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Investigation of land use cover patterns of Sea Shore vegetation of Kannur Coast of Northern Kerala, India using GIS

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ABSTRACTS

The vegetation cover ratio is an indication of beach stability. A detailed evaluation for the assessment of land use land cover morphology and beach stability was carried out by collecting the seasonal field information. Attempts to generate the LULC maps and investigate change detection analysis over a period of 40 years using Landsat satellite images of Landsat 1-5 MSS of 1979, Landsat 7 TM/ Landsat ETM Plus, and Landsat 8 OLI of 2019 sensor of nominal spatial resolution 30m were used. The satellite imageries to assess shoreline behavior the LULC classification, accuracy assessment and extensive field visit along the coast. It is an important technique to use temporal analysis of beach vegetation. The normalized difference vegetation index and LULC mapping methods were done with the help of GIS. Supervised image classifications of maximum likelihood classifier technique were used in the study. Producers Accuracy and Users accuracy were classified Coconut dominant mixed crop (83% and 71.4%), Water body (86% and 85.71%), Residential dominant mixed buildup (75% and 75%) and Barren land (66.6% and 80%). The study had an overall classification accuracy of 78.26% and kappa coefficient (K) was found in 0.706. Coastal environments display the impact of natural forces and processes on man and also the impact of man on the coastal environment. Recreation activities and exploitation of natural mineral resources are an integral part of the problem and affect in the coastal environment.

Key words : *Accuracy Assessment, Beach stability, Land use cover, Kannur.*

Introduction

The coast is an extraordinary climate where the land, ocean and air meet. Varieties in data sources cause changes in the actual climate, for instance an expansion in wave-energy may upgrade beach front disintegration (Aedla, 2015). The sea shore is a thin segment of delicately slanting zone along the beach by and large comprising of sand, residue or unconsolidated materials that expands landward from the low waterline (Toure *et al.*, 2019). The vegetation is significant one to decide the sea shore power. Tides and flows are the main consideration in creation, changing and even demolition of sea shores (Masria *et al.*, 2015). Moreover anthropogenic exercises are gravely influenced and disintegration is serious. Over the most recent twenty years, remote sensing (RS) and geographical information system (GIS) techniques have been generally utilized in different waterfront morphodynamic considers (Jana *et al.*, 2014).

The present effort is an endeavor to consider the sea shore vegetation and sea shore stability along Kannur shoreline of Kerala utilizing distant detecting, and appropriate for RS and GIS applications in addition to field perceptions. It incorporates Land Use Land Cover (LULC), Normalized Difference Vegetation Index (NDVI) method and accuracy assessment strategies. Shoreline changes along Kannur coast is concentrated concerning seaside eco-morphological highlights, for example, vegetation, anthropogenic exercises, sand size of sea shore, atmosphere, sea flow, wind disintegration, and it is assessed that the length of coastline of Kannur area is 82 km. In ongoing many years, the waterfront zones of Kannur locale encounters a momentous change in sea shore vegetation, LULC features and sea shore dependability because of effects of marine and earthbound variables and human exercises (SheelaNair *et al.,* 2018).

Beach and Beach Stability

Beaches are a narrow strip of slightly sloping zone along the seashore, beach consisting of silt, sand and unconsolidated materials that extends from terrestrial or land area to low waterline surface. Beaches are generally formed by wave action. Materials like sand, rocks, pebbles, sea shell fragments, etc, cover beach surface. Weathering and erosion influences the formation of beach material. Tides and currents influence the creation, changing and even destruction of beaches. Moreover anthropogenic activities are badly affected and erosion is severe. Most of the beaches are warm and rich in vegetation. Sea shores are alive; they are home to flying creatures, crabs, grasses, fish, mollusks and little spineless creatures. Sadly, these territories are encountering an unpredicted level of human effect, infringed on the landward side by formative exercises like transportation, settlements, and enterprises and on the sea side via ocean level ascent and waterfront disintegration. Regularly it is a characteristic occasion; however these are the delayed consequence of anthropogenic exercises (Shailesh Nayak, 2017).

Beach stability is maintained by vegetation, rock particles, sand structure, ocean currents and manmade structures which are responsible for shaping the coastal zone. The natural processes, which involve tides, wind, ocean currents, waves, biota, soil and sea level changes, it interacts with the materials from which the coastal zone is built (Kaliraj, 2017). Our nations have numerous amounts of seawalls, groins, jetties and other shoreline stabilization structures. It will generate tremendous impacts on our nation's beaches. Most of the shoreline structures are built to alter the effects of erosion, ocean waves, currents and sand movements, is one of the major issues currently facing coastal areas (Labuz, 2015).

Land Use Land Cover changes

Remote sensing and geographical information systems (GIS) have been widely applied for mapping Land use land cover (LULC) over a variety of spatiotemporal scales in coastal regions (Mokarram *et al.,* 2016). Be that as it may, the remotely sensed data for long haul thick and large scale LULC planning is normally a tradeoff between temporal frequency and spatial resolution (Rawat and Kumar, 2015). LULC maps derived from high-spatial-resolution imagery and it provide fine detailed information, but it is highly expensive for frequent observation over large coastal region. The long-term dense monitoring of land use and land cover (LULC) change is a crucially important one, because it provides essential information about the history, for understanding current situation and future of LULC change (Vogelman *et al.,* 2016).

