DEPARTMENT OF ENVIRONMENTAL SCIENCES
UNIVERSITY OF KERALA

(Reaccredited by NAAC with 'A^{++}' grade)

Kariavattom Campus – 695 581, Thiruvananthapuram, Kerala

Ph. 91-471- 2308146 hodenvscience@gmail.com

www.keralauniversity.ac.in

23.08.2024

CERTIFICATE

This is to certify that Ms. SOWFIYA M, Register No:6152210018, M.Sc. Environmental Sciences student, All Saints' College, Trivandrum has completed her internship as part of the Degree of Master of Science in Environmental Sciences under my supervision and guidance at Department of Environmental Sciences, University of Kerala, Karyavattom. The internship duration of two weeks has been met by the candidate from the time of period of 02.05.2024 to 21.05.2024.

23/8/24

Head of the Department

DEPT. OF ENVIRONMENTAL SCIENCES KARIAVATTOM

Dr. SABU JOSEPH
Professor and Head
Dept. of Environmental Scien
Dean, Faculty of Applied Scie
University of Kerala, Kariavat
Thiruvananthapuram- 6955

REMOTE SENSING TOOLS AND GIS APPLICATIONS IN LANDSURFACE TEMPERATURE CALCULATIONS AND CLASSIFICATION OF LAND USE/LAND COVER PATTERNS.

INTERNSHIP REPORT

Submitted to

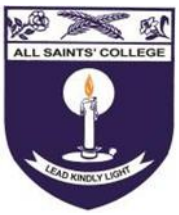
DEPARTMENT OF ENVIRONMENTAL SCIENCES

KERALA UNIVERSITY, KARYAVATTOM

Submitted by

SOWFIYA M

61522100018



DEPARTMENT OF ENVIRONMENTAL SCIENCES ALL SAINTS' COLLEGE,

THIRUVANANTHAPURAM

MAY 2024

DECLARATION

I hereby declare that the presented internship report entitled "**REMOTE SENSING TOOLS AND GIS APPLICATIONS IN LANDSURFACE TEMPERATURE CALCULATIONS AND CLASSIFICATION OF LAND USE/LAND COVER PATTERNS**" is an authentic record of study carried out by me under the supervision and guidance of Dr. Sabu Joseph ,Head of the Department , Department of Environmental Sciences ,University of Kerala, in the partial fulfilment of requirement of Master of Science degree work and no parts of it has been presented in any other purpose work has not been undertaken or submitted elsewhere in connection with any other academic course and the opinions furnished in this report is entirely my own.

Date: January 2024

Place: Thiruvanthapuram

SOWFIYA M

ACKNOWLEDGEMENT

I would like to express my special thanks to the Department of Environmental Sciences, University of Kerala ,for giving this wonderful opportunity, it was a great opportunity to undertake this internship. I express my special thanks to Dr Sabu Joseph to utilize the facilities for our internship.

I wish to express my gratitude to Ms Aswathy Asok for guiding me and helping me throughout the internship programme. I am thankful to Dr. Reshma. K Assistant Professor and Head of Post Graduate Department of Environmental Sciences, All Saints' College, Thiruvanthauram, for providing me with all necessary help and support for the successful completion of my internship.

Finally, I would like to thank my parents, and my friends for their unwavering support and encouragement throughout this journey. I am also grateful to God Almighty for His divine guidance and grace. Their love, blessings, and support have been a driving force behind my accomplishments.

Thiruvanthapuram **SOWFIYA M**

Date: May 2024

INTRODUCTION

Kerala, located along India's southwestern coast, experiences diverse climatic conditions influenced by the Arabian Sea, the Western Ghats, and global climate change. Recently, Kerala has seen a noticeable temperature increase, especially in summer, impacting land surface temperature (LST) and land use land cover (LULC) patterns. This rise in temperature affects forests, agricultural lands, and urban areas, leading to ecosystem and biodiversity changes.

The increase in LST causes heat stress in urban and agricultural areas, affecting human health and productivity. It also alters vegetation and wildlife distribution, shifting land use patterns. Understanding the relationship between LST and LULC is crucial for sustainable land management and climate adaptation in Kerala.

The study focuses on Taliparamba taluk in Kannur district, covering 556.10 sq.km, with a diverse economy reliant on agriculture. The area features plantations of rubber, pepper, cashew, and coconut.

Land Surface Temperature (LST)

LST, as defined by NASA, refers to the thermal condition of the Earth's surface observed from a specific geographical point. It differs from air temperature data and is crucial for understanding global weather patterns and climatic conditions. Factors like urbanization and deforestation contribute to the steady increase in LST, particularly in agricultural areas. Depleted water tables due to agricultural water consumption also elevate temperatures. LST is used to delineate urban heat islands, verify climate models, and assess drought conditions.

