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## An Analysis of Land use / Land cover in Kadalundi River Basin using Remote Sensing and GIS

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### ABSTRACT

The present study aims to find out the land use/land cover features of Kadalundi river basin in Kerala. The river with its total length of 130 km. drains over an area of 1122 sq. km. and is characterised by dendritic type of drainage pattern. In order to understand the existing pattern of land use/land cover of any area, remote sensing and Geographical Information System (GIS) techniques provide consistent and accurate base line information than any of the conventional surveys. The existing land use pattern is derived from high resolution IRS-P6-LISS IV pan merged satellite imagery of 1: 50000 scale. The ERDAS and Arc GIS softwares were utilized to demarcate and analyse the land use/land cover features of Kadalundi river basin. The land use/land cover exhibits the physical and economical situation of any region, determines the living standard of people and natural resources found in a region. The thematic mapping of the land use/land cover consists of built-up land, agriculture land, water bodies, forest and waste land were prepared by using the satellite imagery. The study highlights that the highlands are mostly covered by reserve forests with patches of tea estates in the higher reaches and coffee estates in the lower reaches. In the elevations between 75 m and 45 m above mean sea level, coconut, rubber and pepper are grown. Paddy and arecanut are grown in the valleys. The river estuary is found near the mouth of river and patches of settlement are traced closed to it. The present study gives a detailed account of the existing land use in Kadalundi river basin and it signifies its importance in proper land use planning for sustainable river basin management.

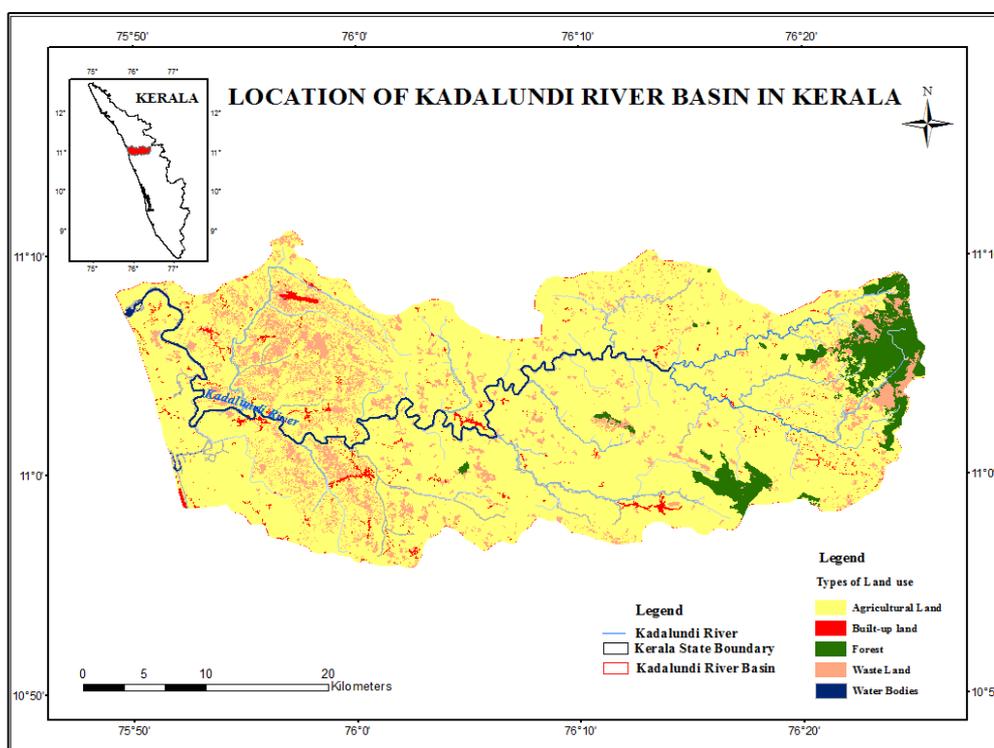
**Keywords:** Land use, Land cover, Kadalundi River Basin, Remote Sensing, GIS