The accuracy assessment is a significant last advance in the preparing of distant detecting information. Accuracy makes the data estimation of the subsequent information to a client. Countless the new assessment applying exactness evaluations utilizes kappa coefficient (K) based files, and in general accuracy as a sign of the legitimacy of the order calculation. However, ongoing improvements in accuracy assessment strategy have brought up the impact of the kappa records. There are various creators have performed assess on arrangement accuracy assessment (Pontius and Millones, 2011). The Kappa coefficient is a mistake network of the most part exactness evaluation which is acquired since non-to one side segments information. Kappa analysis is set up as a tremendous strategy for dissecting a solitary blunder framework and looking at the contrasts between various mistake lattices (Foody, 2004). In view of accuracy assessment has investigated for better introduction regular error matrix (Verma *et al.,* 2020). Considering above realities present investigation was attempted with the accompanying objectives are to monitor the land use land cover change along the sea shores of Kannur district in 21 years, and to recognize the vegetation change along the Kannur beach field information.

Materials and Methods

Study area

The study area of beach zone in Kannur district is extends for about 82 Km in length. It is situated along the western side of the district and threatened by erosion and accretion. It lies between 12R 152323-11R 682203N latitude and 75R 132953-75R 542423E longitude. The breadth of the state varies from 32 km in the extreme north and south to over 120 km in the middle. The district covers longest coastal area in Kerala state. The shoreline of Kerala comprises of 80% of sandy sea shores, 5% of Rocky coast and 15% of Muddy pads. The total length of coastline is about 569.7 km of which about 480.0 km is affected by erosion.

The coast is characterized by long, narrow and straight open sandy beaches, barrier beaches/spits, promontories, estuaries, lateritic and rocky platforms and mangroves. Man-made structures like sea walls, jetties and groynes are constructed along and across the shore in the study area. Some areas are densely populated and have economic and societal significance as most of the local people depend on fishing in estuaries and it has a number of small fishing ports. Most of the beach sides are covered with coastal protection structures such as seawalls and groynes. The seawalls are made up of large rock, stone bricks, etc. The region experiences a tropical climate marked by heavy rainfall and hot weather condition in summer. The average annual temperature is 27.2 °C. The study area map is appeared in Figure 1.

Data used and Image classification

Landsat Image data

The Landsat datasets that are utilized in the investigation incorporates Landsat 1-5 Multispectral scanner (MSS) of 1979, Landsat 7 Thematic Mapper (TM)/Landsat Enhanced Thematic Mapper Plus (ETM+) of 1999), and Landsat 8 Operational Land Imager (OLI) of 2019. The datasets downloaded from USGS Website (https://earthexplorer.usgs.gov/) (Table 1).

Topography

The methodology is utilized with Survey of India (SOI) geography, coastal region mapped using GPS and multi-dated satellite pictures. For geo-amendment of the SOI geographical diagram, Ground Control Points (GCP) was used and the image was projected to Universal Transverse Mercator (UTM)

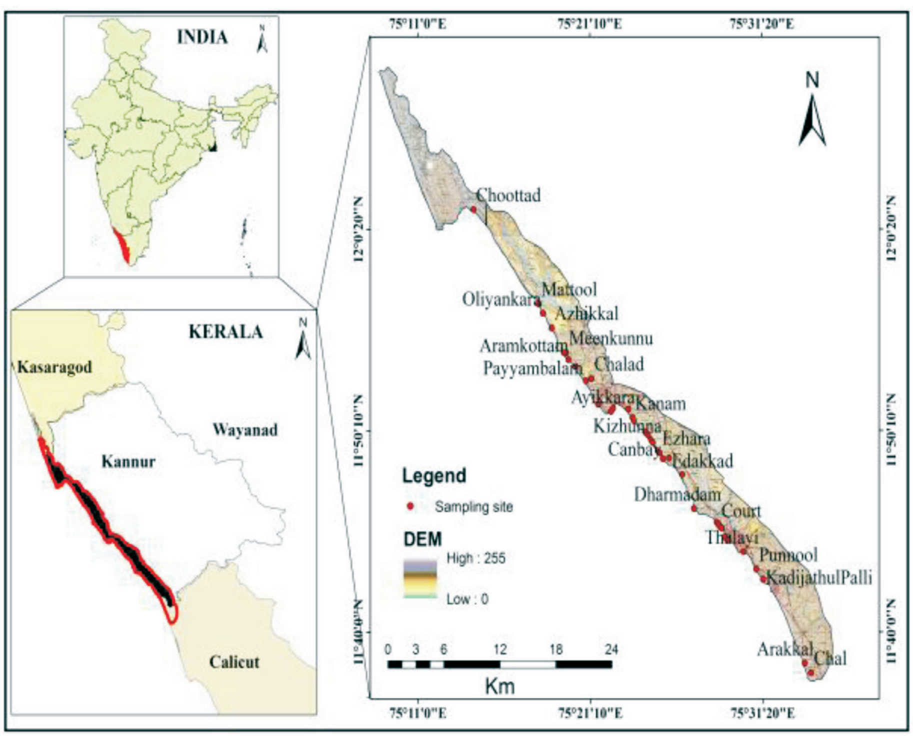

Fig. 1. Map showing Study sites

concerning WGS-84 datum using the ESRI ArcGIS 10.5 software.

