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Land Use / Land Cover Classification of kanniykumari Coast, Tamilnadu, India. Using Remote Sensing and Gis Techniques

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ABSTRACT
The land use/ land cover details of Kanniyakuamri coast which is Located in the southern part of Tamil Nadu (India) is studied. Satellite imagery is used to identify the Land use/ Land cover status of the study area. The software like ERDAS and Arc GIS are used to demarcate the land use / Land cover features of Kanniyakuamari coast. Remote sensing and GIS provided consistent and accurate base line information than many of the conventional surveys employed for such a task. The total area of Kanniyakumari coast is 715 sq.km. The land use / land cover classes of the study area has been categorized into thirteen such as Plantation, Sandy area, Water logged area, Scrub forest, Crop Land, Water bodies, Land with scrub, Reserve forest, Land without Scrub, Salt area, Beach Ridge, Settlement and Fallow land on the basis NRSA Classifications. Among these categories, land with scrub land is predominantly found all over the study area, It is occupied about 336.36 sq.km (44.61 percent), Crop Land 273.82 sq.km(38.29 percent), water bodies lands sharing about 20.44 sq.km (2.85 percent), settlement occupied with 6.96 sq.km (0.97 percent), and Fallow land was occupied 13.98 sq.km (1.95 percent).
Key words: Land Use / Land Cover, False colour Composite, Remote Sensing, IRS

I. INTRODUCTION

Land use refers to man's activities and various uses. Land is put to use by residents of a region or country for various purposes for example building, hospitals, parks and even graves. Balak Ram and Kolarkar (1993), Remote Sensing application in monitoring land use changes in arid Rajasthan. The remote sensing application is a very useful tool for monitoring the changing land use and also studied, Brahmabhatt, Dalwadi, et al (2000), Land use and Land cover change mapping in Mahi canal command area, Gujarat, using multi-temporal satellite data. Such building can be termed as man's activities on land to satisfy his needs, for example agriculture to provide food, reservoirs to store water and forest for wood. Land cover refers to natural vegetation , water bodies, soil, rock, artificial cover and others resulting due to land transformations or vegetation, natural or artificial construction covering the land surface. The two terms land use and land cover is very closely related to each other. The present study of Kanniyakumari district coastal area status of Land use and Land cover pattern have been discussed.

A modern nation, as a modern business, must have adequate information on many complex interrelated aspects of its activities in order to make decisions. Land use is only one such aspect, but knowledge about land use and land cover has become increasingly important as the Nation plans to overcome the problems of haphazard, uncontrolled development, deteriorating environmental quality, loss of prime agricultural lands, destruction of important wetlands, and loss of fish and wildlife habitat. Land use data are needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels. Land use refers to man's activities and the varied uses which are carried on over land and land cover refers to natural vegetation, water bodies, rock/soil, artificial cover and others noticed on the land (NRSA, 1989). Land Cover, defined as the assemblage of biotic and a biotic component on the earth's surface is one of the most crucial properties of the earth system. Land cover is that which covers the surface of the earth and land use describes how the land cover is modified. Land cover includes: water, snow, grassland, forest, and bare Soil. Land Use includes agricultural land, built up land, recreation area, wildlife management area etc.

Human activities are transforming the surface of the Earth at an accelerated pace. Such disturbance of the land can affect local, regional, and global climate by changing the energy balance on the Earth's surface and the chemical composition of the atmosphere (Chase et al., 1999; Houghton et al., 1999; Pielke, 2001). Over the past decades, land use/cover has been widely recognized as a critical

factor mediating socioeconomic, political and cultural behavior and global climate change (International Geosphere-Biosphere Programme (IGBP), 1990; Lambin et al., 1999; Watson et al., 2000). Over the years, remote sensing has been used for land use/land cover mapping in different parts of India (Gautam and Narayanan, 1983: Sharma et al, 1984: Jain, 1992; Brahabhatt et al, 2000).Application of remotely sensed data made possible to study the changes in land cover in less time, at low cost and with better accuracy. Remote sensing and Geographic Information System (GIS) provide efficient methods for analysis of land use issues and tools for land use planning and modelling.