### 1. Introduction

The land is one of the important natural resource next to water, for man to survive on earth. Land use is defined as how man is utilizing the land but land cover refers to the vegetation cover spread over the land. Land cover data documents how much of an area is covered by natural phenomena whereas land use data shows how people utilize the landscape. These land use and land cover data are very important for land resource management, planners, and decision makers (Ndukwe, 1997). However with the development of air and space borne remote sensing technique, it is now possible to acquire the land use and land cover data for any period of recent time. In addition, the advent of GIS made it easier to integrate multisource and multi-date data for the generation of land use and land cover. This is very useful to analyse the trend, rate, nature, location and magnitude of changes in land use and land cover (Adeniyi et al, 1999). The present study is a case study to analyse the land use and land cover in Kadalundi River Basin in Kerala.

## 2. Study area

The Kadalundi river originates from east of Karuvarakkundu village in the District of Kozhikode in Kerala State and lies between  $10^{\circ} 51' 42''$  to  $11^{\circ} 10' 42''$  north latitudes and  $75^{\circ} 48' 21''$  to  $76^{\circ} 24' 30''$  east longitudes. The Kadalundi river is formed by the confluence of its two main tributaries, the Olipuzha and the Veliyar. The Olipuzha takes its origin from the Cherakkombhanmala and the Veliyar tributary from the forests of Eratakombanmala. The total length of the river is 130 km. with a drainage area of 1099 sq. km. The river flow towards Chaliyar and joins into the Arabian Sea at about 5 km. south of Chaliyar river. The Pooraparamba river, a small stream is also included in this basin, as its length is only 8 km. with a drainage area of 23 km<sup>2</sup>. The estuary is situated in Kadalundi and Vallikunnu panchayats. The total drainage area of the basin is 1122 km<sup>2</sup>. Figure 1 shows the study area of Kadalundi River Basin.



**Figure 1:** Study Area

## 3. Methodology

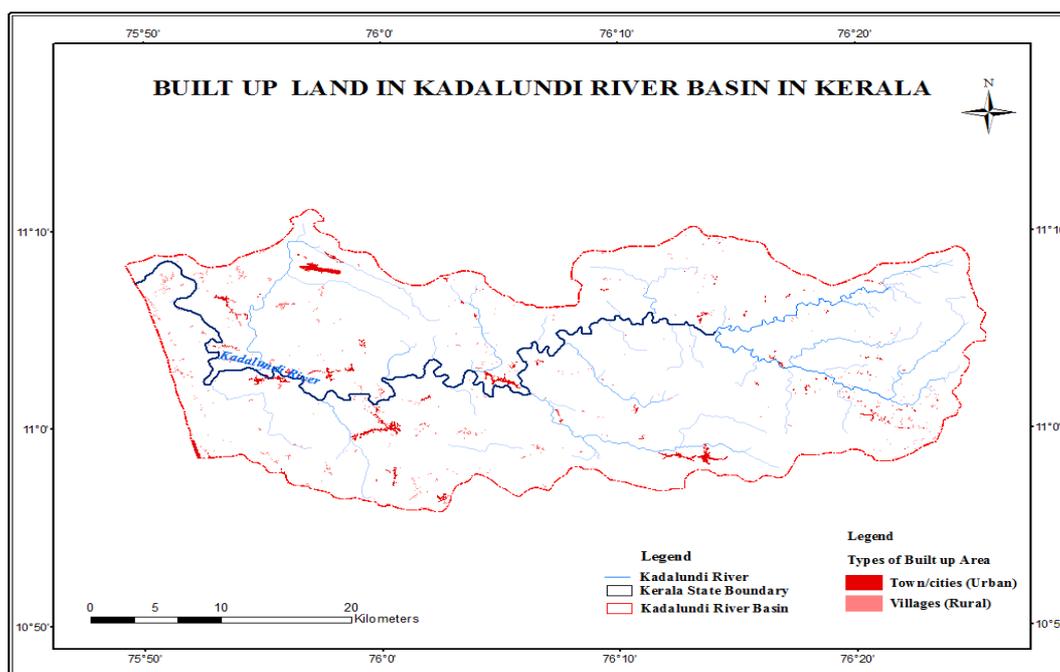
In this study both primary and secondary data are used. The Survey of India (SOI) topographic sheets of (49 M 14, 49 M 15, 49 M 16, 58 A 2, 58 A 3, 58 A 4, 58 A 6, 58 A 7, 58 A 8, 58 A 10, 5858 A 11) of scale 1: 50,000 and satellite images (IRS-P6-LISS IV) are used to derive the present land use information of Kadalundi river basin. Based on the data derived from both GIS and Satellite images the land use map has been prepared. The IRS data was visually and digitally interpreted by using the image interpretation elements and ArcGIS software was used for processing, analysis and integration of spatial data to reach the objectives of the study. The derived output was finalized based on the ground truth verification and as per the result the thematic map was prepared showing the land use of Kadalundi river basin.

