LANDSURFACE TEMPRATURE AND SOIL MOISTURE ITS IMPACT ON VEGETATION IN SOUTH EASTERN PART OF KAMRUP DISTRICT, ASSAM USING GEOSPATIAL TOOL*

BY

Ambika Rabha♣
Research Scholar, Department of Geography, Gauhati University, India
Email: ambikarabha04@gmail.com

Dr. Niranjan Bhattacharjee♣
HoD and Associate Professor, Department of Geography, Pandu College, Guwahati, India
Email: nbc_2008@rediffmail.com

ABSTRACT

Land surface temperature (LST) defines the normal heat of an area. LST is an important influencing component of vegetation and moisture present in an area. Relationship between the LST and Normalized difference vegetation index (NDVI) is strongly negative, and LST and Normalized difference moisture index (NDMI) is also strongly negative but the co-relation with the NDVI and NDMI result show the positive relationship. In the month of data acquisition and estimation outcome express the increasing LST rate and decreasing NDVI rate. Consequences of the increasing Global warming, deforestation, urban sprawl, and population is the main issue began to intensifying the Land surface temperature. While the study period in the month of December, comparatively degraded the health of the vegetation and the moisture also reduced but the land surface temperature rises up. The Study area is also not exceptional in this regard. The south eastern part of the Kamrup district is highly effected due to the deforestation and other man-made activities as it is noticed by the researchers after close verification of their aspects like surface temperature, soil moisture etc. The South eastern part of Kamrup district LST and its relation with NDVI and NDMI scientifically analysis with the help of satellite imagery using the RS and GIS techniques. In the present study an attempt has been made to analytically determining the relationship between the Land surface temperature (LST) with the NDVI (Normalized difference vegetation index) and the NDMI (Normalized difference Moisture Index) and their adverse effect on environment in the study area.

KEYWORDS: Land surface temperature (LST), Normalized difference vegetation index (NDVI), Normalized difference moisture index (NDMI), Correlation, Remote Sensing and Geographical Information System.