Landsat Image preprocessing

Landsat datasets preprocessing measure were produced to deal with all the Landsat images. The process was incorporated atmospheric correction, image co-enrollment, low quality perception location, gap filling, mosaicking and information cutting utilizing the beach front district of study region. The radiometric amendment was done and subsets from every one of the Landsat sensors for various years classified with supervised image characterization (Figure 2).

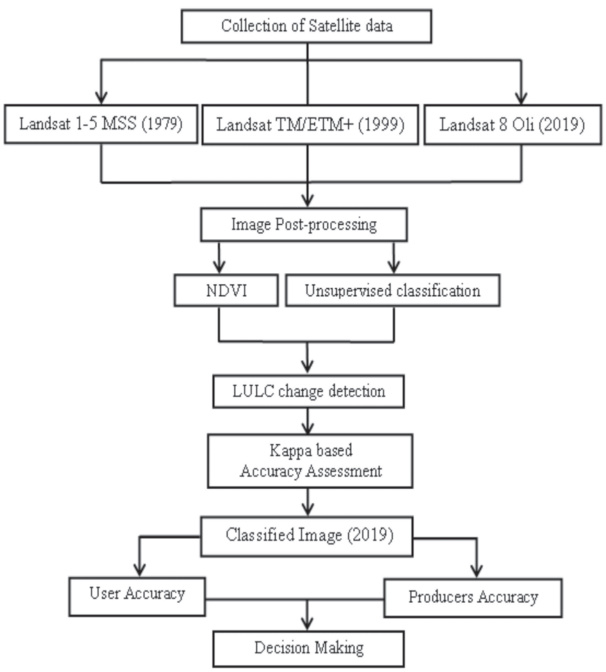

Fig. 2. Flow chart of methodology

Normalized Differential Vegetation Index (NDVI) generation

NDVI computation includes the reflectance in red and near infrared bands of electromagnetic spectrum which is sensitive to coconut dominant mixed vegetation, residential dominant mixed buildup, water body and barren land. The spectral indices were determined utilizing the condition (Singh *et al.*, 2001).

$$NDVI = (NIR- Red) / (NIR+ Red) \quad .. (1)$$

Image Collection, Atmospheric Correction and Geometric Correction

Two issues were considered in choosing high-quality images, the cloud defilement of a chose image was <10% however much as could be expected in the investigation territory. All images were geometrically enrolled into an UTM projection (zone 43, North) with geometric errors less than of one pixel, and all images have a similar coordinate system.

Land use/Land cover classification

For image processing signature file creation device was utilized for creating four classes of LULC. ArcGIS unsupervised characterization is performed utilizing Iterative Self-Organizing Data Analysis Technique (ISODATA) Land use Land cover classifications such as Water bodies, Barren land, and residential dominant mixed built up and coconut dominant mixed crop were distinguished and grouped for a very long time (40 years) of 1979, 1999 and 2019 (Verburg *et al.,* 2016).

Accuracy Assessment Estimator

The accuracy assessment estimator is the quite possibly the main last advance at characterization measure. It is to quantitatively survey how effectively the pixels were inspected into the correct land cover classes. Other than the info accentuation for accuracy assessment pixel selection was on zones that unmistakably recognized on high resolution image, Google earth and Google Map. An aggregate of 23 areas were made in the classified image of the investigation zone. The accuracy assessment cell cluster reference section was filled by the best gauge of each reference point. Geographical guide, Google earth and Google Map were utilized as reference source to arrange the chose focuses. Table 3 shows the connection between ground truth information and the relating ordered information acquired through mistake lattice data recipe given in condition (2)

$$\text{Kappa coefficient} = \frac{(T \times C) - G}{T^2 - G} \quad .. (2)$$

Where
T = test pixels; C = correctly classified pixels
G = sum of multiplied total value

Results and Discussion

A detailed assessment for the appraisal of coastal morphology and beach stability was completed by gathering the special field information and investigates the equivalent basically, utilizing distinctive satellite imageries to evaluate the shoreline conduct and broad field visit along the coast.

Comparison of NVDI three datasets 1979, 1999 and 2019

The NDVI estimations of three datasets were recognized and analyzed the vegetation index analysis. Assessed the NDVI values expose that in 1979 datasets is noticed for the greatest level of vegetation index 68.42% (Figure 3a)., in the time of 1999 datasets is modestly covered for the vegetation index 60.64%, and in the time of 2019 datasets are noticed for the less vegetation covered region 51.23% (Figure 3b). NDVI esteems comparison shows that in 1979 datasets is noticed for the low range of non vegetation record in 31.58%, the time of 1999 datasets is decently covered for the non vegetation index in 39.36% (Figure 3c), and the time of 2019 datasets is noticed for the close by balance in non vegetation shrouded region in 48.77%. The three datasets a comparison of NDVI is in figure 4. The NDVI importance in Kannur seaside territory was mapped for the year 1979, 1999 and 2019 to investigate the pattern of progress that happened in the

