



Preliminary Assessment of Degraded *Kottayam Chira* Wetland using GIS and its Developmental Scope

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Abstract

Conservation and restoration of wetlands is of utmost significance for sustainable development as well as natural resource management. *Kottayam Chira*, which spreads around an area of about 12 acres is located at the northern region of Kerala State, centered at coordinates of 11^o49' N and 75^o33' E., is a significant wetland with irrigational potential to nearby four Panchayats. The wetland is now in a degraded form and a preliminary scientific analysis has been done to characterize the wetland for future restoration efforts. GIS studies were performed to identify the geographical setting and to assess the wetland area change occurred during the past two decades. General slope and drainage pattern were determined. Analysis of land use/land cover pattern which has a decisive impact over surface and sub surface water was done. Invasive plant species spread over the wetland is visible even in the satellite image. Buffer zone and catchment area was demarcated for suggesting the conservation strategies to be adopted. GIS analysis indicates considerable shrinkage of the water body over the recent past. Developmental scope of the wetland in terms of irrigational and ground water recharge potential as well as tourism opportunities is also presented in this paper.

Keywords: *Kottayam Chira*, GIS Analysis, developmental Scope.

Introduction

Wetlands have significant environmental, socio economic, cultural and religious functions. They help in groundwater recharge, act as source for irrigational and potable water, are habitat for a variety of flora and fauna, support tourism and recreational facilities, provide aqua culture potential, etc. Apart from these, *Kottayam Chira* accepts religious performances and upholds predominant aesthetic values. *Kottayam Chira* is a significant water body, at present covering only an area of 9.5 acres and is located about 1.5 km away from Kuthuparamba town in Kannur District of Kerala state. The water body is environmentally, historically, religiously and culturally invaluable. *Chira* is the local terminology, widely established in the Malabar region (northern) of Kerala, which represents inland fresh water bodies such as manmade ponds or lakes carrying water throughout the year. The location of the wetland is significant as it plays an important role in recharge of the water table of the region. The *chira* enhances water percolation to the soil and thus aids in recharge of water table. A proper maintenance of the *chira* can help in maintaining water levels of surrounding wells.

Wetland ecosystem is a valuable asset with multiple roles closely linked with human needs. Ironically wetlands are in the state of degradation mainly due to negligence. Wetland degradation usually occur due to threats such as encroachments and shrinkage, drainage influx and

landfills, waste water and effluent discharge, siltation and sedimentation, agricultural runoff and fertilizer inflow inducing excess weed growth and eutrophication, overexploitation of resources and anthropogenic stress, etc. *Kottayam Chira* is a typical example where all these forms of wetland degradation can be seen. Invasive plant species are found spreading across the *chira*. Water Hyacinth is one of the predominant plant species that prevails at present. Shrinkage has chanced due to encroachment at *Kottayam Chira* occurred over past years. The depths also have decreased as a result of runoff, siltation and sedimentation.

GIS and Remote sensing techniques are widely utilized for the identification and monitoring of wetlands worldwide at present. They are very valuable in the conservation and restoration of wetlands as a planning tool. Conventionally, health of wetlands was assessed through laboratory studies and apparently their environmental status was determined. In this study a preliminary assessment of the comparatively small but environmentally significant wetland was done incorporating the capabilities of GIS using freely available remote sensing data; thus characterizing the wetland. It also included identification of pollution sources and assessment of wetland conditions. Additionally catchment area, drainage pattern and extent of reclamation were assessed during the study¹⁻³.

Remote sensing data helps to study and monitor the wetland characteristics and conditions through repetitive data collection mechanism. It helps to acquire the information of the area which is otherwise inaccessible to human beings. Using remote sensing data, GIS analysis helps to identify the wetland area change occurred over past years¹⁻⁴.

Methodology

Landsat imagery 1990, LISS III imagery 2009 and MODIS digital elevation model were used in the assessment of characteristics of the study area. These data were collected from USGS's Earth Explorer and ISRO's Bhuvan. Contour maps and slope information were developed from the ASTER DEM to demarcate the catchment area and drainage pattern. The elevation information available at 30 m resolution in ASTER DEM was re-sampled to 10m resolution, which gave a smooth and generalized form, as the study area is comparatively small. A contour map was generated with 4m interval from the resampled data. Slope is also generated from the Elevation data^{1,5}. The catchment of the *chira* was demarcated from the contour map, connecting the highest elevations around the *chira*. Elevation and catchment were verified by field observations. An attempt was made to identify the drainage pattern.