#### 4. Results and discussion

Analysis of land use/land cover in Kadalundi river basin using remote sensing data was carried out in order to study the existing land use and land cover pattern in Kadalundi river basin for the year 2008. The study area is mostly occupied by built-up land, agriculture land, water bodies, forest and waste land. The land use and land cover categories of the study area were mapped using satellite images IRS-P6-LISS IV (FCC of band 4, 3 and 2) of scale 1: 50000. The satellite image was first visually interpreted, after the ground truth verification carried out and the land use and land cover was finalized, based on which the thematic maps of Kadalundi river basin were prepared. The figure 1 and table 1 gives a detailed account of these land use/land cover classes of the study area which are described in the following section.

**4.1 Built-up Land:** The built up areas are the places of human inhabitation, developed due to non agricultural activities like building, industries, commercial activities and transportation network. In the satellite image these features are identified with their dark bluish green tone in the centre and bluish tone on the periphery. These features have a coarse texture. In the Kadalundi river basin, the built-up land area covers about 19.7 sq. km. out of which 12.3 sq. km. is town area and the rest 7.5 sq. km. The figure 2 shows in detail about the distribution of built-up land area in the Kadalundi river basin.

**4.2 Agriculture Land:** Agriculture land includes land raised for food crops, commercial crops, plantation crops and horticulture crops. With the help of satellite data, it is possible to identify the various agricultural lands up to Level II. The figure 3 shows the agricultural regions in Kadalundi river basin. The total area under agricultural activities is 906 sq. km. out of which 656 sq. km. was utilized for plantation and the rest of 250 sq. km. is under paddy cultivation. The paddy cultivation area is concentrated in the middle part of the basin where as the plantation areas are found in large patches towards the eastern part of the basin and also found in the central and western part of the basin mixed with other crop cultivation.