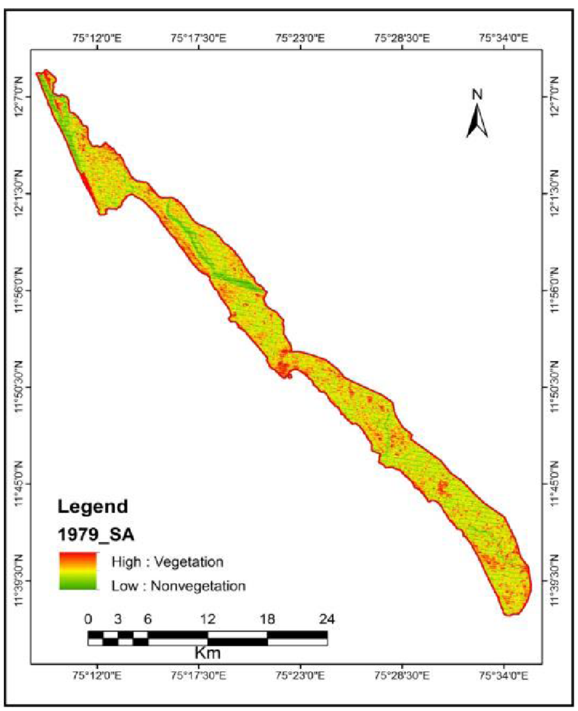

Fig. 3a. NDVI analysis for the year of 1979

course of past four decades. The non vegetation class incorporates water bodies, barren land and build up area, the vegetation class includes forest and agricultural land. Vegetation cover is diminished in consistently; likewise the non-vegetation cover was expanded quickly.

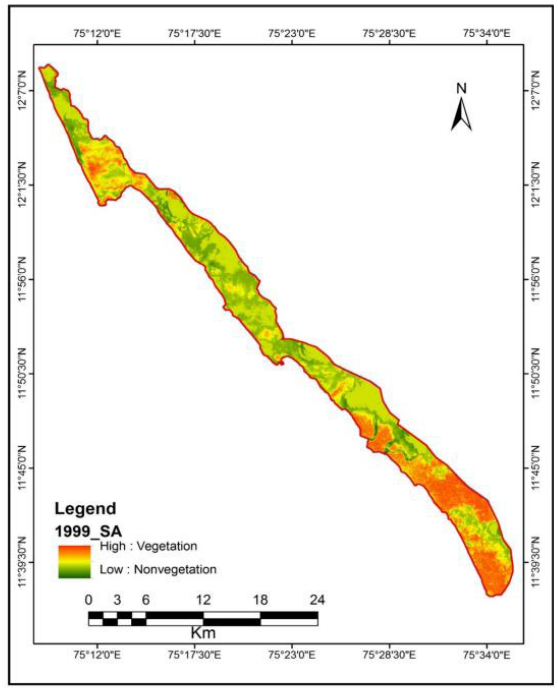

Fig 3b. NDVI analysis for the year of 1999

Anthropogenic exercises and atmosphere varieties are control the NDVI information. Industrial activities in land, agricultural activities, construction of build-up and roads diminish the vegetation cover in coastal region.

Land use/ Land cover change detection of Coastal region during 1979, 1999, and 2019

LULC for the years 1979, 1999 and 2019 were prepared. The classifications, for example, Coconut dominant mixed vegetation, water body, residential dominant buildup and barren land were recognized and classified for the years 1979, 1999 and 2019. LULC change identification during 1979, 1999 and 2019 were given in Figure 5a. The population was the main consideration for change identification in LULC classification. Because of the expansion of population; the settlements were expanded from 14.41% to 52.33% in 40 years. It is an explanation of limiting the non-developed surfaces, particularly vegetation land. Improvement of fast building lo-

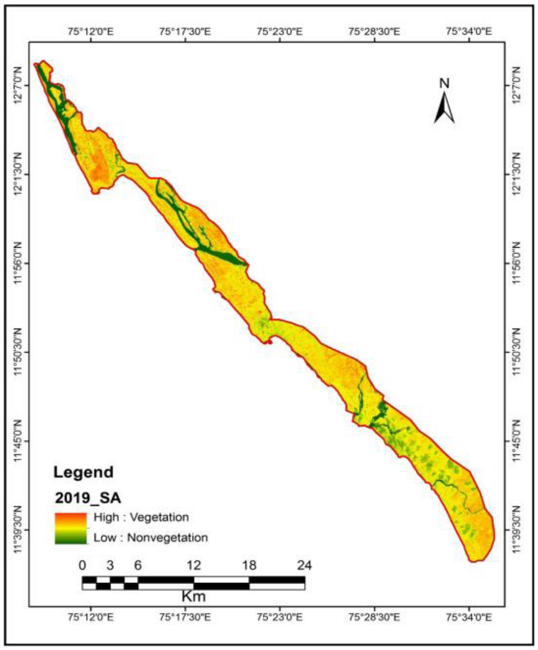

Fig. 3c. NDVI analysis for the year of 2019

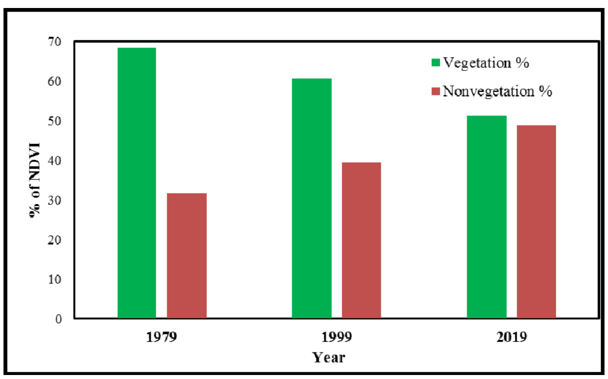

Fig. 4. Comparison of NDVI analysis

cales of private units and street organizations, asphalts and recreation benefits all consolidated together prompted persistent development of developed surfaces in the various corners of the coastal region. Contrasted with 1979, the vegetation covers were diminished in 2019.