Received 28 Dec 2021, Accepted 22 Jan 2022, Published 17 Feb 2022

♣ Correspondence Author: Ambika Rabha

INTRODUCTION

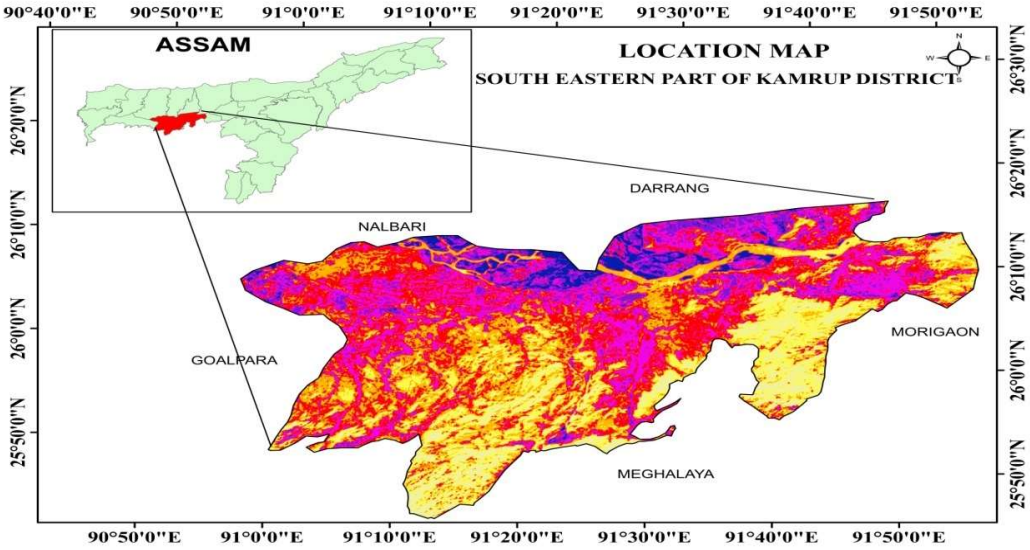
Land Surface Temperature (LST) can be defined as the temperature felt when the land surface is touched with the hands or it is the skin temperature of the ground [1,2,3,10]. It is benefits for high resolution data, consistent and repetitive coverage and able to prepare map of the earth's surface condition [4]. Land surface temperature (LST) is a significant parameter in surface and atmospheric systems which can be used to describe the physical processes of energy and water exchange and their effect on the environment. In more general terms LST can be defined as hotness of surface of earth, from RS satellite's perspective, the surface is whatever it sees when it looks through the atmosphere to the ground [12]. NDVI is highly useful in detecting the surface features of the visible area which are extremely beneficial for municipal planning and management [7]. Usually spatio-temporal surface temperature fluctuated all over the Assam due to prevailing monsoon and typical terrain condition of the area. In the specific estimated time from the month of November it is observed decreasing trend of temperature and simultaneously the NDVI and NDMI also decrease. Increasing NDVI threshold value denoted that health condition of the vegetation is very well but the decrease threshold value indicates the less vegetation index which is well substantiated in case of south eastern part of the Kamrup district. The remote sensing data has many application areas including: land cover classification, soil moisture measurement, forest type classification, measurement of liquid water content of vegetation, snow mapping, sea ice type classification, oceanography [8]. There are several ways to retrieve land surface temperature using satellite imagery [5]. Earth's surface features are monitored using remote sensing multispectral imageries on regular basis and among them vegetation dynamics plays a vital role as it has an influence on regulating the global climate and also reducing and predicting the effects of global warming [9]. Data obtained from remote sensing are based on the reflectance properties of the target and vegetation has higher reflectance in the near infrared regions of the electromagnetic spectrum [10]. The remote sensing method of estimating surface temperature has the following advantages; large area coverage, ability to estimate temperature in accessible areas, very efficient and effective method, and above all, is cost effective [5]. Therefore, in case of south eastern part of Kamrup district the Remote sensing date widely used to determine the influencing aspects. According to surface object reflectance LST has been changed and acquiring information showed LST influences the negative impact on NDVI and NDMI in the study area.

STUDY AREA

The present study area extends over the $91^0 54' 27.912''$E to $91^0 0' 12.242''$E longitude and $26^0 9' 48.128''$N to $25^0 49' 28.577''$N latitude. The mighty Brahmaputra River flowing through the middle of the study area. The study area bounded by Darrang, Nalbari districts and Meghalaya state in the north and south, on the other hand the district is covered with and Marigaon and Goalpara district in the east and western part containing 2750.40 km^2. The topography of the focus area is characterised by the typical terrain condition like floodplain and rarely found the hills and hillocks in the southern part of the district as the region is situated in the tropical monsoon climate area. In this area mostly covered with deciduous

trees along with small patch of the evergreen trees. In the month of December, the deciduous forests lose their leaves.

Fig1: Locational Map



DATABASE AND METHODOLOGY

To carry out the work basically used study area data is collected from the secondary sources. Among the other sources USGS earth explorer is the main source of the data collection. Basically, to find out the result of the study the Landsat -5 data used for the year of 2010 and Landsat – 8 for the year 2020. Landsat-8 (OLI) data Band -10 and Band -6 thermal band are used for the LST calculation and RED, NIR and SWIR band are used. RS and Arc GIS software has been used to find out the threshold value, mapping and analyzed and relationship. To prepare the NDVI and NDMI map along with calculation all the above-mentioned data are used. The correlation calculation has been done with the help of using the Microsoft Excel software. The following formula has been adopted to prepare and find the various maps and results of the study area. These are:

1) Top of Atmosphere (TOA) Radiance: Lλ= ML*Qcal +AL
2) Brightness Temperature: BT=K2/In(k1/Lλ+1)-272.15
3) Normalized Difference Vegetation Index: NDVI= (NIR-RED)/(NIR+RED)
4) Land Surface Emissivity (LSE): PV= [(NDVI-NDVI min)/(NDVI max + NDVI min)]^2
5) Land Surface Temperature (LST): LST = (BT/1)+ W* (BT/14380)*In (E)
6) Normalized Difference Moisture Index: MNDI = (NIR-SWIR)/(NIR+SWIR) (Rabha et al.2020)

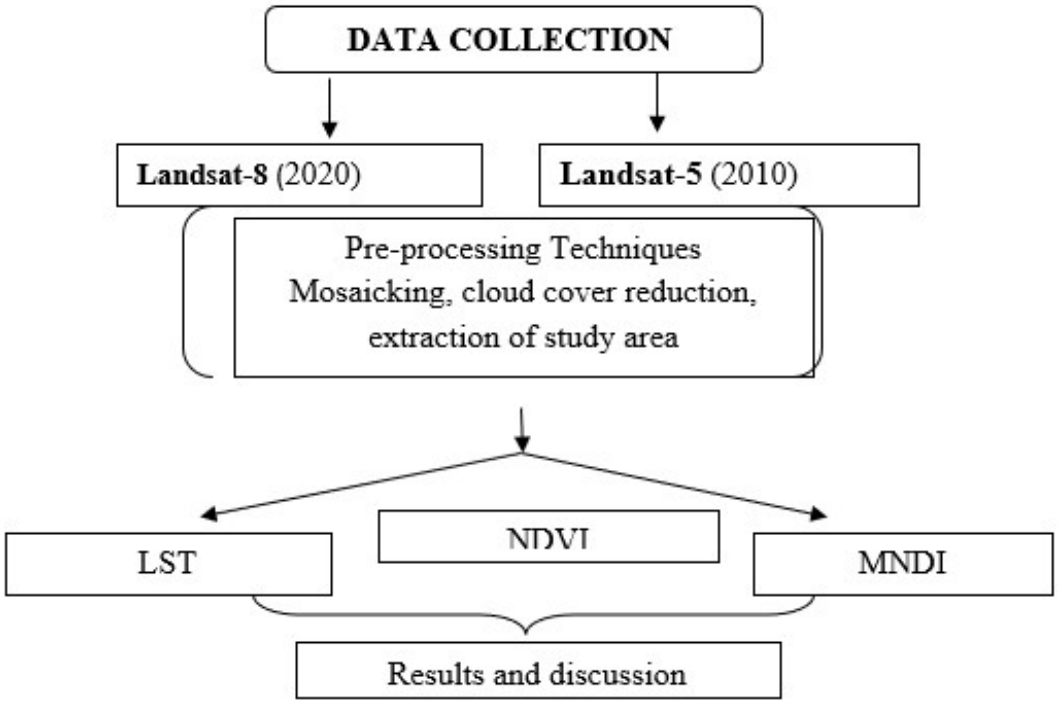
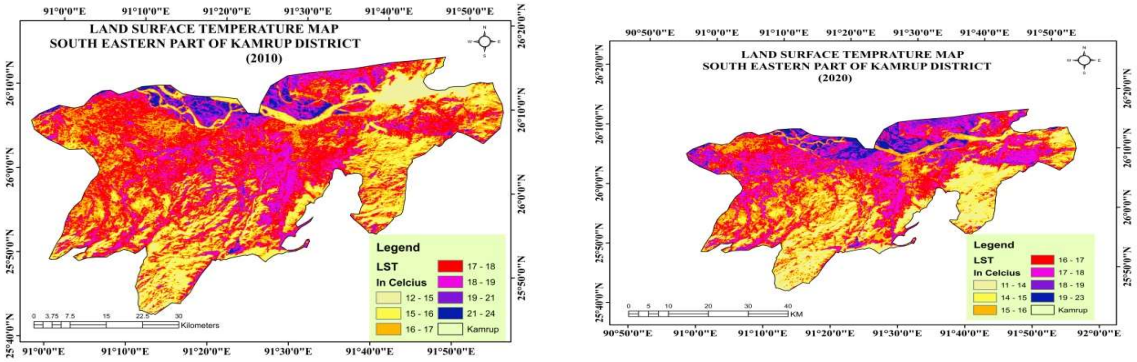


