

## Wetland Mapping using High resolution Satellite Images in the Jaffna Peninsula

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**Abstract:** Wetlands are among the world's most productive environment and important for ecological process as well as for their rich biodiversity. Unique and rare plant and animal species can be found in different wetlands all over the world. Sri Lanka is a tropical country and it has rich biodiversity. According to the Asian wetland directory, 41 wetland sites were identified in Sri Lanka as an international importance. Among these sites, seven wetlands have been identified in the Jaffna Peninsula. Number of wetland conservation projects was implemented to maintain wetland in Sri Lanka. However, such initiatives have not been implemented in the Jaffna Peninsula due to the long unrest ethnic war. There is lack of updated information regarding the wetlands. In fact, information on wetland location, size, type and its characteristics are either out dated or no detailed information is available which are significant to facilitate the conservation and sustainable management of wetland. This study was carried out to prepare wetland map using high resolution satellite images and Geographic Information Techniques (GIS). Images were visually interpreted and carried out digitizing by onscreen method. According to the study, seven wetland types and eleven land covers have been identified and mapped its spatial distribution. This study has been successful in identifying spatial pattern of wetlands and provides useful information for wetland conservation and management of the study area.

**Keywords:** Wetland mapping, GIS, Satellite images.

### I. INTRODUCTION

Wetlands are diverse, highly productive eco systems providing many significant societal and environmental benefits. Unique and rare plant and animal species can be found in different wetland areas over the world. The values of wetlands range from aesthetic to economic, cultural and social benefits. Wetland provides a whole host of benefits to both human and physical environment which are flood control, ground water recharge, water filtration and purification, erosion control, wildlife habitat, recreation, research, education and regional economic vitality [2]. Moreover, wetlands are important conservation areas as breeding sites for certain species of fish and birds. Human unawareness has largely contributed to loss and unwise use of wetlands.

Ramsar convention declared to protect the wetlands all over the world [4]. Sri Lanka is a tropical country and it has rich biodiversity. The Asian wetland directory identified 41 wetland sites of international importance in Sri Lanka [5]. The government of Sri Lanka has drafted a National Wetland Policy to enhance the conservation of wetlands, and established National Wetland Steering Committee (NWSC) to coordinate wetland conservation activities. After wetland management unit has been established under the Central Environmental Authority, several wetlands have been declared as protected areas [3]. Jaffna peninsula is the Northern most part of Sri Lanka and was badly affected during the war over the last thirty years. The war effects are clearly visible in almost every aspect of socio economic and environmental system of the region.

At present, there are several government and non-governmental organizations involved in wetland conservation and management related activities in Sri Lanka. However such initiatives are not implemented in the Jaffna peninsula. Therefore, there is no awareness regarding the wetland conservation among the people. It is urgently needed the updated information of wetland conservation and management. However, available such information regarding the wetland are outdated. In this juncture, Geographic Information System (GIS) and Remote Sensing have been chosen as appropriate techniques for wetland identification, and mapping. These techniques are the vital information for continuous monitoring and sustainable management of wetlands. The use of remote sensing techniques offer a cost effective and time saving alternative for delineating wetlands over a large area compared to conventional field mapping methods [6].

The objective of this study is to prepare wetland types and land cover map. Land cover map gives the detail information of the major wetland types.

## II. METHODOLOGY

The study area is the wetland region of the Jaffna Peninsula. The total area is 628 Km<sup>2</sup> and the topography of this area is low. Three salt water lagoons are in the study area. The Thondaimanaaru and Uppu Aaru Salt water lagoons pass through the main land area of the Jaffna Peninsula and Jaffna Lagoon has direct contact with sea water. They function as natural drainage during the rainy season. Agriculture and fishing are the main economic activities in the study area.

Satellite images were the main source for the wetland mapping. High resolution satellite images acquired by Quickbird satellite in 2010 have been used for image interpretation. Satellite images have been downloaded from Google Earth Pro, available for commercial use. It has two sensor data one is pan another is MS. The images which were in true colour recorded in the bands of Red, Green, Blue and Infrared. The resolution of Pan is 0.6 meters and MS 2.4 meters.

Spatial data from Google Earth requires grid of fishnet to facilitate higher resolution of data. The grid of fishnet was used to define the scene and download the image. A fishnet was created using ArcGIS software and that fishnet was transferred to KML format using KML extension of ArcGIS. The KML format was imported into Google Earth Pro and overlaid on Google Earth data.

Preprocessing was made on satellite image before wetland types map has been prepared. The coordinates from four locations were derived from the Google Earth and used to geo-reference into local coordinate system with nearest neighbor re-sampling method.

