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RESEARCH ARTICLE

STUDIES ON COASTAL GEOMORPHOLOGICAL LANDFORMS IN THE SOUTHEASTCOAST OF THIRUVALLUR COASTAL STRETCH, USING REMOTESENSING AND GIS TECHNIQUES.

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Abstract

Geomorphology is the study of the landforms of the earth and the process that form them especially those that lead to the erosion, transport, and deposition of sediments. The present study has been made to record the varied coastal geomorphic features along the Thiruvallur coastal stretch. The coastal zone of southeast coast have contained a lot of morphological changes due to the many natural hazards. The area of Thiruvallur is the part of the Southeast coast of India. The geomorphic features of this area resulted from various coastal landward process of erosion-accretion or due to other natural causes of sea level changes and sea water interactions. The details of the features such as strand lines, sandy beach, mudflat, lagoon, back swamps, barrier Island, salt marshes, estuary, tidal creeks , spit and shoal has been recorded as well as the significance of their occurrence is presented. The coastal geomorphology of the study area clearly established not only the sea level changes but also landward process and climatic conditions.

Introduction:-

The geomorphology is the study of the physical features of the surface of the earth and their relation to its geological structures. Coastal geomorphology is a branch of geomorphology in- Geomorphology methodologies focused mainly on field observation, description and measurement but also included physical experimentation, there is growing recognition of the importance of geomorphology and geomorphologists in contributing to a range of environmental investigations and management issues. The coastal geomorphology was highly descriptive and much of it was influenced by concept related to the erosion cycle. Much of the research in coastal geomorphology in the past four decades has been concentrated in the zone influenced by wave and tides wave, generated currents, and tidal currents and on the erosional and depositional features associated with these. The coastal zone features have been developed due to the process of erosion-accretion or due to other natural causes. The features can be categorized as depositional features, erosional, and special features (Nair, 1990).The geomorphic unit under different heads namely features formed by present day wave action, features formed due to sea level oscillations and features formed by rock and sea water interaction have been presented. The influence of the sea level oscillations and land and sea interactions forms a diverse coastal geomorphology along the coast (Jaganadha Rao, 2012). The response of coastal geomorphic types and landforms to sea level rise is complex, coastal forms being a product of interactions between energy and material, with stepwise adaptations external forcing sea level rise as a driver of coastal change needs to be seen within the context of other process and determinant particularly in relation to wave tides, storms and

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sediment supply (Flemming, 2011). Geomorphic hazards are regards as related to landscape changes that affect human systems. The process that produces the changes are rarely geomorphic in nature but are better regarded as atmosphere or hydrologic (Paul, 1994). Geomorphology is also concerned with the study of earth surface forms and their evaluation in time and space due to the physicochemical and biological factors acting on them most of the evolution is the product of a cyclic process based on erosion transport deposition of sediment particle (Gerardo, 1995). The geomorphology mapping it involves the partitioning of the terrain into conceptual spatial entities based upon criteria that include morphology, genetics compositions, and structure, chronology environmental system (Michael, 2012).Extreme rainfall and flood events in steep upland catchments leave geomorphological traces of their occurrence in the form of boulder berms, debris and alluvial fans (Foulds, 2014).

The Geoinformatics system provides multiple applications for studying different coastal aspects. With the rapid development and change of GIS software package in the date1980's their utility for coastal management was quickly recognized. The satellite remote sensing due to its repetitive multispectral and synoptic nature provides a unique view to recognize various features on land and sea (Siddiqui, 2003).This technique can be a great help in the collection of continues wave current , wind, tides, suspended matter, shallow water area, wetlands, mangroves mudflats and other coastal features and coastal change like accretion or erosion.