STUDY AREA

The study area, Taliparamba taluk is located at the northernmost tip of Kannur district of Kerala. It lies between latitudes 110 54'52.13" N to 120 16'37.59" N and between longitudes 750 15'48.77" E to 750 34'6.08" E. It has the area of 556.10 sq.km. It consists of 13-gram panchayats and one municipality. Taliparamba Taluk encompasses both highland and midland regions, featuring plantations of rubber, pepper, cashew, and coconut. Its economy primarily relies on agriculture.

METHODOLOGY

METHODOLOGY EMPLOYED

1.Satellite data extraction.

In this study, a methodology for analysing land surface temperature dynamics using satellite data is proposed. The first step of the methodology involves data collection from satellite sources. To collect the necessary data, USGIS earth explorer website was accessed. From there, the search criteria were filled in, selecting the geocoding method of address/place and entering the location name "Kannur". The date range was specified as 1/1/2023 to 30/3/2024 and the cloud cover range was set from 0% to 30% . Data sets from Landsat 8-9 Operational Land Imager and Thermal Infrared Sensor Collection 2 Level-2 was chosen for the study. The extracted land surface temperature data is then used for further analysis and modelling. Date range was given as 1/1/2023 to 30/3/2024 and the cloud cover range was specified as 0% to 30%. A decent image with very less cloud cover over the study area on the date 02/06/2024 was obtained.

For the year 1997, the image on 01/02/1997 with clarity was obtained from Landsat 4-5 Thematic Mapper Collection 2 Level 2, data sets. The various bands from these two both data sets and other details corresponding to it is utilized to carry out the study further.

2.Shape file generation

The required shapefile Taluks level boundary map of India was downloaded from ‘diva-gis.org’ and Taliparamba Taluk Map was extracted using ArcMap 10.8.

3. LST calculation

The Land Surface Temperature can be estimated or calculated using the Landsat 8 thermal bands. It simply requires applying a set of equations through a raster image calculator in arc map. The image file downloaded from USGIS is unzipped and the required thermal bands is opened in ARRCMAP as layer. For LANDSAT 5, band six is the thermal band and band 10 for LANDSAT 9. Bands 4 and 5 is used for calculating

Normal Difference Vegetation Index (NDVI). To calculate the Land Surface Temperature, the formula mentioned in USGS website is utilized. The process is synthesized in six steps below:

1.- Calculation of TOA (Top of Atmospheric) spectral radiance.

TOA (L) = ML *Q Cal + AL

The equation was solved using the Raster Calculator tool in ArcMap.

2.- Conversion of TOA to Brightness Temperature conversion

BT = (K2 / (ln (K1 / L) + 1))

where:

BT = (1329.2405 / Ln ((799.0284 / "%TOA%") + 1))

3.- Calculation of the NDVI

NDVI = (Band 5 – Band 4) / (Band 5 + Band 4)

The calculation of the NDVI is important because, subsequently, the proportion of vegetation (Pv), which is highly related to the NDVI, and emissivity (ε), which is related to the Pv, must be calculated.

NDVI = Float(Band 5 – Band 4) / Float(Band 5 + Band 4)

4.- Calculation of the proportion of vegetation Pv

Pv = Square ((NDVI – NDVImin) / (NDVImax – NDVImin))

Pv = Square(("NDVI" – 0.216901) / (0.632267 – 0.216901))

5.- Calculation of Emissivity ε

ε = 0.004 * Pv + 0.986

The formula is applied in the raster calculator, the value of 0.986 corresponds to a correction value of the equation.

6.- Calculation of the Land Surface Temperature

LST = (BT / (1 + (0.00115 * BT / 1.4388) * Ln(ε))) Finally applied the LST equation to obtain the surface temperature map. (GIScrack,2018)

As a result of the process developed, a map of the Land Surface Temperature is generated.

The map thus generated is clipped using the shapefile.

LU/LC CLASSIFICATION

The Land Use / Land Cover classification was done using the maximum likelihood classification in ArcMap. For this purpose, the False composite image using the visible and near Infrared bands of the respective years wear used. For the image obtained from LANDSAT 5(1997 year), bands 1,2,3 are visible bands and band 4 is the near infrared band. Meanwhile bands 2,3 and 4 are visible bands and band 5 comes under the near IR spectrum.

Land use Landcover classification was done through maximum likelihood classification. Taliparamba Taluk was categorized into the following classes: waterbody, build area, open area, agriculture, plantation,

mixed vegetation, and forest cover.