Research like this, on how such human factors interact in driving land use will improve projection of land use/land cover and our comprehension of human responses to environmental changes (Turner *et al.*, 2006). Land use and land cover changes leading to degradation and have impact on the global carbon cycle and as such this can add or remove carbon-di-oxide from the atmosphere, contributing to climate changes, which can lead to global warming. It is well established that land cover change has significant effects on basic processes including biogeochemical cycling and thereby on global warming (Penner, 1994), the erosion of soils and thereby on sustainable land use (Douglas, 1999), and for at least the next 100 years is likely to be the most significant variable impacting on biodiversity (Chapin et al., 2000).

II. STUDY AREA

The study area selected for the present research is the Kannyakuamari coast of Tamil Nadu State extending from south of Tirunelveli to India Ocean, in the south,Kerala state on the northwest and Arabian Sea on the west and a breadth of 10 km in east – west direction. Thus total length of 71.5 km (west coast 60km and east coast 11.5 km and total area coverage is 715 km2). It is bounded by the north latitudes 80˚04'N and 80˚17'N the east longitudes of 77˚32'E and 74˚54'E and falling in parts of survey of India topographic sheets (SOI) and 58 H/12, 58 H/8, 58 H/4, on 1:50000 scale. The study area has well developed network of roads and railway lines providing good linkages with major cities in Tamil Nadu and also with rest of the country. Many major towns , Pilgrimage attraction (Kannyakumari) and tourist's importance are located in the study area.