Study Area:-

The study area lies in the coastal stretch of Thiruvallur district, Tamil Nadu, India it is bounded to the north by Pulicut lake south by Chennai east by the bay of Bengal and west by Minjur area It lies between 80˚02'30''E and 80˚22'30''E longitude13˚15'00''S and 13˚35'00''S latitude. The coastal stretch of the study area has a total length of 28km along the Bay of Bengal. The Thiruvallur coastal stretch is known for diverse coastal geomorphic features. The environment namely as strand lines, sandy beach, mudflat, lagoon, back swamps, Barrier Island, salt marshes, estuary, tidal creeks, spit and shoal resulted in characteristic and significant coastal geomorphology because of land-sea interaction. This coast has a very vast coastal plain, which extends from north of toppalapalayam to south of sattangadu. The physiography of the coast consist of sandy beach sands and extends over a width of 500m from the coastline. The main geological formation occurring in the coast are upper Gondwana sand silt, quaternary sand and clay undulation by Archean crystalline rocks Charnockite.

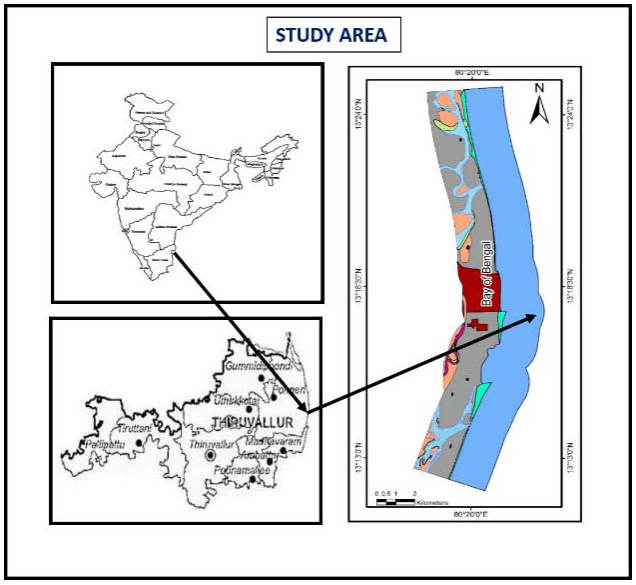

Figure 1:-study area map.

Methodology:-

In this study deals with the description, mapping, and field analysis of various coastal geomorphological assemblages along the southeast coast of Thiruvallur. Coastal geomorphological studies involve mapping of different types of landforms. Mapping of coastal is primary to the understanding of the evolution of any coastal area. The integrated remote sensing and GIS techniques are employed for extracting the coastal geomorphological landforms at high resolution. The success met with the geomorphology mapping from imagery for obtaining accurate results and imageries are mainly utilized for mapping. The various types of spatial data source such as

topographical map (scale of 1:50,000) published by Survey of India the year of 1970-1971, satellite data Landsat- 8 OLI image interpreted based on the visual interpretation keys and identified the geomorphology of the study area using ArcGIS 10.2 software. The Trimble GPS was used for ground truth validation. The geomorphic features formed by present day coastal process, features formed due to sea level oscillation and most of the coastal features has been developed due to the process of erosion and accretion or due to the natural causes have been identified at different places and description of individual features have been recorded. The features were confirmed using field data.

Resultsand Discussion:-

The area of Thiruvallur coastal stretch between Pulicut to Tiruvottiyur a length of the shoreline 28km the entire area is marked by varied and geologically significant geomorphological features the geomorphic units under different domes namely features formed by present day wave action features formed due to sea level changes and land and sea water interaction have been presented. The entire area is marked by varied geomorphological features. The extensive structure-activity due to rapid urbanization is resulting in the damage of these beautiful features day by day. As such these features are verified for the help for the feature researchers. All the significant features have been studied for scientific documentation. Geomorphological map of this area is prepared fig:2. The study area occurs different land forms that detailed description of individual features is presented below. For the ease of arrangement, the features have been classified into two types that are marine landforms and fluvial landforms.