Landsat image and LISS III images were used to identify the land cover changes in the catchment area over the periods^{3, 6, 7}. These images were inaccurate to delineate the exact boundary of the *chira* and thereby to calculate the total area. Hence high resolution satellite image of QUICKBIRD was used from Google earth⁸. For a yet better evaluation of the *chira*, GPS coordinates around it were collected and uploaded into Google earth environment in .GPX format. These points were marked as Ground Control Points (GCPs) in Google earth frame. This image was then downloaded and Geo-referenced in the GIS environment. This was further used for preparation of development plan for the *Kottayam Chira*⁹.

Results and Discussion

Geographical settings of water body: The water body is located in a plain area with a total area of around 11 acres. The general elevation of surrounding land varies between 20 to 50 meters above mean sea level with highest elevations towards northern sides. The *Chira* is located at 11°49' N and 75°33' E.

Catchment of water body: Catchment of the water body was found to be 147 acres. It was seen that the *chira* has no prominent drainage input channels, hence rain is the major source of water. The catchment area also got divided into 2/3rd of its actual size due to the construction of a canal towards the western side of the *chira*. This construction prevents surface run off from the north-western part of the catchment area.

General Slope: This region is characterized with gentle slope. Here the surface gradient changes gradually between 20 to 50 meters above the mean sea level. General slope of the area is in north-south direction. Generally the rainwater track consequent slope. The estimated slope within the catchment area is below 17°.

Drainage Pattern: In case of *Kottayam Chira* water body, surface run off resulting from rain is the source of water. This wetland is drained through nearby one small manmade irrigational channel. During rainy season, surplus outflow from this wetland occurs through this channel. The water body is not forming any part of the natural drainage system. The water body gets major share of its water during monsoon season and the excess amount of water, flows through the stream in southward direction which traverse through agricultural lands. But this excess water flow happens only in rainy season and in rest of the year, only nominal outflow occurs.

Sedimentation: Shrinkage of area of water body occurred due to continuous siltation and sedimentation. Long term accumulation of silt and clay in the *chira* has caused reduction in depth of water.

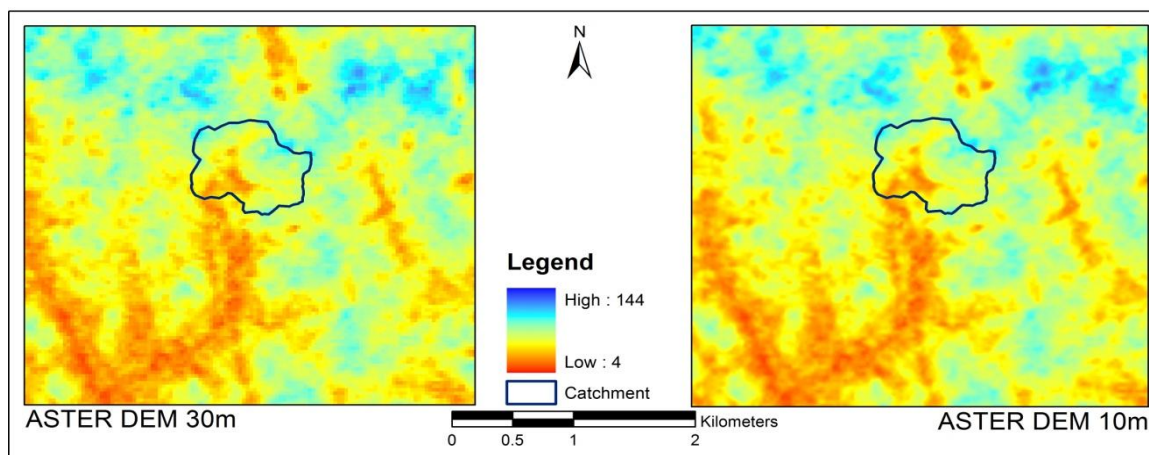


Figure-1
Aster Dem

Land use: Land use plays an important role in determining the quality as well as quantity of surface and sub-surface water in an area³. Major land use categories found in this region includes settlement with mixed trees, arecanut, coconut and paddy fields. In the agricultural lands water fed by the *chira*, the land cover is getting converted to areca nut and coconut plantations.