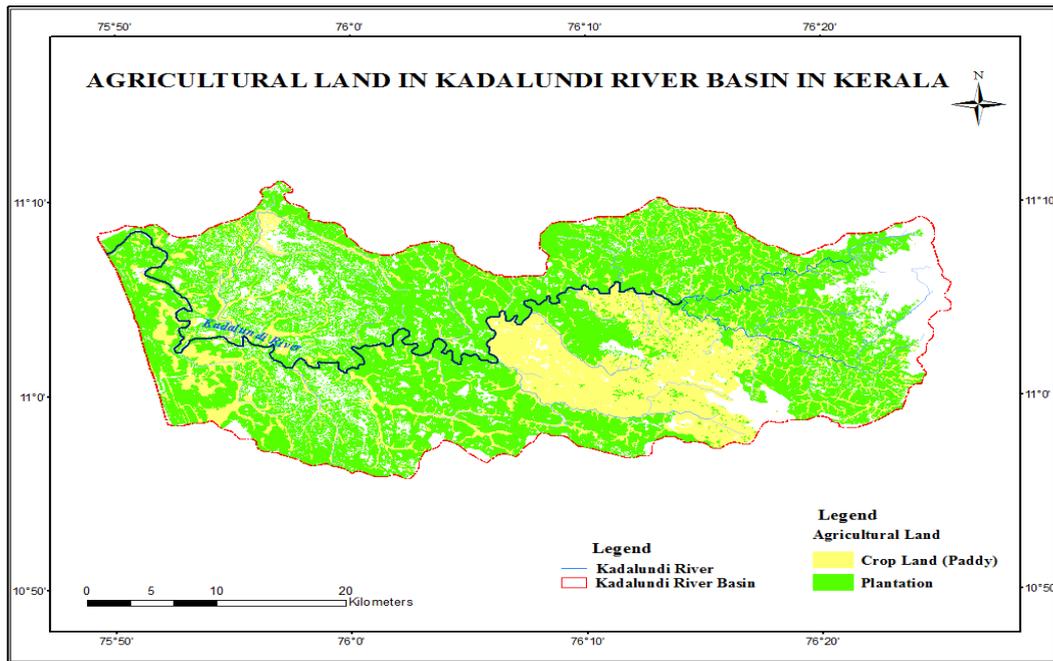


**Figure 2:** Built-up Land in Kadalundi River Basin in Kerala

**Table 1:** Land use/Land cover Classification of Kadalundi River Basin in Kerala

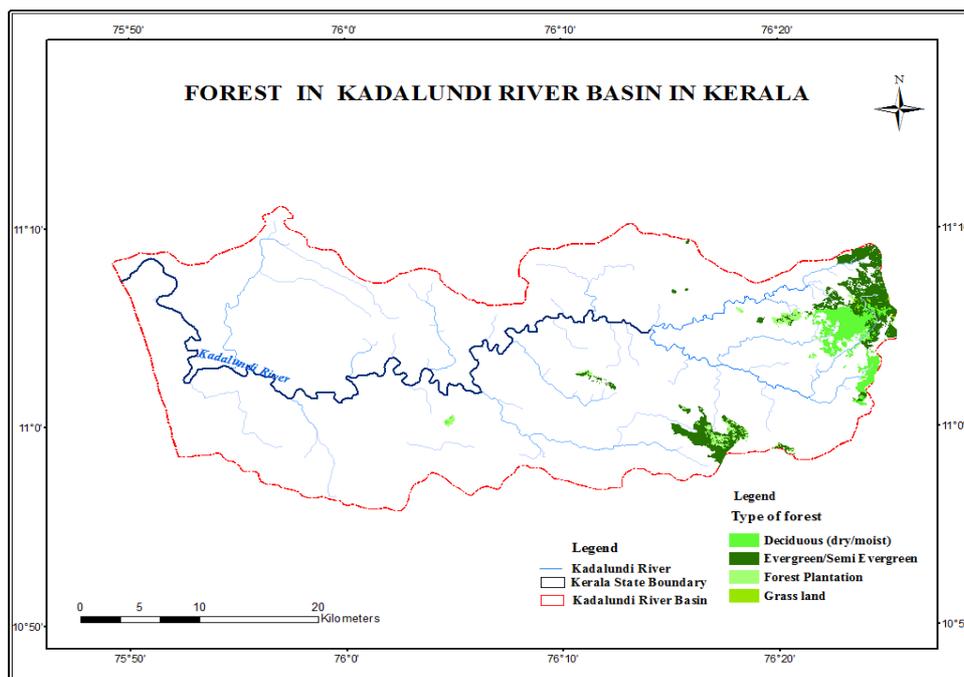
Sl. No.	Level - I	Level – II	Area in sq.km.	Percentage of the area (%)
1	Built-up Land	Town Area	12.2	1.08
		Village Area	7.5	0.66
		<b>Total Area</b>	<b>19.7</b>	<b>1.75</b>
2	Agricultural Land	Crop Land	250	22.27
		Plantation	656	58.44
		<b>Total Area</b>	<b>906</b>	<b>80.71</b>
3	Forest Area	Deciduous ( Dry / Moist )	18	1.60
		Evergreen / Semi Evergreen	35	3.11
		Forest Plantation	6	0.53
		Grass Lands	1	0.08
		<b>Total Area</b>	<b>60</b>	<b>5.34</b>
4	Waste Land	Barren Rocky/Stony waste	2.78	0.24
		Degraded land under plantation	8.8	0.08
		Land with or without scrub	103.26	9.19
		Mining / Industrial Waste Lands	0.58	0.05
		Sandy Land	0.17	0.01
		Under Utilized / Degraded	4.8	0.42
		Water Logged and marshy Area	3.06	0.27
		<b>Total Area</b>	<b>123.45</b>	<b>10.99</b>
5	Water Bodies	River / Canal	13.17	1.17
		Water Bodies	0.17	0.01
		<b>Total Area</b>	<b>13.34</b>	<b>1.18</b>
		<b>Grand Total</b>	<b>1122.49</b>	<b>100</b>

