands. The dynamic land use changes and the migration of population from the city to the sub-urban area have led to rapid development of settlement and this has led to rapid decline in the areal extent of the Pallikaranai Wetlands. The disposal of Solid waste by the Chennai Municipality inside the wetland has not only reduced the area of the wetlands but has also polluted the waters of this wetland. Added to this the sewage waste are also released in the wetland which further diminishes the quality of the water. In spite of all the negligence and abuse of these wetlands by anthropological agent, this wetland has managed to survive. The NGO's, Academicians and Environmentalists have played a major role in protecting these wetlands from being completely wiped out from the map of the City. The location of Pallikaranai wetlands is presented in Figure 1.

Fig 1



The Pallikaranai wetlands have suffered from the impact of urbanization. This wetland has been diminishing continuously. During the period of study, the extent of wetlands has reduced to 8.5 per cent from 36.51 per cent of the total area. In the year 1991, it occupied 25.56 sq.km. In the year 2001, the area under wetland declined by 8 per cent compared to the previous decade. The most remarkable decline in the wetland was in a small period of 5 years between 2001 and 2006. The wetland declined by almost 50 per cent of the previous area. It diminished

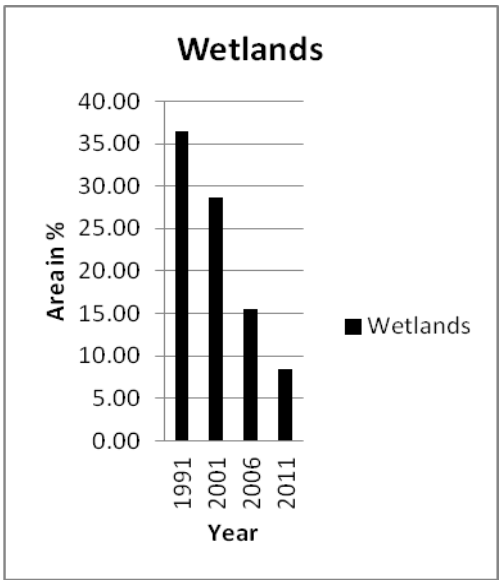
from 28.59 per cent in the year 2001 to 15.53 per cent in the year 2006. The rapid decline in the wetland in this period was due to rapid increase in the settlement which also had a steep increase in the same period. In the year 2011, the area under wetland fell to a single digit, and it further declined from 15.53 per cent in 2006 to 8.50 per cent in the year 2011. It should also be noted that a portion of the wetlands was being used to dump Municipal Solid Waste, and it played its own role in diminishing the area extent of the wetland and pollute the wetlands. Table 1, graph 1 and figure 2 to 5 shows the decrease in the Wetlands from 1991 to 2011.

Table 1: Wetlands

Wetlands		
Year	Area in Sq. Km	Area in Per cent
1991	25.56	36.51
2001	20.02	28.59
2006	10.87	15.53
2011	5.95	8.50

Source: Generated by the Author

Graph 1: Wetlands



Source: Generated by the Author

Fig. 2 Wetlands- 1991

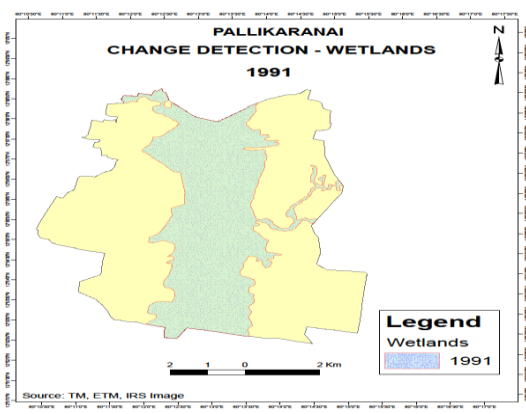


Fig.3 Wetlands - 2001

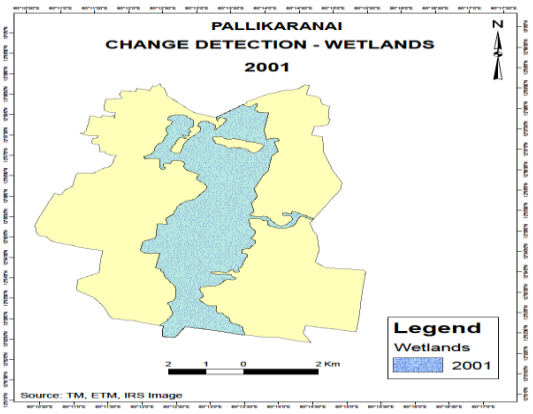


Fig 4 Wetlands -2006

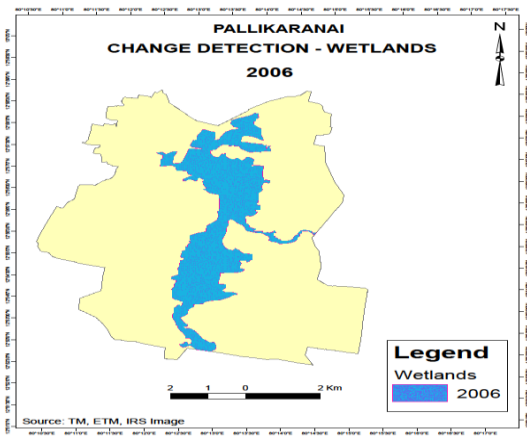
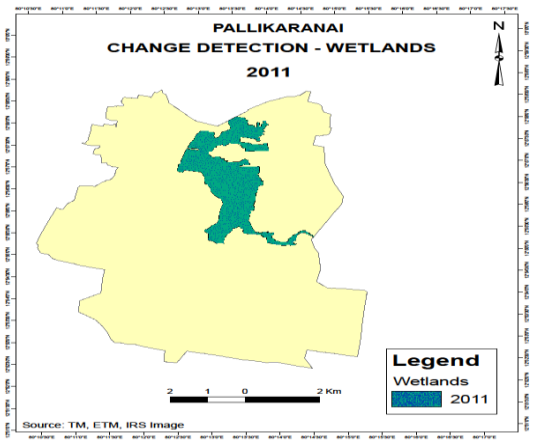


Fig 5 Wetlands -2011



Conclusion

"Wetlands conservation ensures drinking water and food security", is the slogan of the Ramsar Convention of Wetlands, but wetlands not only helps in protecting and conserving water and ensuring food security it also helps to control global warming and reverse climatic change as they are one of the greatest sink of carbon. Wetlands are also rich in Bio-diversity and are a habitat of numerous organisms. Depletion of wetlands not only effects the environment but the habitats of many organisms are destroyed resulting in the extinction of those organism. Wetlands are natural filters and purify water there by helping to supply clean water. All the above stated facts make it imperative to save Wetlands. Wetlands have been targeted for developmental activities since ancient times and it has resulted in destruction of vast area of wetlands. Man needs to protect and preserve the present remaining wetlands which are estimated to occupy approximately 6% of total area of the Earth as they are one of the most productive areas of the world. The destruction of wetlands will be at the cost of human peril.

The case study of Pallikaranai Wetlands Ecosystem of Chennai vividly illustrates the fall in the areal extent of wetlands with the passage of time and the increase demand of land for settlement and other anthropological activities. The wetlands under study has been diminished in its size in spite of it being the central of attraction as it is a major destination of many migratory birds. It being located in

the Urban area has been studied widely and many NGO's and academic professional have labored hard to protect it and are still striving hard to save it from being totally erased.

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