Fig2: flow chart

RESULTS AND DISCUSSION

From the analysis of the satellite images by using different geospatial tools the result has been found that the Land surface temperature rate is decreased. Therefore, it has a bit influence on the vegetation coverage and soil moisture condition of the study area. Average 1^0c land surface temperature has been decreased in the month of December during the 10 years evaluations period of time. On the other hand NDVI threshold value and NDMI threshold value show that the decrease throughout the years. Depending upon the surface object LST fluctuated.

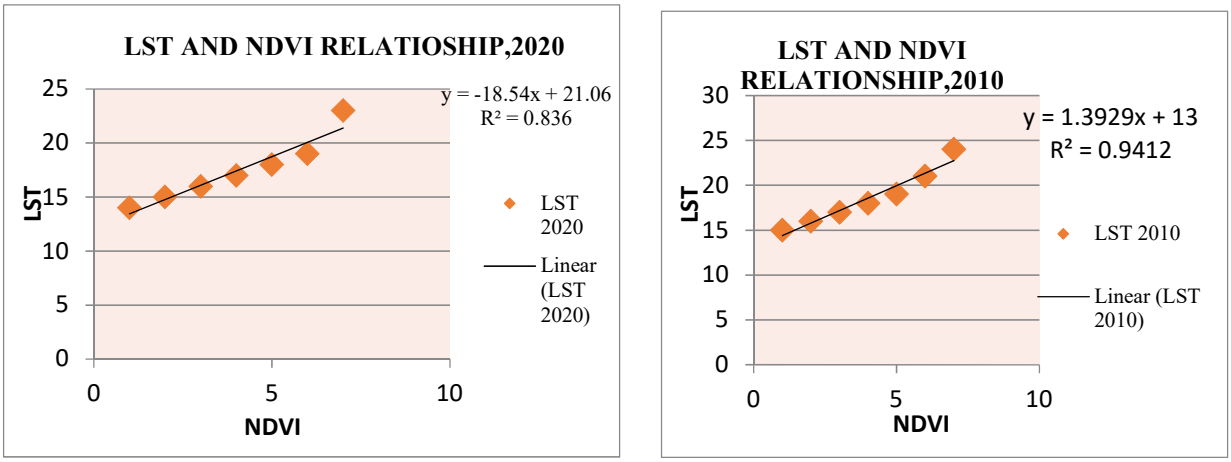


(a)
(b)

Fig3: LST Maps (a) 2010,(b) 2020

RELATIONSHIP WITH LST AND NDVI

The relationship with the LST and NDVI has been calculated and it is found that the strong negative co- relation R^2=.836(2020), R^2=0.923(2010) among the LST and NDVI. The maximum LST threshold value 23(2020), 24 (2010) and minimum threshold values are 14(2020) and 15(2010). The NDVI map result shows the highest threshold value 0.462(2020), and 0.714(2010). It refers to the healthy vegetation of the study area and lowest value displayed on the maps 0.002 (2020) (-0.141) (2010) it indicates the water as well as the built up area.



(a) (b)

Fig 4: LST and NDVI Co- Relation Graph (a) 2020,(b) 2010

Relationship with LST and NDMI

The soil moisture is depending on the climate and land surface temperature which is also depends upon the land use and vegetation covered of an area. In the present study area the relationship with LST and NDMI is approaching towards negative where the regression value is R^2= 0.516 (2020), R^2=0.771

(a) (b)