OCATION MAP OF THE STUDY AREA

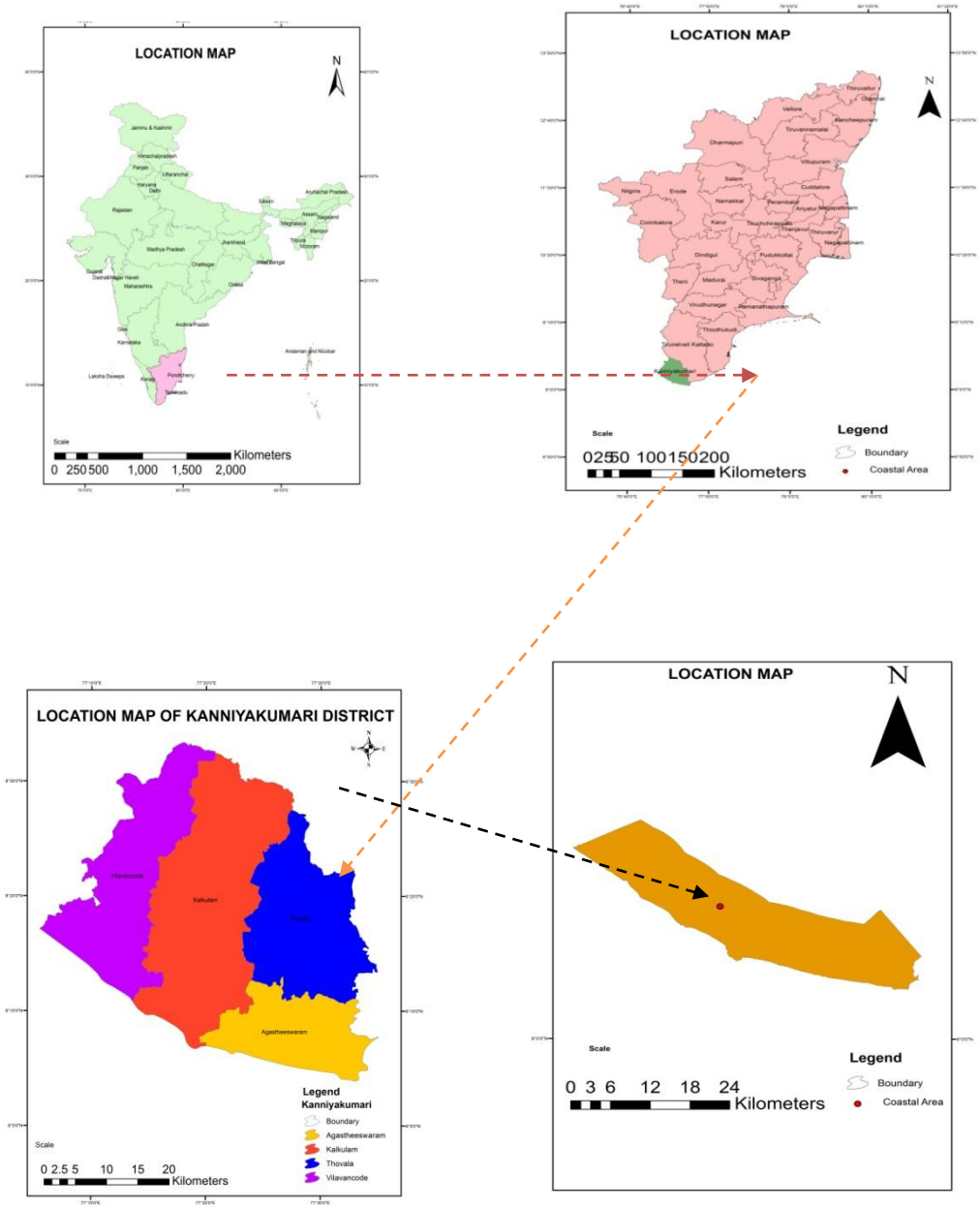

Fig 1

III. METHODOLOGY

The Land Use / Land Cover categories of the study area were mapped using IRS 1C, LISS III data (FCC of bands 2, 3 and 4) using ERADAS 9.0. The Satellite data was digitally interpreted and after making through field check, the map was finalized using Arc GIS 9.10. The various land use / land cover classes were interpreted further.

IV. LAND USE / LAND COVER IN KANNIYAKUMARI COAST - 2000

Knowledge of Land use / Land cover is important for coastline resources planning, management and related activities. The inventory of various Land use/ Land cover categories, their spatial distribution and understanding, changes in their pattern are nowadays assuming significance in generating a geographical information system aimed at resources management and conservation efforts.

The present chapter deals with the identification of various Land use classes of the study area.

The study area has made use of IRS-IC (LISS-III) geo coded satellite data on 1:50,000 scale. The various Land use classes of the study area were identified based on the image interpretation elements. For the study, the Land use / Land cover classification was made, by following the classification proposed by the National Remote Sensing Agency (NRSA 1999).

By using the satellite data it was possible to classify the Land use / Land cover classes up to thirteen classes as shown in Table 1 & Figure 2

PLANTATIONS

These plantations land occupied with an area of 7.9 sq.km (percent 1.11) of the total area. These include areas were crops such as palm trees, coconut, casuarinas etc. In the satellite imagery this category was identified from the Gray colour, irregular in shape, smooth texture and contiguous to non-contiguous pattern. In the study area such plantation were found to occur from Villavancode to Takkalai patches of west coast up to Kanniyakumari, small patches of Kanniyakumari and Endur.

SANDY AREA

These are the areas which have stabilized accumulation of sand formed in-situ or transported by wind. In the Satellite imagery, Sandy areas appear to be Orange tone that occurs close to Flood plain, natural levees/ beaches etc. In the study area, such sandy areas are found the North East Siman colony, Kodimunai. Sandy area occupied with an area 8.40 sq.km (percent 1.17) of the total area.

WATER LOGGED AREAS / AQUACULTURE

These are the areas where the water is at on near the surface and has been stagnated for the most part of the year. Water logged areas occupied with an area 23.78 sq.km (percent 3.32) of the total area. Such land usually occupied topographically low-lying areas. In the satellite imagery such water logged areas were identified from there blue tone and these proximity to water bodies. In the study area such waterlogged areas were observed in the eastern part of the east coast.

SCRUB FORESTS

These plantations land occupied with an area 12.06 sq.km (percent 1.68) of the total area. This Land use type is subjected to degradation of erosion. The scrub may be thorny or mixed jungle. These areas in the satellite data were Dark Red in tone. In the study area were single patches of scrub forest found in the Kayamoli area.

CROP LAND

These could be identified in the satellite images from the green tone, proximity to the water sources and from the rectangle/square shape. These Crop land occupied with an area 273.82 sq.km (percent 38.29) of the total area. In the study area such wet cropped areas were observed in six places with varying Arial extents, of which the larger patch occurs adjacent both sides of the rivers like Tambrabarani, Valliyar, Playar. The other important patches are found near, Panniyar River, Hanuman River, and Nambiyar River. Patches of west cropped areas are found in and around Palayar River.

These areas purely depend upon rainfall due to non-availability of appreciable ground water due to nature of slope and soil characters. It shows non-contiguous dispersed pattern. Mostly these lands are surrounded in the vicinity of west agriculture lands and also associated with gentle relief with moderating sloping areas. Most of the dry agricultural lands of the study area are found in the adjacent tract of wet agriculture and away from the channel paths. This Land use category is largely found in the areas of Takkalai, Nagarkoil, Some parts of Radhapuram, Udaivadai and Kurumbur.