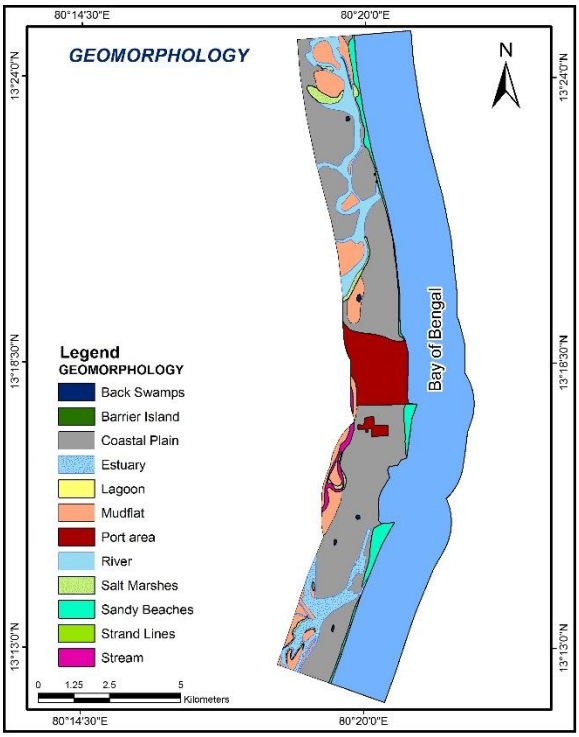

Figure 2:-Geomorphology Map.

Depositional features:-

Coastal deposition is the arranging depressed of material on the coast by the sea it occurs when waves lose energy or when large inputs of sediments are made into the coastal system. Here, the study area occurs different type of depositional features that is a sandy beach, coastal dunes, Barrier Island, coastal plain, Back swamps, mud flats, strand line, salt marshes, and tidal creek. In this study area, the coastal depositional features are categorized by marine landforms and fluvial landforms.

Marine landforms:-

The sea implements the function of erosion and deposition through sea waves, supported by currents, tides, and storms in coastal areas. The study area falls under different marine landforms such as the sandy beach, Sand dunes, Coastal plains, Barrier Island, Strandlines, Lagoons, Mudflat, Salt marshes.

Sandy Beach:-
The sandy beaches are extensively developed along the entire coast and its occupied nearly 3 sq.km of the study area. A gently sloping zone and it is composed of particles. Beach typically occur in areas along the coast where wave or current action deposit and rework sediments. Coastal sediments are affected by wave courses, but commonly the deposition of sediments along the shoreline are referred to as the beaches. In this study area beaches are present for about a length of 28 km in a linear from Tiruvottiyur to Pulicut. A marked landward ridge which forms the landward limit of wave swash is referred to as the berm. The berm is predominantly visible in the Kattupalli and Tiruvottiyur location also it has been observed all along the beaches between Tiruvottiyur to Pulicut. Wave cut face of the berm reveals the alternative layering of black sand and white sands thickness of the individual layers varies from a few mm to few cm. beach morphology of the study area is highly dynamic and changes with wave energy, sediment supply, long shore current and substrate physiography. The surface structure like ripple marks also occur. The ripple formation can be ascribed in due to the oscillatory flow of wind.

Sand dunes:-
In this study area, coastal morphological features of dunes are presently more active.the feature is met all along the south-eastern side of the study area. Coastal is the formation of coastal and dunes the material for the formation these dunes is essentially derived from the present day beach covering from foreshore to backshore. The furthermost characteristic of this features are dunes is the vegetative cover the vegetation is a good effect in helping to bind together the sand by their complex root system and those help to protect the dunes from erosion. Coastal dunes sediments from the intertidal area get regularly and periodically exposed to the onshore winds to be reworked in the form of coastal dunes. Dunes from where constructive wave encourage the accumulation of sand and where preventing onshore winds blow this sand inland. The wind starts to affect the mound of sand by eroding sand particles from the windward side and depositing them on the leeward side gradually this action causes the dune to migrate inland as it does so it accumulate more and more sand.

Coastal plains:-
The coastal plain is the relatively flat landforms created by the deposition of sediment over a long period of time by one or more rivers coming highland regions. The study area occurred 25 sq.km of flat coastal plain along the Tiruvottiyur to Pulicut region. The coastal plain is a flat, low laying piece of land next to the ocean are separated from the rest of the interior by nearby landforms such as mountains coastal plains can also develop when river current carry rock soil and sedimentary material into the ocean (Nsengmuuremayi 2016). Level or gently sloping region or a slightly undulating land surface produced by extensive deposition of alluvium usually adjacent to the river that periodically overflows its banks.