Coconut dominant mixed vegetation

The class includes forest and agricultural land. The pace of progress in coconut predominant mixed vegetation land during 1979 to 2019 was extremely far above the ground. In 1979, the total coconut dominant mixed vegetation is 1535.29 km^2; it covers the 63.36% of the complete study region. Yet, on account of 1999, it is decreased to 1021.31 km^2; the complete rate is about 42.16%. In 2019 it is diminished to 529.53 km^2. The complete level of vegetation zone is diminished by 21.85%. This may prompts an adjustment in sea shore security. The high populace development and anthropogenic exercises, the change rate somewhere in the range of 1979 and 2019 was 1005.76 Sq.km. Mass destruction of vegetation land in coastal region is appeared in Figure 5a.

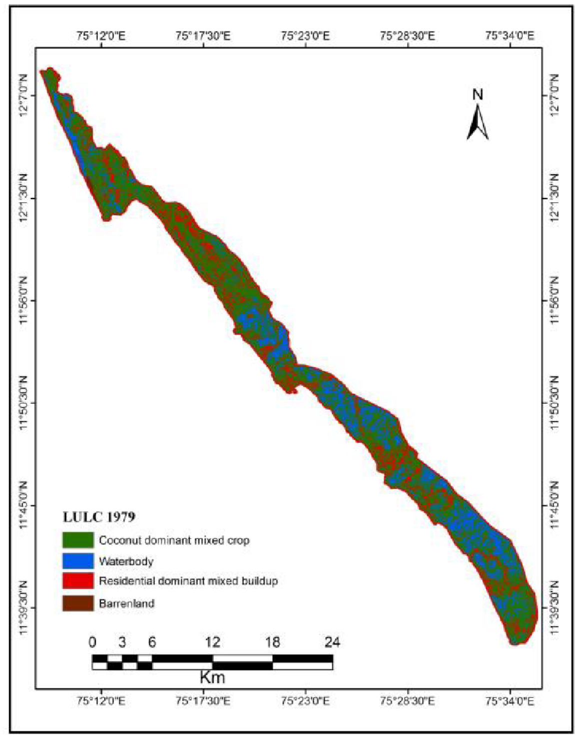

Fig 5a. Lulc map of 1979

Water body

The water bodies bunch involves regions with surface water as ponds, lakes, streams, depletes and waterways and so forth during 1979, the 21.23% of study region is covered with water body, it is about 514.30 km^2. This may marginally increment in 1999, the total area covered by water body in 1999 was 530.69 km^2, it is around 21.91% of the all out investigation region. In 2019, it expanded as 23.23%. The absolute water body covers about 562.53 km^2. The temporal varieties are marginally expanded in at regular intervals (20 years). The pace of progress of water body was expanded as 48.23km^2 as is appeared in Figure 5b.

Residential dominant mixed buildup

The grouping of residential dominant mixed

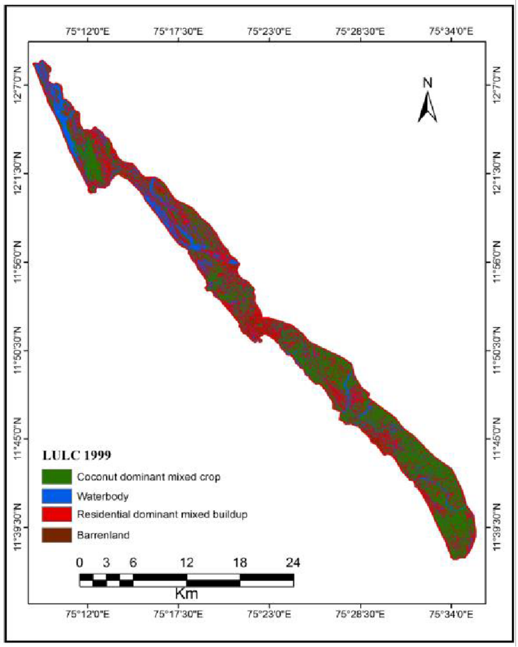

Fig. 5b. Lulc map of 1999

buildup rapidly growing in consistently. During the year 1979 the residential dominant mixed buildup area is 14.41%, it is about 349.16 km^2. In 1999, it is expanded to 31.21%, it is 756.02 km^2 of the absolute examination region. At that point additionally is expanded in 2019, 52.33% the total area of mixed buildup is about 1268.19 km^2 in 2019. During 1979 to 2019, the development territory was quickly expanded. The absolute changing rate from 1979 to 2019 is 919.03 km^2, it is straight forwardly influenced in vegetation cover. Residential dominant mixed buildup was decay the vegetation territory as introduced in Figure 5c.

Barren land

The grouping of infertile land incorporates strip mines, quarries and rock pits, transitional regions and mixed barren land. In 1979, the study region covers 1% of infertile land, it is about 24.26 km^2. In 1999 it is expanded as 114.48 km^2, i.e., 4.73% of absolute region, and in 2019 diminished as 62.59 km^2. It is about 2.58% of the total study area. Because of mining exercises, quarries, deforestation the all out zone of infertile land is expanded in late the time of 1990, it is diminished in 2019. The pace of progress of Barrenland was diminished as of 38.33 km2 as demonstrated in Table 2.