Class	Landcover	Description
1	Water body	Rivers, streams, lakes, canals, ponds.
2	Build area	Residential buildings, intuitions, constructed roads, concreted pavements, concreted grounds, commercial facilities
3.	Open area	Soils, rock surfaces, or sand surface, where vegetation or constructed buildings are absent
4.	Agriculture	Fields used for cultivation of variety of food produces like paddy field.
5.	Plantation	Coconut plantation, rubber plantations arecanut, black pepper, cardamum
6.	Mixed vegetation	Vegetation including tall tress, short trees, shrubs and plants that come in clusters.
7.	Forest	Forest cover along the western ghats and adjacent regions.

Description of land cover and land use classes

5 .Area Calculation

A new field was added in the attribute table. Area was calculated using the Field Calculator by giving the following equation: Count *900/1000000

6. Accuracy assessment

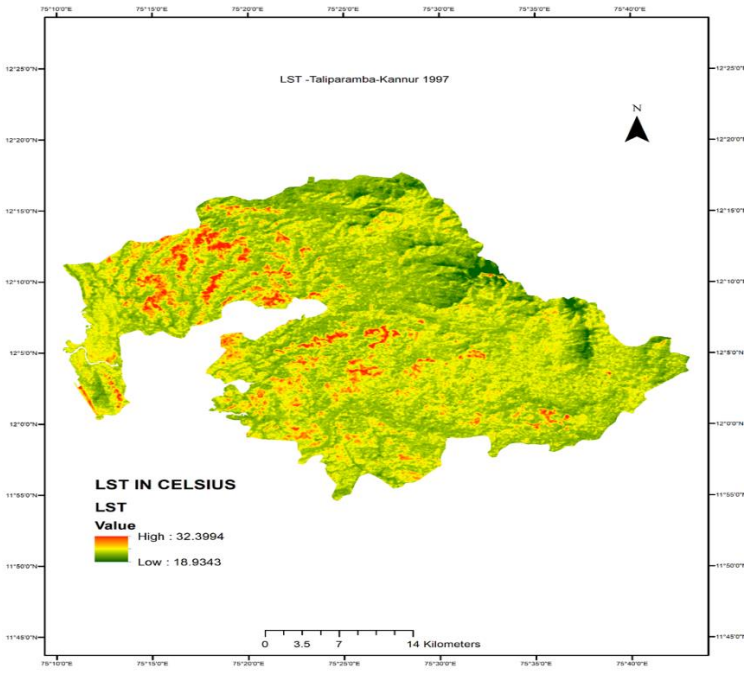
To provide credibility for the data generated in LU/LC mapping, accuracy assessment was carried out using Arc Map tools. A news shapefile was created, points were generated for each class and frequency of occurrence of each class was generated in Excel Software and accuracy was calculated.

RESULTS

Land surface temperature of 1997

The measurements of land surface temperature exhibit a notable variation, with values ranging from a maximum of 32.39 degrees Celsius to a minimum of 18.93 degrees Celsius. The peak temperature of 32.39 degrees Celsius was recorded specifically in regions characterized by barren landscapes, such as those found in Mathamangalam, as well as in densely populated urban areas like Peringome, which is situated within the Taliparamba taluk. This discernible trend in temperature fluctuations has been systematically observed across locations that encompass both densely populated settlements and areas of desolate land. In contrast, regions that are characterized by mixed agricultural practices demonstrate a temperature that is marginally lower than that recorded in urban environments and barren terrains. Furthermore, areas dominated by a diverse array of vegetation cover, which constitute a significant portion of the landscape, have been shown to exhibit a reduction in temperature, bringing it down to a

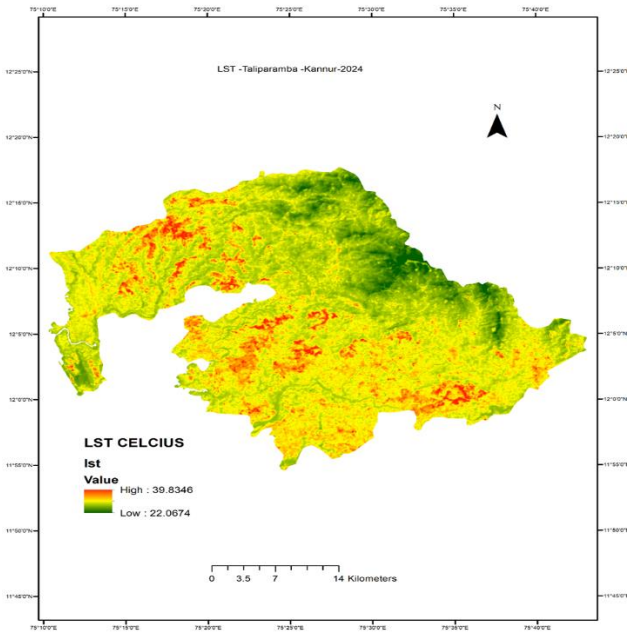
more moderate and intermediate level. It is particularly remarkable to note the significantly lower temperatures recorded in areas that are densely covered by forest vegetation, which consistently show the lowest temperature measurement of 18.93 degrees Celsius.