Barrier Island:-
These islands are long, narrow, offshore deposits of sand or sediment that run parallel to the coastline. They are separated from the mainland and it's a type of dune system that is exceptionally flat or lumpy areas of sand that form by a wave and tidal action parallel to the mainland coast. The area of Pulicut Lake occurred one barrier island north part of the study area. The length and width of the barrier and overall morphology of barrier coast are related to parameters containing tidal range, wave energy, sediment supply, sea-level trends and basement controls. Barrier islands are very important for reducing the divesting effect of wind and waves and for absorbing storm energy. They are also imported marine habitats that support commercially important fish species as well as birds, sea turtles, and other wildlife species.

Strandlines:-
The study area contains two strand lines it is a broad belt of sand along a shoreline with a surface exhibiting well defined parallel sand ridges separated by shallow swales. A strand plaindiffers from a barrier island in that it lacks either the lagoons or tidal marshes that isolated barrier islands from the shoreline. The strand plain is directly attached strand plain typically are created by the redistribution by waves and longshore current of coarse sediment on either side of a river mouth. Beach ridges include all relict stand plain ridges, whether dominated by wave/swash-built or by Aeolian lithesome. A strand line refers collectively to the assemblages of various features characteristics of the former coastal area the strand lines here represent the transgression and regression process.

Lagoons:-
A lagoon is the shallow body of water separated from a larger body of water by Barrier Island of reefs. The inside of Ennore estuary has lagoon they have also been identified as occurring on mixed sand and gravel coastline. Coastal

lagoons from along gently sloping coasts where barrier islands or reefs can develop off-shore, and the sea level rise is rising relative to the land along the shore, coastal lagoons do not from a long steep or rocky coast or if the range of tides is more than 4 meters due to the gentle slope of the coast the coastal lagoons are shallow. The lagoons are sensitive to change in sea level due to global warming. Coastal lagoons are young and dynamic and many be short lived in the geological term. Coastal lagoons are usually connected to the open ocean.

Mudflat:-

Mudflat is a flat area containing 6 sq.km of the study area. Mudflatsare fluid to a mixture of finely divided particles and solid materials mainly silt, clay and water they are associated with the sheltered environment like lagoons, estuaries and another embayment the barrier beaches occurring on the seaward side of the backwaters create a sheltered environment which has favored the development of mud flat. Mudflats are developed where enough fine sediments are available and the wave action is not strong enough to disturb the sediments. This area is very suitable sites for the deposition of mud flats because of the availability of sediments monthly suspended very fine grained. Are wide expanses of fine grained soft mud along the shore they generally consist of deposit of clay, silt, oozes etc. they are further classified into high tidal, subtidal and supratidal mudflats, intertidal slopes and subtidal zones. High tide tidal flats are more or less flat and are near the high – water line deposition is provided by the highest tides. The intertidal slope is the area of instability and is affected by daily tides.

Salt marshes:-

Low laying Athipettu area that is stabilized by cordgrasses and flooded by daily tidal activity. Salt marshes are salty because they are flooded by seawater every day. The study area contained 2 sq.km marshy because their ground is composed of grass and peat. The more often area is flooded, the more saline it is planted living in salt marshes have different tolerance to salt. Those with higher tolerance and found in the low marsh, and those with lower tolerance to salt are found in the high marsh zones. Plants from one marsh zone are never found the other. Salt marshes serve as the transition from the ocean to the land, where fresh and salt water mix. Salt marsh plants are salt tolerant and adapted to water levels that fluctuate with the tide. Tide carry in nutrients that stimulate plant growth in the marsh and carry out organic material

Fluvial landforms:-

The fluvial landform process associated with rivers and streams and the deposits and landform created by them. Coastal lowlands contain a variety of landforms most of which are geologically young. Today coastal landforms are quite recent their formation and properties depend in part on whether fluvial process interacted with the marine process. The combined actions of fluvial and marine process determine whether or not a depositional body can form at the mouth of a river and what kind of body will form.