WATER BODIES

These water bodies occupied with an area 20.44 sq.km (percent 2.85) of the total area. These includes the natural of artificial structures were water is impounded at least for a part of the year. This includes rivers, streams, tanks/lakes and lagoons. From the satellite data rivers such as Tambraparani, Valliyar River, Panniyar River, Palayar River, Hanuman River and Nambiyar River. From their linear shape, white representing the sand bodies in the river and agricultural lands along their flanks. Further, tanks/lakes distributed in various part of the study area also been identified.

LAND WITH SCRUB

These Land with scrub occupied with an area 336.36 sq.km (percent 47.04) of the total area. These include the uplands or high grounds with scrub. These lands are subjected to degradation or erosion and consist mainly of thorny bushes. In the satellite imagery this category is identified from the Rose tone, they association with high grounds, and its irregular shape. In the study areas this category is found near Arockyapuram, Chinnamuttom, Ramanthurai, Melamanakuddy, and Keezhamanakuddy.

RESERVER FOREST

These Reserve Forest occupied with an area 0.15 sq.km (percent 0.02) of the total area. Reserve forest includes an area, which comprise thick and dense canopy of tall trees which predominately remain

green throughout the year. These forests can be identified from their dark orange tone and smooth texture. Based on tonal and texture variation, it is possible to divide the Reserve forests of the study area into two sub categories namely, dense and open forest.

LAND WITHOUT SCRUB

These Land without scrub occupied with an area 3.41 sq.km (percent 0.47) of the total area. These lands are also found associated with high ground and or formed by degradation or erosion. It could be identified in the satellite data from its Black tone and its association with high grounds. The observers of vegetation distinguish these categories from the earlier described one. In the study area land without scrubs are found near Marthandurai, Rajakkamangalam, and Periakadu.

SALT AFFECTED LANDS

These Salt Affected Lands occupied with an area 5.89 sq.km (percent 0.82) of the total area. These are lands, which are characterized by the presence of excess soluble or, high exchangeable sodium. These results mainly due to prolonged are of the land for agricultural lands. They appear in Yellow tone or in some areas as light Yellow tone. They are irregular and discontinuous in shape, and occur close to the agriculture areas. In the study area such salt affected lands are found in all parts.

BEACH RIDGE

These Beach Ridges occupied with an area 2.2 Sq.km (0.30%) of the total area. This category was identified from the sarellite data by their light Pink tone. Occur in Kovalam, Chinnamuttam and Kanniyakumari.

SETTLEMENTS

These Settlements Lands occupied with an area 6.96 sq.km (percent 0.97) of the total area. In the satellite data the settlements were identified within dark Blue tone on the periphery. They have a typical coarse and mottled texture. These areas are also associated with network of canals, roads and railway lines. By bring the above characteristics, major settlements in the study area such as Kanniyakumari, Agastheswaram, Melamanakudi, Pallam, Kesavaputhenthurai, Muttam, Manavalakurichi, Kolachal, and Marathandamthurai.

FALLOW LANDS

These Fallow Lands occupied with an area 13.98 sq.km (percent 1.95) of the total area. These are the lands, which remains presently without any crops. These areas are agricultural lands, which have been up for cultivation, but it is temporally allowed to rest, un cropped for one or more season. This category was identified from the satellite data by their brown tone, smooth texture, square/rectangular shaped pattern in the study area and the fallow lands occur in and around Chinnamuttom and Punnakayal.

TABLE 1
LAND USE AND LAND COVER IN KANNIYAKUMARI COAST - 2000

S.NO	LAND USE/ LAND COVER	AREA SQ.KM	PERCENTAGE
1	PLANTATION	7.91	1.11
2	SANDY AREA	8.40	1.17
3	WATER LOGGED AREA	23.78	3.32
4	SCRUB FOREST	12.06	1.68
5	CROP LAND	273.82	38.29
6	WATER BODIES	20.44	2.85
7	LAND WITH SCRUB	336.36	47.04
8	RESERVER FOREST	0.15	0.02
9	LAND WITHOUT SCRUB	3.41	0.47
10	SALT AFFECTED LANDS	5.89	0.82
11	BEACH RIDGE	2.2	0.30
12	SETTLEMENTS	6.96	0.97
13	FALLOW LANDS	13.98	1.95
	TOTAL GEOGRAPHICAL AREA	715.00	100.00