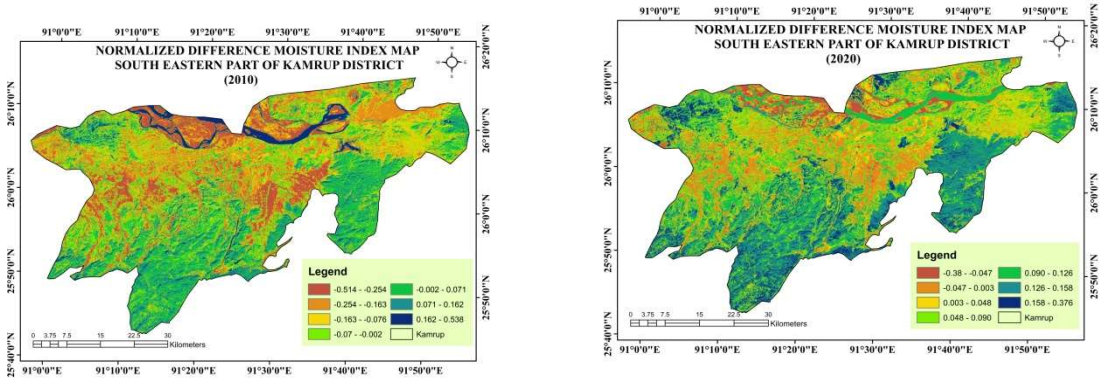
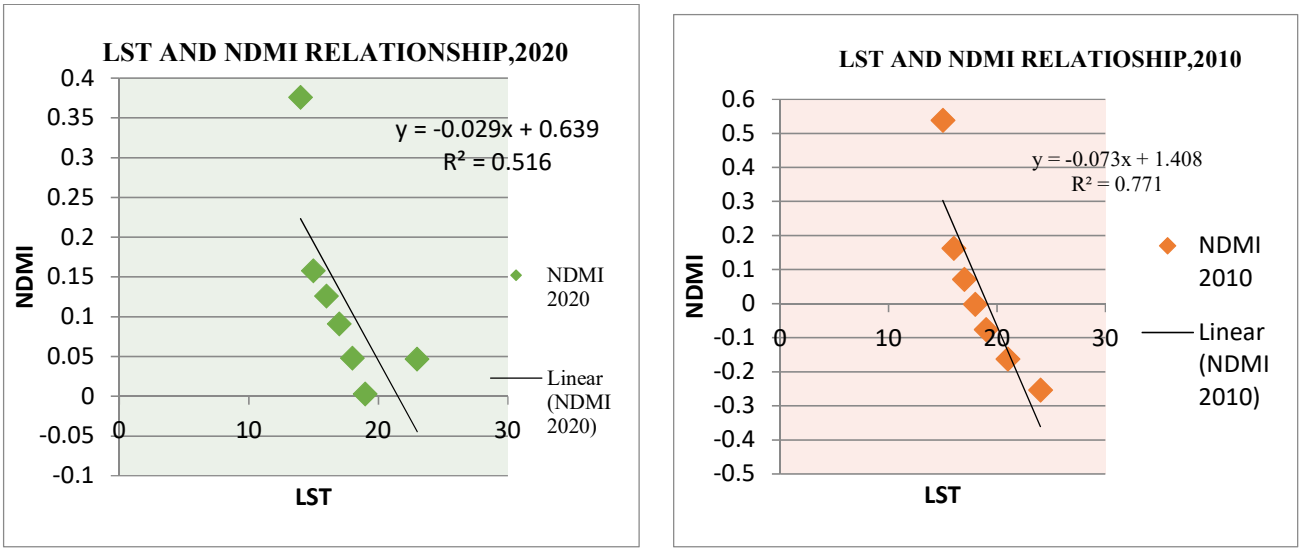