The classification schemes for the wetland types and land cover were adapted based on National wetland directory of Sri Lanka [1]. However, significant modification has been carried out in the classification scheme when preparing land cover map according to the local context.

Quickbird satellite images have been interpreted using existing land use map and interpretation keys which were formulated from ground truth information. Preliminary map was prepared through the on screen digitizing process. As images used in this study were very high spatial resolution, demarking different categories of wetland and land cover have been made efficiently. However some of the confusing sites were corrected after the field verification.

Interpreted image was compared with another set of ground truth information to evaluate the accuracy of each types of wetland and land cover. Accuracy of the mapping process were carried out comparing the randomly selected sites of the interpreted map and the ground truth

information collected in the field for each types of wetland and land cover. Accordingly five randomly selected sites for each type were checked with ground truth information. After the field checking, wetland types map and Land cover map have been prepared for the study area.

### III. FINDINGS AND CONCLUSIONS

According to the image interpretation and ground truth information, seven wetland types have been identified. These are mangroves, marshland, paddy field, salt marsh with palmyrah and shrub, saltpan, water bodies and sand. Figure 1 represents the spatial distribution of wetland types map and Table 1 express the area of different wetland types.

Table 1: Wetland Types and Area

Wetland Types	Area (Hectare)
Mangroves	4880
Marshland	6804
Paddy	1829
Salt marsh with Palmyrah and shrub	1426
Saltern	544
Sand	768
Water	46590

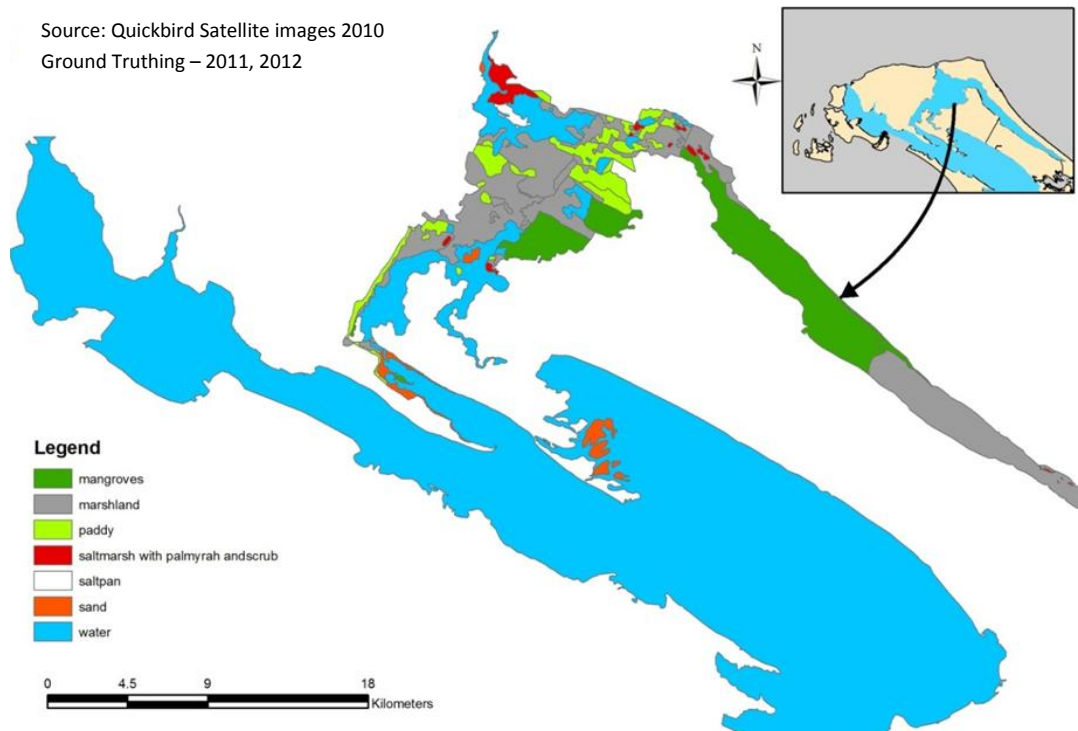


Figure 1: Wetland Types of the Study Area

Table 2: Land cover types and area

Land cover Types	Area (Hectare)
Dense mangrove	2938
Sparcely distributed mangroves	1942
Seasonal water	6002
Peranialwater	46590
Paddy	1829
Palmyrah with scrub	1126
Saltern	768
Sand	544
Mining	853
Built-up area	217
Waste dumping site	71

Further a detail land cover map has been prepared based on wetland types map and intensive field visit. Some of the wetland types further classified in to different land cover. As a result, eleven land cover have been identified in the study area. These are, dense mangroves, sparsely distributed mangroves, seasonal water, perennial water, paddy field, Palmyrah with scrub, saltern, sand, built-up area, waste dumping site, mining. Figure 2 shows the land cover map and Table 2 shows the area of different land covers.