**4.3 Forest Land:** Forest, comprises of thick and dense canopy of trees. These lands are identified by their red to dark red tone and varying size. They are irregular in shape with smooth texture. The forests are found on the south eastern part of basin and in few patches in the central region of the river basin. The study area mostly covers evergreen/semi evergreen forest, deciduous (dry/moist), forest plantation and grass lands. The major type of forest found in the study area is the evergreen/semi evergreen forest covering 35 sq. km. , followed by deciduous (dry/moist) with 18 sq. km. forest plantation in 6 sq. km. and grass land found in small area in 1 sq. km. The figure 4 shows the distribution of forest in Kadalundi river basin.

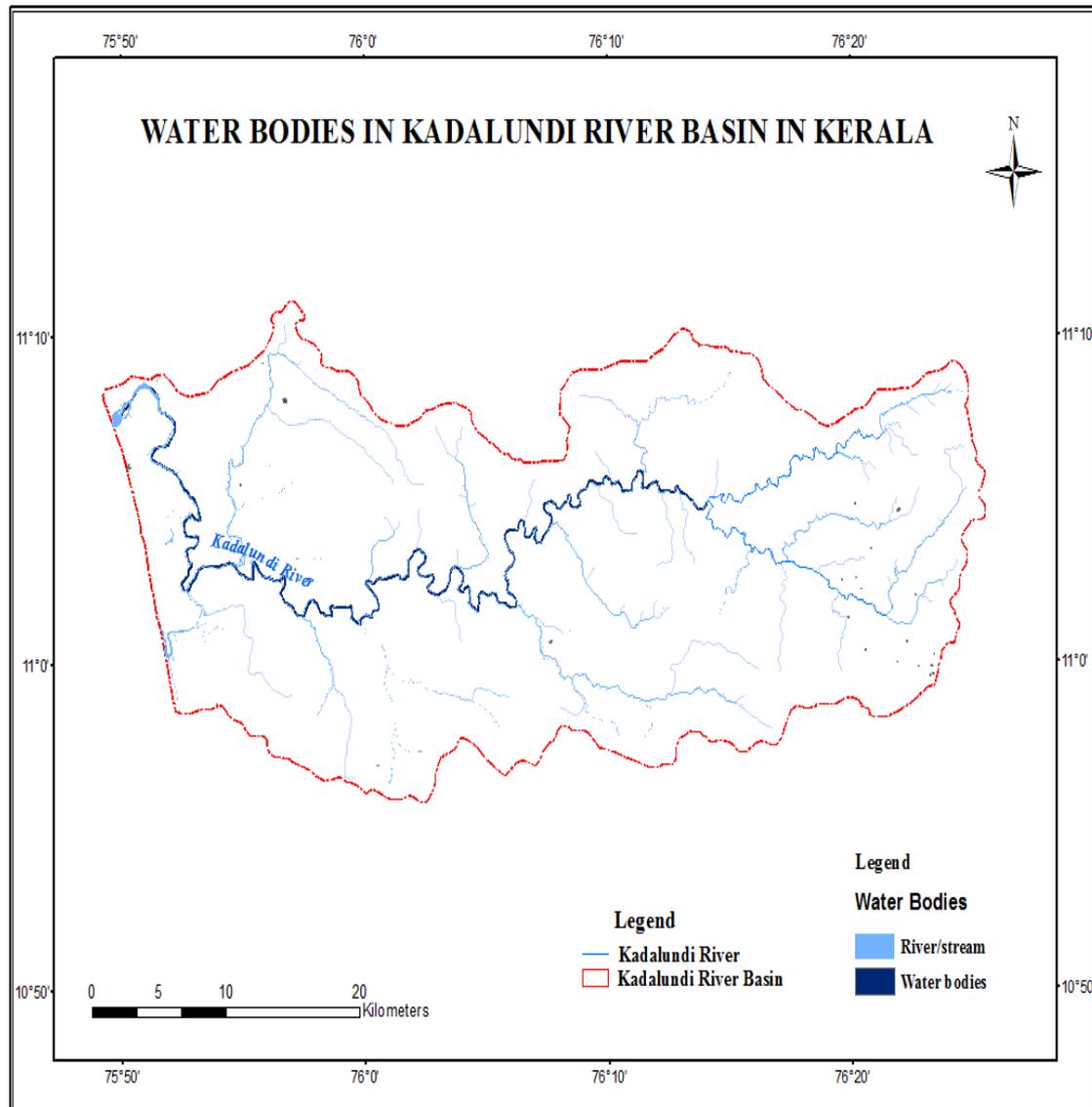


**Figure 3:** Agricultural Land in Kadalundi River Basin in Kerala

**4.4 Water Bodies:** The water bodies include both natural and man-made water features namely rivers/streams, lakes/tanks and reservoirs. The water features appear black in tone in the satellite image. The shallow water and deep water features appear in light blue to dark blue in colour. Tanks with plantation are identified by the square/rectangle shape and red colour tone. Tanks without plantation are recognized by the shape and light blue to dark blue tone. The figure 5 shows the water bodies and its spatial distribution in Kadalundi river basin. The total area of 13.35 sq. km. is covered by water bodies, out of which 13.17 sq. km. is under Kadalundi river / streams and small water bodies like tanks and pond covers 0.17 sq. km.