Fig5: NDMI maps (a) 2010, (b)2020

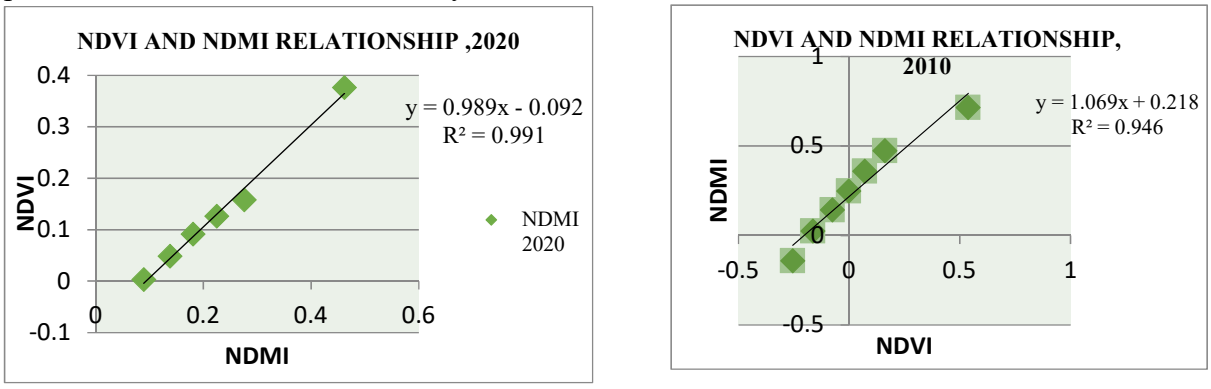


(a) (b)

Fig 6: LST and NDMI Correlation Graph (a)2020,(b)2010

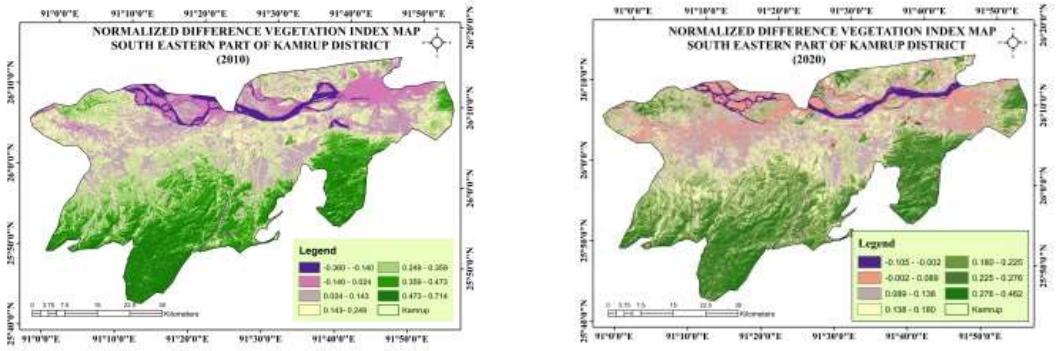
RELATIONSHIP WITH NDVI AND NDMI

The relationship in between NDVI and NDMI is found strong positive trend where, correlation is R^2= 0.785(2020), R^2=0.946. The decrease value of NDVI and NDMI value refers to sandbar, river, built-up area and the fellow land area where vegetation cover is less and also the soil moisture is less. On the other hand NDVI and NDMI threshold value is hierarchically higher orderly spread in southern part of the district which is far away from the town area.



(a) (b)

Fig7: Co- relation graph NDVI and NDMI (b)2010,(a)2020



(a) (b)

Fig8: Normalized Difference Vegetation Index Map,2010(a),2020(b)

CONCLUSION

After the analysis of south-easten part of the Kamrup district the result shows a significant decreasing trend on the land surface temperature. At the same way the value of Normalized Difference Vegetation Index threshold also decreased during evaluation period. In the month of december the satellite imagery Landsat-5 and landsat-8 reflected the less amount of the brightness and radiance, at the same time the health of the vegetation is found comparatively unhealthy because of the influnce of the soil moisutre and prevailling dry season of the area. After the close varification, calculation and analysis of all the three vital parameters i.e. LST, NDVI,and NDMI are it has been found that all are co-related with each other depending upon the time the values are decreased. To grow or to sustain a healthy environment for the survival of bio-diversity in a region like South-eastern part of the Kamrup district it is not suitable as the result found in the present study. Apart from the traditional methods the modern tools and technology like GIS and Remote sensing are more helpful for the sustainable development and future planing. Definitely it will help to cope with the different enivronmental problems like deforestation, global warming, greenhouse effect etc. as covering the news limelight.