The arrangement of private transcendent mixed advancement rapidly extending in consistently. During the year 1979 prevailing blended development region area is 14.41%, it is about 349.16 km^2. In 1999, it is extended to 31.21%, it is 756.02 km^2 of the absolute investigation area. By then moreover is an extended in 2019, 52.33% the total area of mixed improvement is about 1268.19 km^2 in 2019. During 1979 to 2019, the advancement zone was immediately extended. The total changing rate from 1979 to 2019 is 919.03 km^2, it is direct impacted in vegetation cover. Private prevalent mixed advancement was decline the vegetation district as presented in Figure 5c.

Land use Land cover change detection during 1979 to 2019

The overall result of this study indicates that a significant amount of change has occurred in the vegetation cover and residential buildup area since 1979, and that has effect on the areas ecosystem and human livelihoods. Due to population growth, industrialization, urbanization and anthropogenic activities, the land use land cover pattern of Kannur coastal region was changed dramatically from 1979 to 2019 (Figure 5a, 5b & 5c). The study also recognized that the population growth had important effect on land use changes in coastal region of Kannur. The land use changes affected the beach

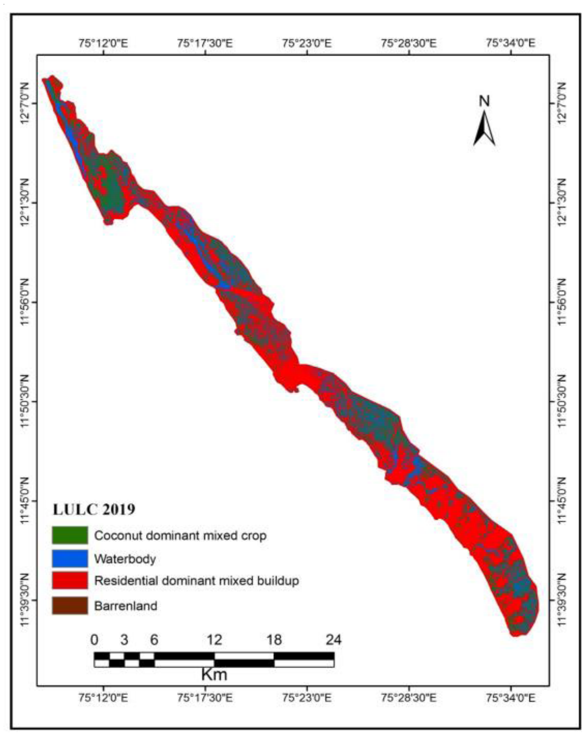

Fig. 5c. Lulc map of 2019

stability; it reduced the morphological stability of beach. Barren land and buildup area reduced the vegetation cover. The vegetation cover was minimizing the coastal erosion rate and stabilizes the beach characteristics. So, the beach vegetation is an important factor for stabilization of beach. During the last 40 years, the rate of deforestation, number of settlements and barren land were increased dramatically. Industrialization, urbanization and poor agricultural practices are the major part in LULC change in Kannur coastal region. The general LULC change in 1979 to 2019 is given in figure 6.

Overall Change detection

The overall Kappa Coefficient was made from a measurable investigation to survey the accuracy of order. The overall system used for accuracy assessment is a close to strategy which is analyzing the checking centers with the arranged figures for all the land cover class. Accuracy assessment method was chosen to survey the precision of characterized guide of 2019. Landsat 8-Oli of 2019 was utilized for accuracy assessment, stratified random points in each class were were produced (Table 2). The LULC maps created from satellite images for study area consists of four thematic land cover classes such as coconut dominant mixed crop, waterbody, residential dominant mixed buildup and barrenland. For the accuracy assessment an aggregate of 23 reference locales in the field were utilized to confirm the land cover type. Out of these reference sites, coconut dominant mixed crop producer (7) comparing the error estimator producer accuracy is 83% and users accuracy is presented in 71%, waterbody (7) evaluating the error estimator producer accuracy is 86% and users accuracy is presented in 86%, residential dominant mixed buildup (4) analyzing the error estimator producer accuracy is 75% and users accuracy is presented in 75%, and barrenland (5) investigating the error estimator producer accuracy is 67% and users accuracy is presented in 80% over the time of 22 years as introduced in Table 3. By and large maker exactness and clients precision nearly waterbody and private blended development territory were introduced in same way. Rest of the other classes, for example, coconut dominant mixed crop when looking at users' accuracy variety is more than producers' accuracy, and barrenland is having high contrasts noted in producer accuracy when contrasting the users' accuracy. The overall appraisal is obtained 78.26, and the kappa coefficient was found in 0.706. Considering the evaluation standards of Kappa measurements this investigation has demonstrated considerable Strength of arrangement for the guide of 2019.