LAND USE AND LAND COVER MAP OF KANNIYAKUMARI COAST - 2000

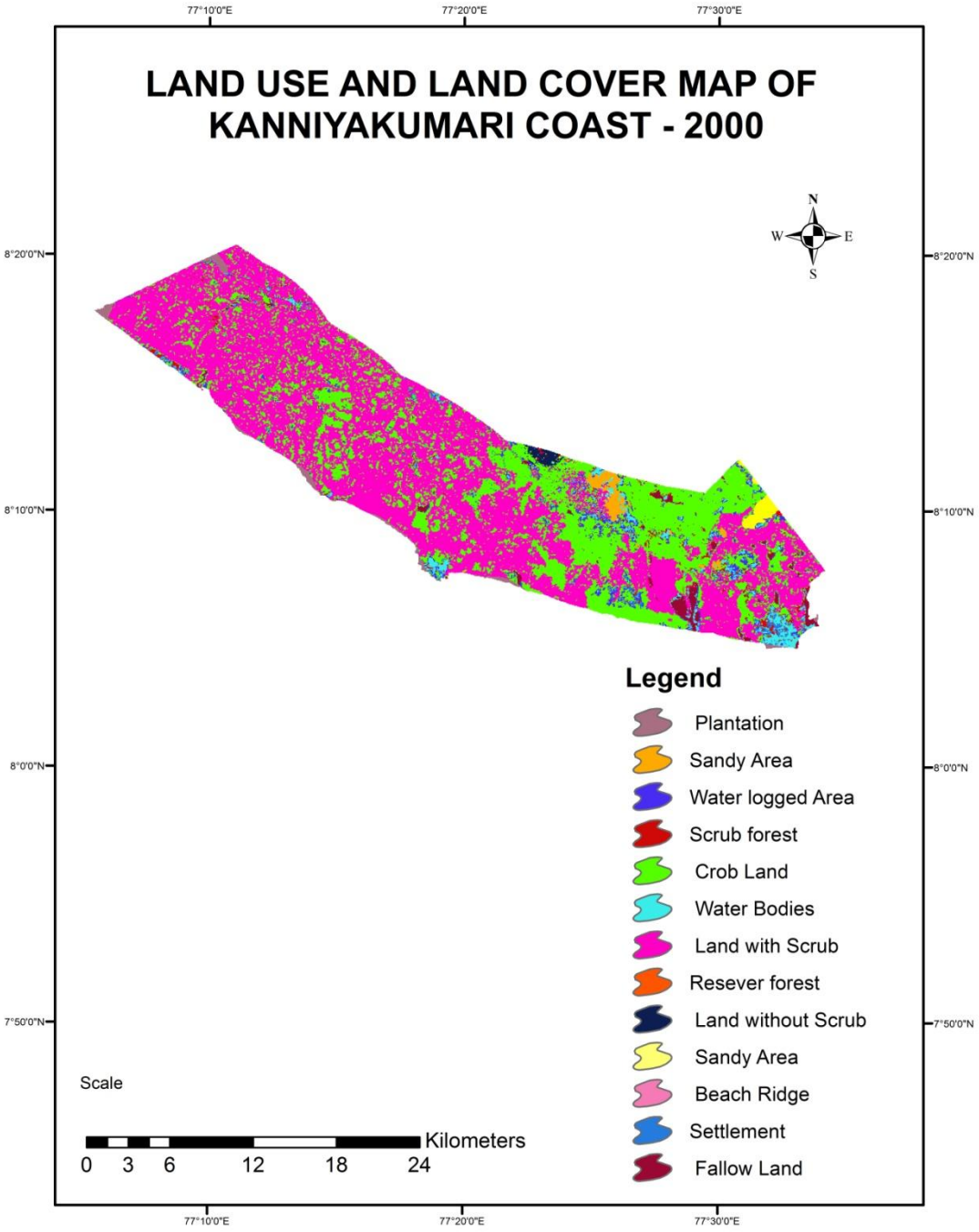

Fig 2

V. LAND USE AND LAND COVER IN KANNIYAKUMARI COAST – 2013

PLANTATIONS

These plantation lands occupied with an area 7.9 sq.km (percent 1.11) of the total area. These include areas were crops such as palm trees, coconut, cashurina etc. In the satellite imagery this category was identified from the green colour, irregular in shape, smooth texture and contiguous to non-contiguous pattern. In the study area such plantation were found to occur from Villavancode to Takkalai patches of west coast up to Kanniyakumari, small

patches of Kanniyakumari, Endur, Manappad and Kulasekarapattinam.