Summary: The catchment area, derived from the contour map, consists of an area of 146.7 Acres. It has an elevation ranging from 20m to 50 m above MSL. The *chira* is situated at a height of 20 m from the MSL, and the higher elevation is towards the northern side. The area has a gentle and moderate slope of up to 17 degrees. There is a canal constructed in the western side of the *chira* which cuts off 1/3rd of the total area from the actual catchment area. Within the catchment area, there is no definite drainage channels which bring in water throughout the year. A major road on the northern part of the catchment carries storm water in to the water body.

On interpreting the satellite images, it was found that area of settlement at the northern parts of the *chira* has increased due to construction activities as domestic households, a likely reason for the increased siltation in the *chira*; as the loose exposed soil easily erode with rainwater. This area was earlier covered with sparse vegetation / shrubs including open areas. The total area of the *chira* is estimated as 11 acres with an average depth of 5 m. But due to siltation and encroachments this area has shrunk by 1.5 acres. The total area of the *chira* was covered with water plants even by 2009 and hence it is quiet impossible to distinguish it from the surrounding landscape from the LISS image.

Conclusion

The study helps to demarcate the catchment area as well as the drainage pattern, with which restoration and conservational plans can be designed effectively. The proper maintenance of the *chira* shall ensure water availability of the region. Also this can be used for irrigation of surrounding fields. If developed properly the agricultural water supply through the channels can be extended to benefit four nearby panchayaths. If a proper restoration plan is implemented, the extent of *chira* can be protected, ensuring its ecological functions and recreational requirements of future generations.

Future Developmental Scope: A developmental scope of the *chira* is prepared and visualized. The area of agricultural land which can be possibly irrigated from the *chira* is found to be more than 550 acres. There is an existing irrigation path towards the south of the *chira*, which was developed for irrigating paddy fields about three decades ago, but subsequently abandoned

The development scope includes the restoration of the *chira* in different aspects, which will be beneficial in agriculture, aquaculture, tourism etc.

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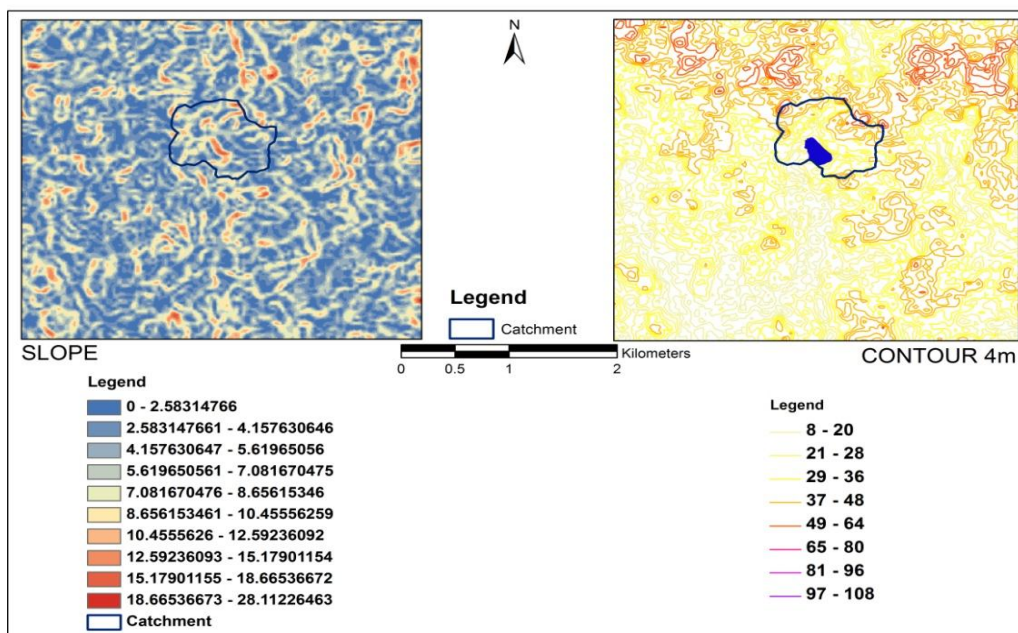