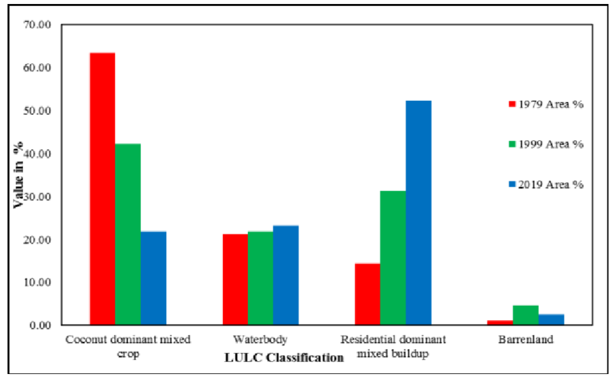

Fig. 6. LULC change detection analysis

Surveying of beach characteristics of coastal region

From the chose a locale of the field contemplates, it was seen that the present-day sandy coastlines of Choottad, Mattool, Chal, Thottada and Muzhupilangad which were presented to the Arabian Sea were steady to accumulating in environment. Notwithstanding, those sandy coastlines and sloppy beaches introduced to the Neerkadavu, Chalad, Mappila Bay, Arakkal, Kadalpalam, Kizhunna para estuary on the eastern side of the Neerkadavu, Chalad, Mappila Bay, Arakkal, Kadalpalam, Kizhunna para estuary on the eastern side of the Dharmadam Island were being crumbled at a quicker rate. As confirmation of this, extras of tremendous stones used in the advancement of seawall were found in a straight model on the low water line near to Mappila narrows, Ayikkara, and Maithanappalli. It was obvious from the field overview that seawalls were devastated and reconstructed in zones like Mattool, Azhikkal, Mappila bay, Ayikkara, and Maithanappalli. From this, it might be deduced that the improvement of a seawall is definitely not a never-ending response for crumbling control of our coastline. Day-today breakdown of sloppy riverbanks and banks was discovered near Chootad (north-stream mouth of Perumba), Azhikkal (Valpattanam stream mouth), Neerkadavu, Ayikkara (near fish market), Adikadalayi (Kanam coastline), Edakkad Beach (near Narath stream mouth), Dharmadam Sea shore (Anjarakandy stream mouth) and Near Bishop House sea shore (Eranjoli stream Mouth).

By and large, the sea shore was being dissolved at a quicker rate on the previously mentioned zone as demonstrated in Table 4-8. Coastal parts such as Ayikkara, Arakkal, Neerkadav (near Sree Kurumba Temple), Payyambalam Beach Road near Dew Drop Inn, Near Guest House, beach near Maithanappalli Darga, Adikadalayi, Chera rock, Beach near Parappalli Masjid and near overburry' Follywere the basic zones of disintegration. The western part of the Arakkal, Port Office, Arakkal Palli, City Masjid, city post office and Sree Kurumba Temple additionally were presented to huge scope disintegration in the earlier period. As a preventive proportion of beach front disintegration, seawalls were developed practically all over these zones besides in some zone. They were essentially worked by utilizing large stones and concrete blocks. One such seawall, around 3 km long and built on the shore of the western piece of the Arakkal, Port Office, Arakkal Palli, City Masjid, city mail center and Sree

Table 1. Satellite data specifications

Datasets	Date of acquisition	Sensor	Resolution (m)	Source
Landsat 1-5	Oct 25, 1979	MSS	30	USGS Earth Explorer
Landsat 7	Oct 01, 1999	TM/ETM+	30	USGS Earth Explorer
Landsat 8	Oct 21, 2019	OLI	30	USGS Earth Explorer

Table 2. LULC classification for three time periods for coastal region for Kannur District

LULC Classes	Area (Km^2) 1979	% of 1979	Area (Km^2) 1999	% of 1999	Area (Km^2) 2019	% of 2019	Overall changes	% LULC changes
Coconut dominant mixed crop	1535.29	63	1021.31	42	529.53	22	1005.76	50
Waterbody	514.3	21	530.69	22	562.53	23	48.23	2
Residential dominant mixed buildup	349.16	14	756.02	31	1268.19	52	919.03	46
Barrenland	24.26	1	114.48	5	62.59	3	38.33	2
Total	2423.01	100	2422.5	100	2422.84	100	2011.35	100

Table 3. Accuracy Assessment confusion Matrix of classified image (2019)

LULC Classes	Coconut dominant mixed crop	Water body	Residential dominant Mixed Buildup	Barren land	Total No. of pixels	Producers Accuracy	Users Accuracy
Coconut dominant mixed crop	5	0	0	2	7	83%	71.4%
Waterbody	0	6	1	0	7	86%	85.71%
Residential dominant Mixed Buildup	1	0	3	0	4	75%	75%
Barrenland	0	1	0	4	5	67%	80%
Total No. of pixels	6	7	4	6	23		

Table 4. CRZ details of study area

Grama Panchayath/ Corporation	High tide Length (km)			Mangrove (CRZIA) (km^2)	Mangrove Buffer zone (CRZ I) (km^2)
	Total	Along sea coast	Along creek		
Mattool	32.44	7.5	24.94	0.42	0.40
Valapattanam	3.45	0	3.45	0.03	0.11
Azhikode	22.25	7.18	15.07	0.07	0.19
Kannur corporation	48.02	9.89	38.13	0.2	0.37
Muzhappilangad	18.06	4.68	13.38	0.10	0.26
Dharmadam	23.41	2.61	20.8	0.31	0.69
Thalassery	43.76	8.71	35.05	0.26	0.60

Kurumba Temple totally fallen in light of estuarine and oceanographic measures.