SANDY AREA

These are the areas which have stabilized accumulation of sand formed in-situ or transported by wind. In the Satellite imagery, Sandy areas appear to be Rose tone that occurs close to Flood plain, natural levees/ beaches etc. In the study area, such sandy areas are found the North East Siman colony, Kodimunai. Sandy area occupied with an area 8.40 sq.km (percent 1.17) of the total area.

WATER LOGGED AREAS / AQUACULTURE

These are the areas where the water is at on near the surface and has been stagnated for the most part of the year. Water logged areas occupied with an area 23.73 sq.km (percent 3.32) of the total area. Such land usually occupied topographically low-lying areas. In the satellite imagery such water logged areas were identified from there Re\ tone and these proximity to water bodies. In the study area such waterlogged areas were observed in the eastern part of the east coast.

SCRUB FORESTS

These plantations land occupied with an area 11.03 sq.km (percent 1.54) of the total area. This Land use type is subjected to degradation of erosion. The scrub may be thorny or mixed jungle. The areas in the satellite data were Dark Red in tone. In the study area were single patches of scrub forest found in the Kayamoli area.

CROP LAND

These could be identified in the satellite images from the green tone, proximity to the water sources and from the rectangle/square shape. These Crop land occupied with an area 201sq.km (percent 28.11) of the total area. In the study area such wet cropped areas were observed in six places with varying Arial extents, of which the larger patch occurs adjacent both sides of the rivers like Tambrabarani, Valliyar, Playar. The other important patches are found near, Panniyar River, Hanuman River, and Nambiyar River. Patches of west cropped areas are found in and around Palayar River.

These areas purely depend upon rainfall due to non-availability of appreciable ground water due to nature of slope and soil characters. It shows non-contiguous dispersed pattern. Mostly these lands are surrounded in the vicinity of west agriculture lands and also associated with gentle relief with moderating sloping areas. Most of the dry agricultural lands of the study area are found in the adjacent tract of wet agriculture and away from the channel paths. This Land use category is largely found in the areas of Takkalai, Nagarkoil, Some parts of Radhapuram, Udaivadai and Kurumbur.

WATER BODIES

These water bodies occupied with an area 20.44 sq.km (percent 2.85) of the total area. These includes the natural of artificial structures were water is impounded at least for a part of the year. This includes rivers, streams, tanks/lakes and lagoons. From the satellite data rivers such as Tambraparani, Valliyar River, Panniyar River, Palayar River, Hanuman River and Nambiyar River. From their linear shape, white representing the sand bodies in the river and agricultural lands along their flanks. Further, tanks/lakes distributed in various part of the study area also been identified.

LAND WITH SCRUB

These Land with scrub occupied with an area 329 sq.km (percent 44.61) of the total area. These include the uplands or high grounds with scrub. These lands are subjected to degradation or erosion and consist mainly of thorny bushes. In the satellite imagery this category is identified from the Rose tone, they association with high grounds, and its irregular shape. In the study areas this category is found near Arockyapuram, Chinnamuttom, Ramanthurai, Melamanakuddy, and Keezhamanakuddy.

RESERVER FOREST

These Reserve Forest occupied with an area 0.3 sq.km (percent 0.02) of the total area. Reserve forest includes an area, which comprise thick and dense canopy of tall trees which predominately remain green throughout the year. These forests can be identified from their dark orange tone and smooth texture. Based on tonal and texture variation, it is possible to divide the Reserve forests of the study area into two sub categories namely, dense and open forest.

LAND WITHOUT SCRUB

These Land without scrub occupied with an area 3.41 Sq.km (percent 0.47) of the total area. These lands are also found associated with high ground and or formed by degradation or erosion. It could be identified in the satellite data from its Black tone and its association with high grounds. The observers of vegetation distinguish these categories from the earlier described one. In the study area land without scrubs are found near Marthandurai, Rajakkamangalam, and Periakadu.

SALT AFFECTED LANDS

These Salt Affected Lands occupied with an area 11.78 Sq.km (percent 0.82) of the total area. These are lands, which are characterized by the presence of

excess soluble or, high exchangeable sodium. These results mainly due to prolonged are of the land for agricultural lands. They appear in Yellow tone or in some areas as light Yellow tone. They are irregular and discontinuous in shape, and occur close to the agriculture areas. In the study area such salt affected lands are found in all parts.