Land Surface Temperature 2024.

The analysis of the land surface temperature recorded for the year 2024 within the geographical confines of Taliparamba Taluk, specifically during the month of February, reveals a noteworthy temperature spectrum that fluctuates between an impressive high of 39.83 degrees Celsius and a low of 22.06 degrees Celsius. This noteworthy increase in temperature, reaching a peak of 39.83 degrees Celsius, can primarily be attributed to the rapid phenomenon of urbanization and the subsequent expansion of built-up areas, particularly evident in locales such as Kuttiyeri, Payannur, and Korom, which have experienced significant infrastructural development. Furthermore, areas characterized by barrenness, such as Kalliad, in addition to grassland regions including Paithal Mala, which is recognized as a

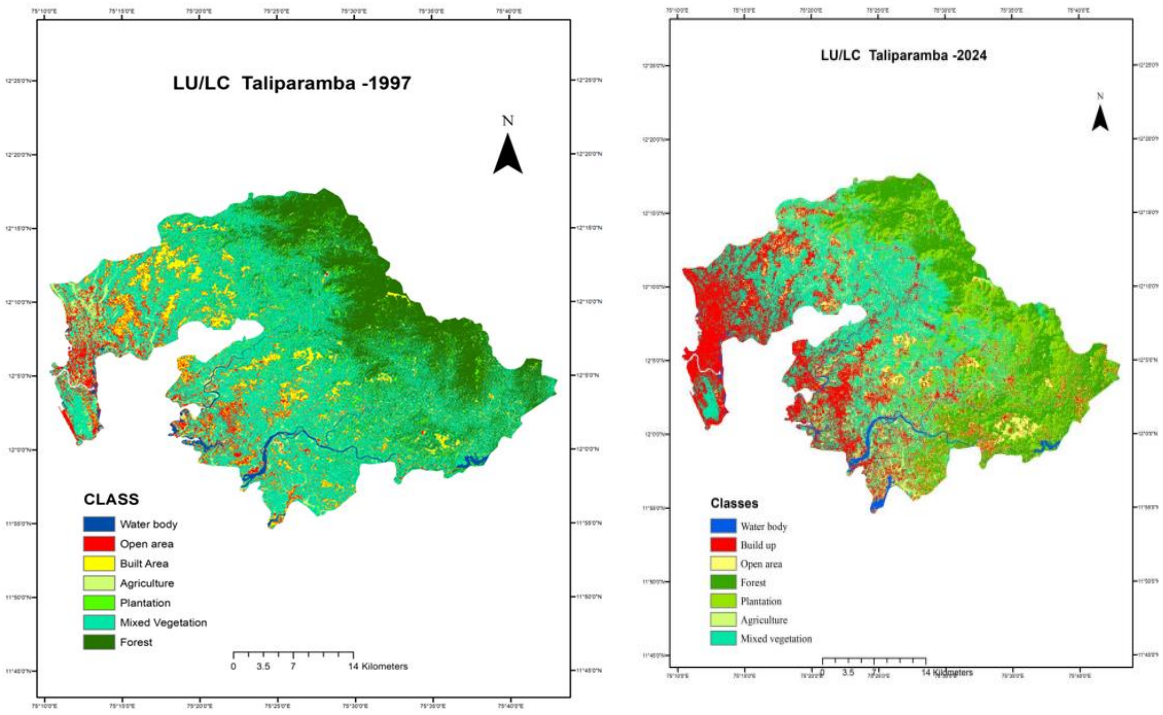
hill station, have also demonstrated elevated temperature levels, indicative of the influence of land use and vegetation cover on local climatic conditions.