In profoundly disintegration inclined regions, there are no landward second embankments. Such areas were ensured generally via seawalls. During storm season greater part of these spots are without sea shores. The waves encroach upon the seawall during the rainstorm season, particularly during the elevated tide. Hence, they are the counterfeit boundaries halting the waves/tides at the coast. There are a few areas with a three lines of seawall, especially in the accumulating territories. On the other extraordinary, on account of constantly dissolving locales there are lines of ocean divider which are currently in the ocean. From the prior examinations and present field overviews, it tends to be perceived that the districts, which were steady prior, have been exposed to serious disintegration, and those which were dissolving are currently steady to accumulating.

Management of coastal morphology and ecosystems through Coastal Regulation Zone

The Coastal Regulation Zone (CRZ) notification which was originally notified in 1991 and later re-notified in 2011 and 2019 has provided a powerful legal instrument for the protection of coastal morphology and ecosystem (Table 4). It provides a buffer zone for the coast and has provisions to protect the beach, mangroves, seagrass, corals and salt marsh. The CRZ notification emphasizes that protection of coastal morphology and ecosystems is that the best gratitude to protect the coast from erosion and other natural hazards.

The land ward relocation of the shoreline brought about by the powers of waves and flows is named as Coastal Erosion. The Coastal regions have gotten more inclined and powerless against regular and human made perils which lead to Coastal Erosion. The Shoreline retreat is perceived as a thriving danger due to worldwide environmental change and other anthropogenic exercises that adjust the regular cycles of supporting sea shores and drifts. Coastal erosion fundamentally happens when wind, waves and long shore flows move sand from shore and store it elsewhere. The sand can be moved to another sea shore or beach, to the more profound sea base, into a sea channel or onto the landside of a rise. The expulsion of the sand from the sand sharing framework brings about perpetual changes fit as a fiddle and design.

Conclusion

The investigation was done in Coastal area of Kannur region. The investigation plainly perceived that the satellite remote sensing along with GIS can be an integral asset for planning and evaluation of land use/land cover changes of a given region. The significant changes in the land use/land cover during the investigation time frame between the years 1979 to 2019 noticed some momentous perceptions. The assessment shows that the fundamental changes happened in Coconut dominant mixed vegetation (50%), water body (2.4%), residential dominant buildup (45.7%) and barren land (1.9%). The overall accuracy estimator is acquired 78.26, and the kappa coefficient was found in 0.706.

In Kannur, the ecological problems of the coastal zone are unique due to the high density of population, loss of land due to coastal erosion, mining of beach sand for construction purposes, drastic morphological and shoreline changes due to shore structures, destruction of coastal vegetation including mangroves, saline water intrusion into water table etc. It is estimated that the length of coastal line of Kannur district is 82 km. The major shares of mangroves in Kerala are seen in Kannur (44%). The monsoonal high waves, cyclones, tsunami, long period high swell waves during non-monsoon months (Kallakkadal), rip currents, etc. These forces have the potential to cause serious damages through coastal erosion and coastal flooding resulting in the loss of life and property. The coast has distinctly different morphologies and ecosystems like sandy beaches, sand dunes, tidal inlets, estuaries and backwaters, pocket beaches, lateritic and rocky platforms, earth cliffs and hard rock promontories. Mangroves, mudflats and other intertidal zones, corals and coral reefs, sea grass and seaweeds are important coastal ecosystems.

From the field reviews, it was perceived that the present-day sandy sea shores of Choottad, Mattool, Chal, Thottada and Muzhupilangad which were presented to the Arabian Sea were steady to accumulating in nature. Nonetheless, those sandy sea shores and sloppy shores presented to the Neerkadavu, Chalad, Mappila Bay, Arakkal, Kadalpalam, Kizhunnapara estuary on the eastern side of the Dharmadam Island were being dissolved at a quicker rate. Clearly seawalls were wrecked and modified in regions like Mattool (looking towards Azhikkal) Azhikkal, Mappila inlet, Ayikkara, and Maithanappalli. From this, it very well may be gathered that the development of a seawall is definitely not a perpetual answer for disintegration control of our beach. Everyday breakdown of sloppy riverbanks and banks was found close to Choottad (north – waterway mouth of Perumba), Azhikkal (Valpattanam stream mouth), Neerkadavu, Ayikkara (close to fish market), Adikadalayi (Kanam sea shore), Edakkad Beach (close to Narath rivermouth), Dharmadam sea shore (Anjarakandy waterway mouth), Near Bishop House sea shore (Eranjoli waterway Mouth). Coastal erosion along the coast of Kerala is perennial in nature. The magnitude of erosion is alarming during the south-west monsoon season month of June to September causing huge loss/damage to the property adjacent to the shoreline. Kerala, being a land for diversified communities of many live along the coast and depend on fishing for their livelihood. Receding from the shoreline 500 m from the shoreline as per the CRZ Act by the coastal regulation authority, even though is the best option for any coastal stretch will not be effective along the Kerala coast due to the reasons stated above. Hence, in order to enhance the security of the people living along the coast, there is an urgent need to construct/rehabilitate the frontline sea defenses. There are also changes that occur over the land surface, such as in vegetation, which are associated with changes in climatic variations. However, a better understanding of developmental activities on vegetation, relationships on various time and space scales is needed.

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