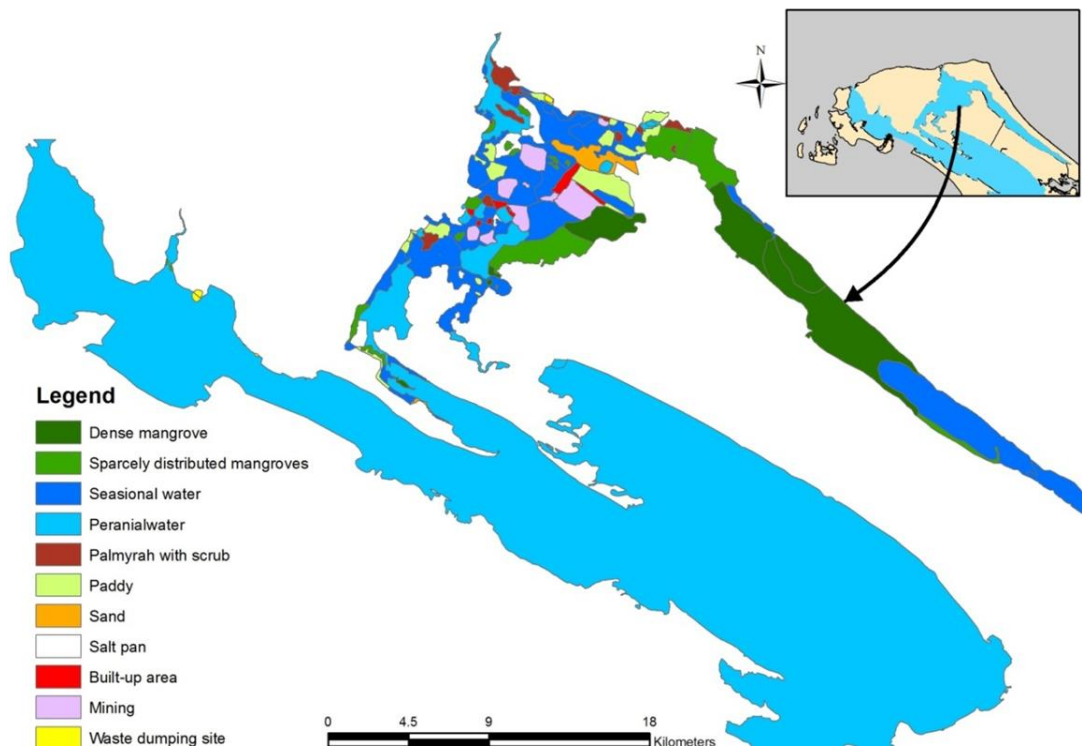


Figure 2: Land Cover map of the Study Area

Among the wetland type, water stretches over in the largest area. This type has been classified as seasonal water and perennial water in the land cover map. Jaffna lagoon has direct connection with sea and contain full of water throughout the year. Marsh land spread over in second largest area. This is mostly found in Karaveddy and Kopay Divisional Secretariat Divisions. During the rainy season, these areas will be flooded with water. Seasonal fishing takes place in this area. In addition this also serves as natural drainage system. Mangroves is an important wetland vegetation. It affords various economic and ecological services. This stretches densely in Maruthankerny Divisional secretariat Division. The Chundikulam area has densely seen this vegetation and has been declared as a bird sanctuary. Further, the area dense with mangroves serves as a seasonal bird habitat in Sarasaalai in the Chavakachcheri Divisional Secretariat Division. Mangroves are being destroyed for firewood collection, declining in its extent. Salt marsh with palmyrah and shrub is found in small stretches in the study area. Paddy field is mostly found in Karanavai, Kapputhu and Anthananthidal area in Karaveddy Divisional Secretariat Division. Salt pan and sand are found in smallest area. Saltpan seems to be adversely affected by the recently implemented fresh water scheme.

GIS reveals an excellent techniques in this study to prepare smart maps and statistics of wetland types. These are updated information to the study area and facilitate environmental related wetland conservation and management programme in the present and future development project. Land use changes are expected by the recently implemented lagoon scheme. In this context, these wetland types map and land cover map will help to evaluate the land use changes in future.

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