REFERENCE

1. Definition of LST available online:http://www.springrereference.com/dos/html/chapterdb id/327143.html
2. Definition of LSTavailable online:http://earth observatory.nasa.gov/global maps/view.php?
3. Definition of LST.available online:http://www.itrs.edu/research/LST-page/LSTpage.html
4. Bora, Minakshi, and Dulal Chandra Goswami. "RS-GIS based assessment of the impact of Hatimura embankment on the channel planform of the Kolong River, Assam, India." *Geocarto International* just-accepted (2021): 1-10.

5. Aliabad, Fahime Arabi, Mohammad Zare, and Hamidreza Ghafarian Malamiri. "Comparison of the accuracy of daytime land surface temperature retrieval methods using Landsat 8 images in arid regions." *Infrared Physics & Technology* 115 (2021): 103692.

6. Bhandari, A. K., A. Kumar, and G. K. Singh. "Feature extraction using Normalized Difference Vegetation Index (NDVI): A case study of Jabalpur city." *Procedia technology* 6 (2012): 612-621.

7. Hacihaliloglu, Ilker, and M. Karta. "DCT and DWT based image compression in remote sensing images." *IEEE Antennas and Propagation Society Symposium, 2004.*. Vol. 4. IEEE, 2004.

8. Pettorelli, Nathalie, et al. "Using the satellite-derived NDVI to assess ecological responses to environmental change." *Trends in ecology & evolution* 20.9 (2005): 503-510.

9. Lillesand, Thomas, Ralph W. Kiefer, and Jonathan Chipman. *Remote sensing and image interpretation*. John Wiley & Sons, 2015.

10. Rajeshwari, A., and N. D. Mani. "Estimation of land surface temperature of Dindigul district using Landsat 8 data." *International Journal of Research in Engineering and Technology* 3.5 (2014): 122-126.

11. Borkotoky, Kasturi, et al. "Surface Morphology and Its Impacts on Vegetation Dynamics of Morigaon District Using Geospatial Techniques."

12. Rabha,Ambika,et al.” Analysis of LST changing in morigaon district, Assam Using GIS and RS.” Sambodhi 43.4(2020):2249-6661’

13. Gandhi, G. Meera, et al. "Ndvi: Vegetation change detection using remote sensing and gis–A case study of Vellore District." *Procedia Computer Science* 57 (2015): 1199-1210.

14. Méndez-Barroso, Luis A., et al. "Seasonal and interannual relations between precipitation, surface soil moisture and vegetation dynamics in the North American monsoon region." *Journal of hydrology* 377.1-2 (2009): 59-70.

15. Mallick, Javed, Yogesh Kant, and B. D. Bharath. "Estimation of land surface temperature over Delhi using Landsat-7 ETM+." *J. Ind. Geophys. Union* 12.3 (2008): 131-140.

16. Bendib, Abdelhalim, Hadda Dridi, and Mohamed Issam Kalla. "Contribution of Landsat 8 data for the estimation of land surface temperature in Batna city, Eastern Algeria." *Geocarto International* 32.5 (2017): 503-513.

17. Wang, Honglin, et al. "Drought dynamics and impacts on vegetation in China from 1982 to 2011." *Ecological Engineering* 75 (2015): 303-307.

18. Goswami, Jonali, Shreya Roy, and S. Sudhakar. "A novel approach in identification of urban hot spot using geospatial technology: a case study in Kamrup Metro District of Assam." *International Journal of Geosciences* 4.05 (2013): 898.

19. Kumari, Maya, Kiranmay Sarma, and Richa Sharma. "Using Moran's I and GIS to study the spatial pattern of land surface temperature in relation to land use/cover around a thermal power plant in Singrauli district, Madhya Pradesh, India." *Remote Sensing Applications: Society and Environment* 15 (2019): 100239.