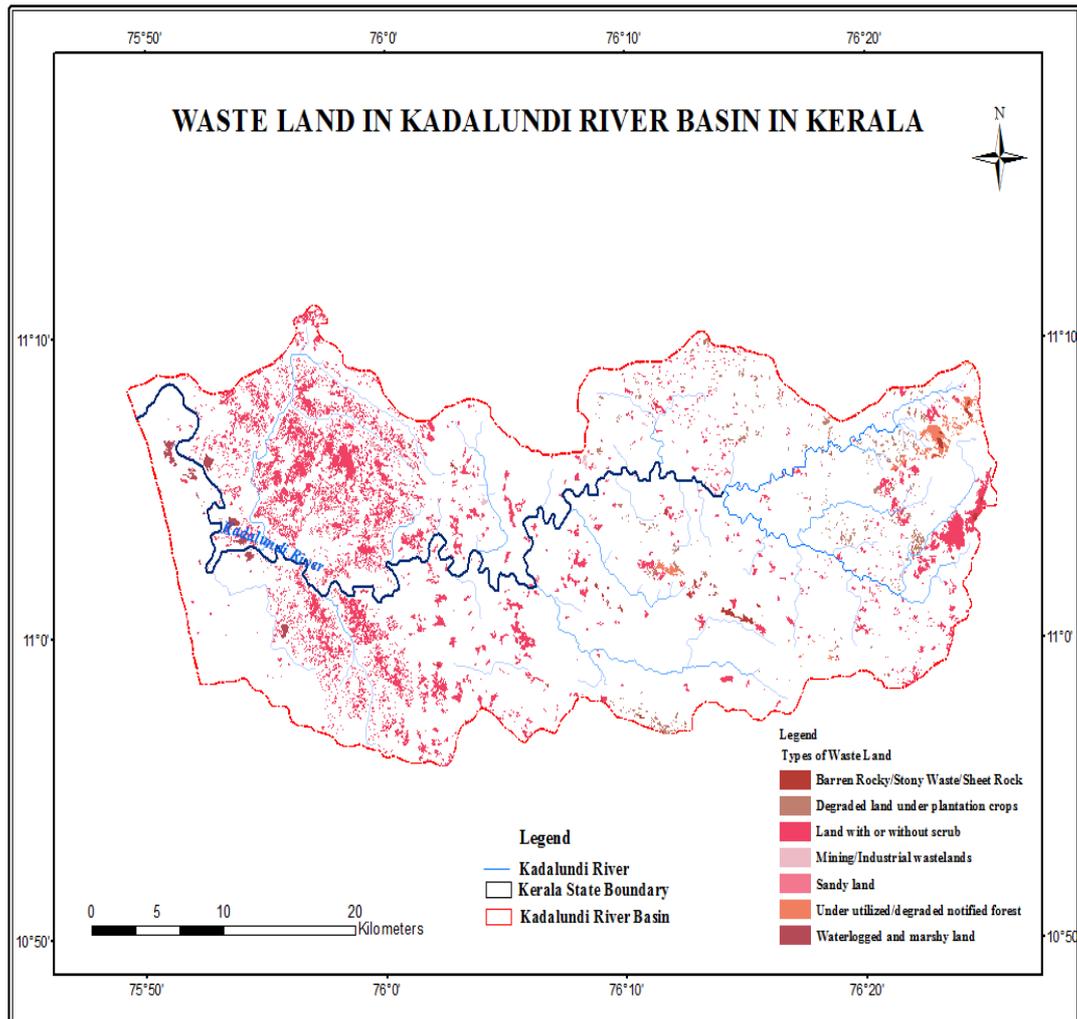


**Figure 4:** Forest Area in Kadalundi River Basin in Kerala



**Figure 5:** Water Bodies in Kadalundi River Basin in Kerala

**4.5 Waste Land:** Land which does not support any vegetation is known as waste lands. Barren rocky, degraded land under plantation, land with or without scrub, mining/industrial wastelands, sandy land, underutilized/degraded forest land, water logged and marshy area. Such lands are formed due to chemical and physical properties of soil, temperature, rainfall and local environmental conditions. The figure 6 shows the distribution of waste land in the study area. This map shows the Level II type of waste land category. The land with or without scrub is the major type of waste land found in study area covering 103.26 sq. km. in the western part of the basin slightly away from the coastal area. The next major type of waste land is degraded land under plantation crop spread over 8.8 sq. km. land area found in the central part of the study area. The other type of waste land detected in the study area is underutilized/degraded notified forest covering 4.8 sq. km. in few patches, waterlogged marshy area in 3.06 sq. km. found near the coastal area, mining/industrial wastelands 0.58 sq. km. and sandy land covering a small area of 0.17 sq. km. near the mouth of the river along the coastal belt.



**Figure 6:** Waste Land in Kadalundi River Basin in Kerala

## 5. Conclusion

The study has classified as per the major land use/land cover types. The Indian Remote Sensing Satellite (IRS) data, image processing and GIS techniques were used to identify the land use categories such as built-up lands, agricultural lands, forests, waste lands and water bodies. In the particular study area, agriculture area is the major dominating land use type followed by wasteland, forest, built up area and water bodies. The spatial distribution of the built – up area reveals that the Kadalundi river basin is not much affected by man-made influences. There are town areas with commercial and industrial activities but they are found in few patches here and there. There are village areas also with the mixed built-up and residential area. The major agricultural activity in the study area is plantation followed by paddy cultivation. There are different types of waste land and the spatial distribution of waste land indicates large area of land with or without scrub. The major water body is the Kadalundi river and its stream, followed by small tanks and ponds, hence the Kadalundi river is the only major source of water in the study area. The present study will be more useful to analyse changes in land use/land cover in Kadalundi river basin and it will be a basic referring data for proper land use management, natural resource management and integrated river basin management plan for Kadalundi river basin.

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