Figure-2
 Slope and Contour Maps

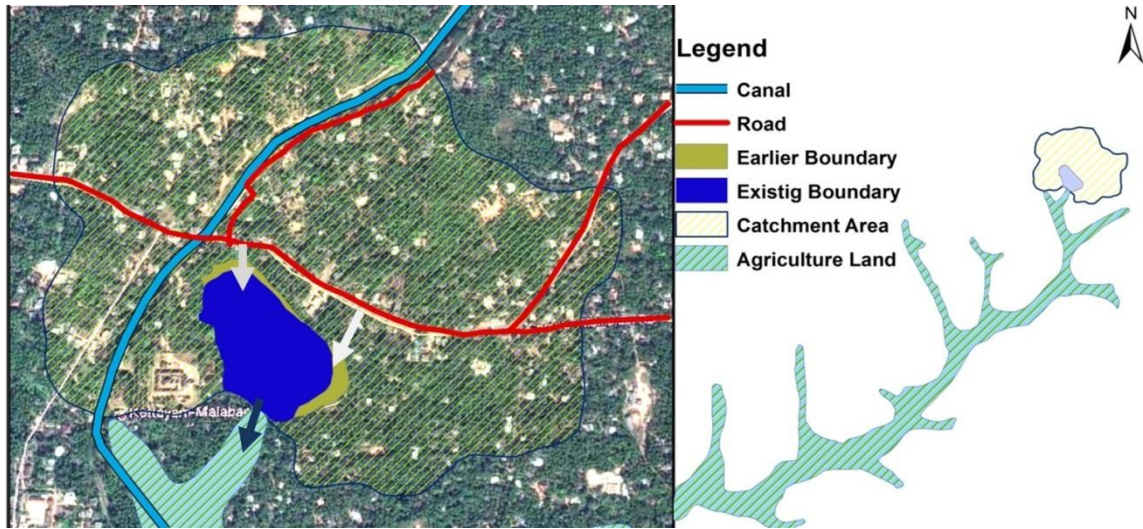


Figure -3
 Catchment and Drainage

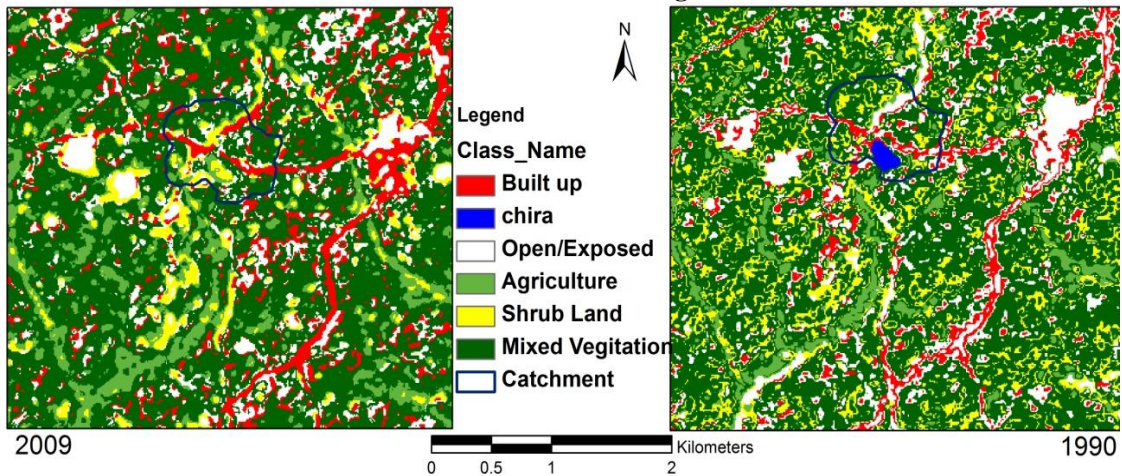


Figure-4
 Land use Map

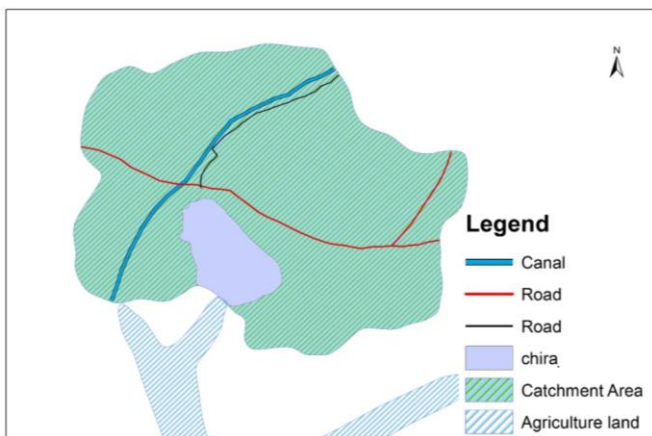


Figure-5
 Catchment



Figure-6
 Proposed Layout

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