Land Use Land Cover Map (LU/LC) -1997

The cartographic representation produced through the utilization of ArcGIS software indicated a commendable level of precision, specifically an accuracy rate of 85 percent as determined by the accuracy assessment methodologies inherent to ArcGIS itself. Fig 5.1 shows the LU/LC map of the year 1997 generated through the same software. A comprehensive evaluation of the map revealed that an expanse measuring a total of 19 square kilometres is encompassed by water bodies, which include not only rivers but also their various tributaries, streams, lagoons, and backwaters, thereby illustrating the extensive hydrological features present in the region. Furthermore, an extensive area measuring approximately 107 square kilometres has been identified as being occupied by human settlements, institutions, and infrastructural elements such as roads and pathways, highlighting the anthropogenic modifications to the landscape. The category designated as

open area contributes significantly to the overall land utilization, encompassing a total of 95 square kilometres within the larger geographical framework. In addition, an area of 60 square kilometres has been designated for agricultural activities, which entails land that has been either utilized for farming purposes or cleared for agricultural development. The land allocated for plantation activities occupies a considerable area of 48 square kilometres, further illustrating the extent of cultivated land in the region. Notably, mixed vegetation constitutes the predominant type of land cover, accounting for an impressive area of approximately 624 square kilometres, thereby reflecting the biodiversity and ecological variety of the environment. A detailed assessment calculated that the forest cover spans an expansive area of 364 square kilometres, which extends across and along the contours of the Western Ghats that border the state of Kerala. Specific regions such as Kanjirakolli, Ezharakund, and Chathamangalam are among the notable areas characterized by substantial forest cover, indicating the ecological significance of these locales.



Land Use Land Cover of Taliparamba ,2024

The region that falls under the classification of covered land has expanded to encompass a total of 18 square kilometres, a figure that notably includes the significant waterways of the Valapattanam River and the Perumba River within its geographic boundaries. Furthermore, there has been a notable increase in the extent of built-up areas, which has now reached an impressive total of 290 square kilometres, reflecting substantial urbanization and development in the region. In contrast, the expanse of land categorized as barren has been reported to occupy an area that is nearly 54 square kilometres, indicating a considerable portion of land that remains unutilized or devoid of vegetation. The area designated for plantation activities has risen to an extent of up to 196 square kilometres, highlighting the region's agricultural potential and efforts towards cultivation. Additionally, the land that has been systematically cleared for agricultural purposes amounts to approximately 134 square kilometres, suggesting active land management practices aimed at enhancing agricultural productivity. Mixed vegetation has been observed to be dispersed throughout an area measuring approximately 384 square kilometres, showcasing a diverse ecological landscape within the region. Lastly, it is imperative to note that the total forest cover has witnessed a significant decline, now reduced to an area of 241 square kilometres, raising concerns regarding environmental sustainability and biodiversity conservation in the area.

DISCUSSION

Humanity faces a daunting reality as we grapple with the imminent challenges posed by the escalating climate crisis. As forecasts for the coming decades reveal alarming trends, such as increased risks of lethal heat waves affecting up to 1.2 billion people and significant economic losses due to flooding, the need for proactive measures becomes all the more

pressing. urbanization significantly contributes to rising temperatures in Lagos, necessitating immediate action to incorporate sustainable practices in urban planning.

Strategies such as increasing vegetated areas and implementing green infrastructure are recommended to mitigate the UHI effect and improve urban climate resilience. The study contributes to the understanding of urban heat dynamics and emphasizes the importance of integrating remote sensing data in urban environmental management

CONCLUSION

The primary objective of this study was to meticulously investigate and analyse the intricate interplay between various land use practices and the presence of vegetation in relation to the alterations in temperature that occur as a result of these factors. The geographical area selected for this comprehensive study was the Taliparamba taluk, which is situated within the boundaries of the Kannur district. In summary, the project work successfully identified and evaluated a multitude of land use practices that have a discernible influence on the phenomenon of rising temperatures. This research underscores the urgent necessity to enhance green cover through the planting of tall, dense trees and the establishment of expansive canopies while simultaneously striving to minimize the prevalence of constructed and concrete surfaces. The recorded temperature peak reaching an alarming 39 degrees Celsius in urban regions has detrimental implications for human productivity, particularly in terms of thermal comfort, rendering individuals more susceptible to heat-related illnesses such as heat strokes, while simultaneously diminishing biodiversity and jeopardizing food security by adversely affecting the agricultural sector. Agriculture is the sector most vulnerable to climate change due to its high dependence on climate and weather conditions. Climate change is a main challenge for agriculture, food security and rural livelihoods for millions of people in India. Among India’s population of more than one billion people, about

68% are directly or indirectly involved in the agricultural sector. This sector is particularly vulnerable to present-day climate variability (Sreedevi,2014). Furthermore, the escalation of land surface temperatures contributes to global warming, which in turn triggers a cascade of catastrophic events including heat waves, the warming of oceanic bodies, cloud bursts, erratic rainfall patterns, and creates an environment conducive to the proliferation and increased virulence of various pathogens.

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