BEACH RIDGE

These Beach Ridges occupied with an area 2.2 Sq.km (0.30%) of the total area. This category was identified from the sarellite data by their light Pink tone. Occur in Kovalam, Chinnamuttam and Kanniyakumari.

SETTLEMENTS

These Settlements Lands occupied with an area 12.05 Sq.km (percent 1.68) of the total area. In the satellite data the settlements were identified within dark Blue tone on the periphery. They have a typical coarse and mottled texture. These areas are also associated with network of canals, roads and railway lines. By bring the above characteristics, major settlements in the study area such as Kanniyakumari, Agastheswaram, Melamanakudi, Pallam, Kesavaputhenthurai, Muttam, Manavalakurichi, Kolachal, Marathandamthurai.

FALLOW LANDS

These Fallow Lands occupied with an area 27.96 Sq.km (percent 1.95) of the total area. These are the lands, which remains presently without any crops. These areas are agricultural lands, which have been up for cultivation, but it is temporally allowed to rest, uncropped for one or more season. This category was identified from the satellite data by their brown tone, smooth texture, square/rectangular shaped pattern in the study area and the fallow lands occur in and around chinnamuttom, punnakayal

Table 2
LAND USE / LAND COVER IN KANNIYAKUMARI COAST - 2013

S.NO	LAND USE/ LAND COVER	AREA SQ.KM	PERCENTAGE
1	PLANTATION	7.91	1.11
2	SANDY AREA	8.40	1.17
3	WATER LOGGED AREA	23.78	3.32
4	SCRUB FOREST	11.03	1.61
5	CROP LAND	201.82	34.96
6	WATER BODIES	20.44	2.85
7	LAND WITH SCRUB	321.36	47.04
8	RESERVER FOREST	0.15	0.02
9	LAND WITHOUT SCRUB	3.41	0.47
10	SALT AFFECTED LANDS	5.89	0.82
11	BEACH RIDGE	2.2	0.30
12	SETTLEMENTS	12.05	1.68
13	FALLOW LANDS	13.98	1.95
	TOTAL GEOGRAPHICAL AREA	715	100