Estuary:-

An estuary is a partially enclosed coastal body of brackish water with one or more rivers or streams flowing into it and with a free connection to the open sea. The estuary is otherwise known as where the salt water and fresh water mix. The study area have included Ennore estuary and it is very vast and extent from Tazhamkuppam to Tiruvottiyur. Estuaries and their surroundings wetlands are bodies of water usually found where rivers meet the sea. Estuaries are home to single plant and animal communities that have adapted to brackish water a blend of fresh water draining from the land and salty seawater. Estuaries are among the most productive ecosystems in the world many animals rely on estuaries for food.Estuarine environments are among the most productive on earth, creating more organic matter each year than comparably-sized areas of forest, grassland or agricultural land. The sheltered waters of estuaries also support unique communities of plants and animals specially adapted to life at the margin of the sea.

Figure 3:-Sand Dune.

Figure 4:-SandBerm.

Figure 5:-Sandy Beach.
Figure 6:-Sand Ripple.

Figure 7:-EnnoreEstuary.

Figure 8:-Coastal Plain Area.

Figure 9:-Salt Marshes.

Back swamps:-
Back swamps are the section of floodplain where a deposit of fine silts and clays settle after a flood. These are usually lying behind a stream's natural levees are located some distance away from the stream channel on the flood plain when water spills over onto the flood plain. The fine-grained alluvium holds much water and drains rather slowly creating altered areas back swamps are retained water that might cause severe flooding downstream. Some area has identified with back swamps and that contains thevery small area.

Tidal creek:-
Any inlet through which water flows alternatively towards landward with the rising tide and seaward with the falling tide is called as tidal creeks on inlets. Inlet may be permanent or temporary. Kalikuppam location south one permanent inlet through which water flows alternatively towards land with the rising tide and seaward with the falling tide throughout the year is seen. Is a tidal water channel in the coast creeks may often dry to a muddy channel with little or no flow at low tide but often with significant depth of water at high tide, creek are seen mostly in the southern region and some in the northern region of the study area, which includes the Ennore creek. The mouth of certain paleochannels is also seen as present day creeks in the study area.

River and stream:-
The river is a natural flowing watercourse, the river flowing over gently sloping ground begin to curve backs and forth across the landscape the moving water washes away the sediment like sand and mud. The stream is a narrow river and it also a body of water. Rivers in the study area covers nearly 4 Sq. km. all rivers are carrying flood during monsoons.

Conclusion:-

The attempt to determine the coastal geomorphology from Tiruvottiyur to Pulicat by using Landsat- 8 OLI data. The present study shows the satellite remote sensing based coastal geomorphological features mapping is very useful and very effective for getting the result of coastal geomorphology. The study has been conducted with Landsat- 8 OLI data; the study area falling the coastal area Tamil Nadu shows major geomorphological landforms under the influence of the coastal parameters.

The geomorphological features are classified by two that is marine landforms and fluvial landforms. The study area is marked by diverse geomorphic features of these two landforms with the help of the field validation. The coastal geomorphic features clearly established the sea level oscillations and variations in climatic conditions along this study area.

References:-

1. Aringoli, D., Calista, M., Gentili, B., Pambianchi, G., Sciarrab, N., (2008): Geomorphological Features and 3d Modeling of Montelparo Mass Movement, Engineering Geology99, pp.70-84.
2. Arulbalaji, P., Gurugnanam, B., (2015): Geomorphological Changes Assessment Using Remote Sensing and GIs in Salem District, Tamil Nadu, India, Int.J.Inf.Res.Rev, pp.327-330.
3. Beau, B., Whitney, James., Hengesh, V., (2015): Geomorphological Evidence for Late Quartarnary Tectonic Deformation of the Cape Region, Coastal West Central Australia, Geomorphology241, pp.160-174.
4. Chandra Giri., Bruce Pengra., Zhiliang Zhu., Ashbindu Singh., Larry L. Tieszen., (2007): Monitoring Mangrove Forest Dynamics Of The Sundarbans In Bangladesh And India Using Multi Temporal Satellite Data From 1973 to 2000, Estuarine, Coastal and Shelf Science,pp.91-100.
5. David Livingstone., Jonathan Raper., Timothy Mc Carthy., (1999): Integrating Aerial Videography and Digital Pholtography with Terrain Modelling an Application for Coastal Geomorphology, *Geomorphology 23, pp.77-92.*
6. Flemming, B. W., Hanson, J.D., (2011): Estarine and Coastal Geology and Geomorphology- A Synthesis.
7. Gurugnanam, B., Venkitaraman, A.T.V.R., Arunkumar, M., Biravi, S., (2013): Digital Satellite Data Based Geomorphology Interpretation and Its Role in Niligiri Landslides Study Using GPS and GIS, Clear Int.J.Res.Appl.Geosci, pp.1-10.
8. Gerardo M.E Perillo., (1995): Geomorphology and Sedimentology of Estuaries an Introduction, Geomorphology and Sedimentology of Estuaries, Development in Sedimentology 53.
9. Jagannadha Rao, M., Greeshma Gireesh, A. G., Avatharam, P., Anil, N.C., Karuna Karudu, T., (2012): Studies on Coastal Geomorphology along Visakapatanam to Bhimunipatanam, East Coast Of India, J.Ind.Geophys. Union, pp.179-187.
10. Joann Mossa., (2016): The Changing Geomorphology of the Atchafalaya River Louisiana a Historical Perspective, Geomorphology252, pp.112-127.
11. Kaliraj, S., Chandrasekar, N., Ramachandran, K.K., (2017): Mapping Of Coastal Land Forms And Volumetric Analysis In The South West Coast Of Kanyakumari, South India Using Remote Sensing and GIS Techniques, The Egyptian Journal Of Remote Sensing And Space Sciences.
12. Kenneth Pye., Simon, J, Boltt., (2014): The Geomorphology of UK Estuaries the Role of Geological Controls Antecedent Condition and Human Activities, Estuarine Coastal And Shelf Science,pp.1-19.
13. Nsengumuremyi Donet., Mukesh, M.V., Kumaravel S., Rajmohan R., Premkumar R., Immanual David T., (2016): A Study On Dissipation Of Coastal Geomorphological Features In Part Of East Coast From Cuddalore To Chidambaram, Tamil Nadu Using Remote Sensing And GIS Techniques. Int.J.Adv.Res, pp235-245.
14. Narayana, A.C., Tatavarti, R., Shinu, N., Subeer, A., (2007): Tsunami of December 26, 2004 on The South West Coast Of India Post Tsunami Geomorphology and Sediment Characteristic, Marine Geology 242, pp.155-168.
15. Pieter, G.E.F., Augustinus., (1995): Geomorphology and Sedimentology of Mangroves, Geomorphology and Sedimentology of Estuaries Development in Sedimentology 53.
16. Paul A. Gares., Douglas J. Sherman., Karl F. Nordstrom., (1994): Geomorphology and Natural Hazard, Geomorphology, pp. 1-18.
17. Patrick A. Hesp., Marie Helene., Ruz Arnaud Hequette., Denis marin., Graziela miotdaSilva., (2015): Geomorphology And Dynamic Of A Travelling Cuspate Foreland,Authie Estuary Frannce, Geomorphology 5445.
18. Ruta B.Limaye., Kumaran, K.P.N., Padmalal, D., (2015): Mangrove Habitate Dynamic in Response to Holocene Sea Level and Climate Changes Along South West Coast Of India, Quaternary International 325, pp.116-125.
19. Sulaimi J .Al., Mukhopadhyay, A., (2000): An Overview of the Surface and near Surface Geology Geomorphology and Natural Resource of Kuwaith. Earth Science Reviews, pp. 227-267.
20. Sushama Prasad., Pandarinath, K., Gupta, S.K., (1998): Geomorphology Techtonism and Sedimentation in the Nal Region, Western India,Geomorphology25, pp.207-223.