LAND USE AND LAND COVER MAP OF KANNIYAKUMARI COAST - 2013

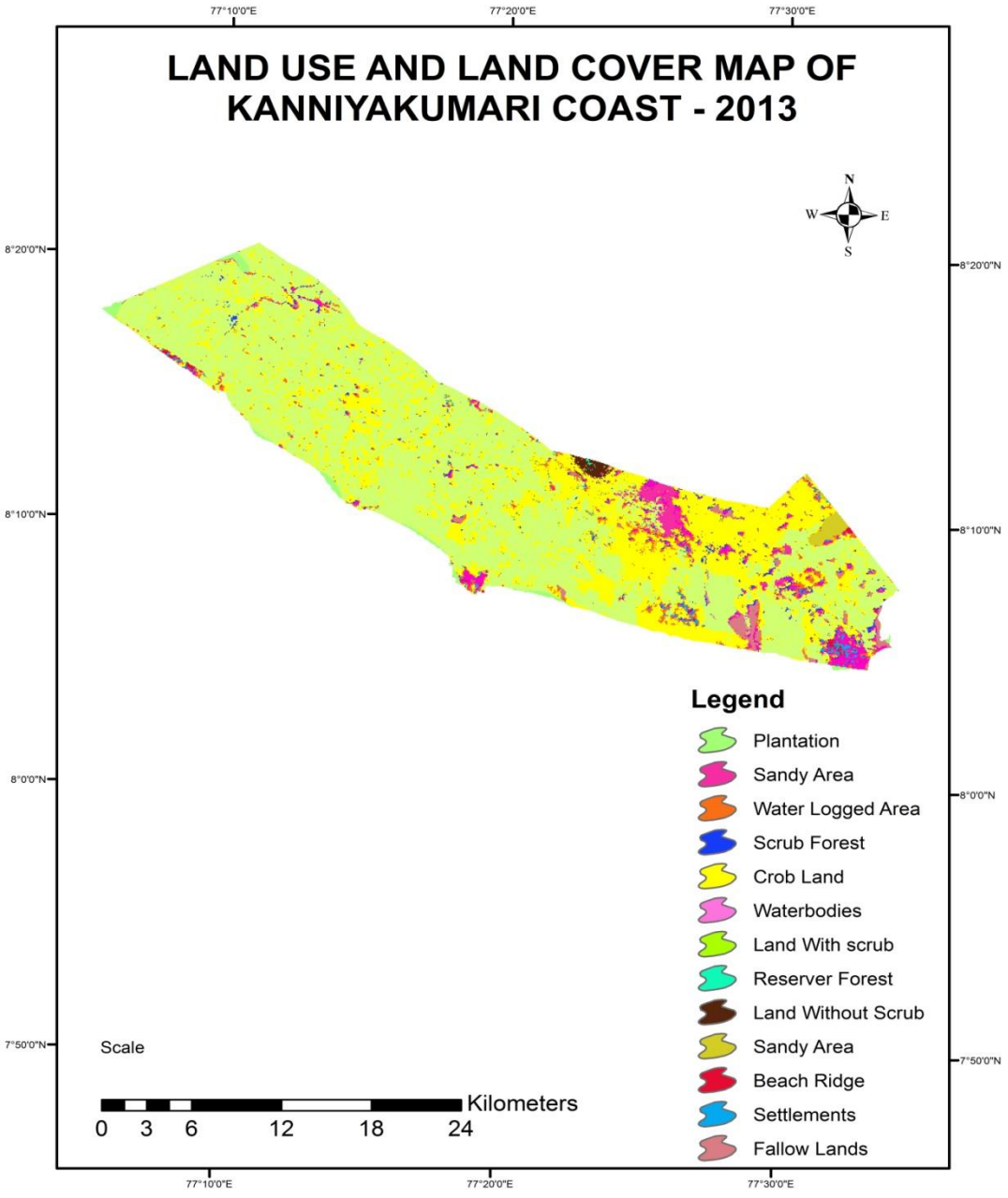

Figure 3

VI. LAND USE CHANGE DETECTION IN KANNIYAKUMARI COASTS 2000 -2013

In Kanniyakumari District Land use and Land cover changes occur in Settlement, Scrub Forest and Crop land.

In Settlements Changes increased from 0.97 to 4.4. In scrub forest changes decreased from 1.68 to 1.61 and In crop land changes decreased from 38.29 to 34.96

Table 3
LAND USE AND LAND COVER CHANGE DETECTION IN KANNIAYAKUMARI COAST 2000 TO 2013

S.NO	LAND USE/ LAND COVER	AREA SQ.KM 2000	PERCENTAGE	AREA SQ.KM 2013	PERCENTAGE	CHANGE DETECTION
1	PLANTATION	7.91	1.11	7.91	1.11	0
2	SANDY AREA	8.40	1.17	8.40	1.17	0
3	WATER LOGGED AREA	23.78	3.32	23.78	3.32	0
4	SCRUB FOREST	12.06	1.68	11.03	1.61	-0.7
5	CROP LAND	273.82	38.29	201.82	34.96	-4.73
6	WATER BODIES	20.44	2.85	20.44	2.85	0
7	LAND WITH SCRUB	336.36	47.04	321.36	47.04	0
8	RESERVER FOREST	0.15	0.02	0.15	0.02	0
9	LAND WITHOUT SCRUB	3.41	0.47	3.41	0.47	0
10	SALT AFFECTED LANDS	5.89	0.82	5.89	0.82	0
11	BEACH RIDGE	2.2	0.30	2.2	0.30	0
12	SETTLEMENTS	6.96	0.97	12.05	4.4	+3.8
13	FALLOW LANDS	13.98	1.95	13.98	1.95	0
	TOTAL GEOGRAPHICAL AREA	715.00	100.17	715	100.17	

VII. CONCLUSION

The study area focused on the Land use/Land Cover classification and its types. The Indian Remote sensing Satellite IRS-1C, LISS III data, image processing and Geographical Information System techniques were used to identify the Land use categories such as Plantation, Sandy area, Water logged area, Scrub forest, Crop Land, Water bodies, Land with scrub, Reserve forest, Land without Scrub, Salt area, Beach Ridge, Settlement and Fallow land. Scrub Land, Crop Land, Land with Scrub Land, Settlement are shows in increased, otherwise Plantation, sandy area, water Logged , water bodies, Reserve Forest, Land without Scrub, Salt area, Beach Ridge, and Fallow land compare to 2000 to 2012 no other changes.

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