Biological Forum – An International Journal 15(10): 164-168(2023)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Analyzing Land Use and Land Cover Changes using Geospatial Techniques, A Review

Jaskaran Singh Sohal[1] and Arun Kaushal[2]*
[1]*M.Tech. Student, Department of Soil and Water Engineering,*
Punjab Agricultural University, Ludhiana (Punjab) India.
[2]*Professor, Department of Soil and Water Engineering,*
Punjab Agricultural University, Ludhiana (Punjab) India.

(Corresponding author: Jaskaran Singh Sohal)*
(Received: 19 July 2023; Revised: 17 August 2023; Accepted: 16 September 2023; Published: 15 October 2023)
(Published by Research Trend)

ABSTRACT: Land use and land cover (LULC) changes are crucial indicators of environmental transformation and development. This study comprehensively reviews research studies that have employed geospatial techniques to analyse LULC changes in various regions. Research papers spanning different geographical locations and time periods are summarized, highlighting their methodologies, findings, and implications. These studies employ remote sensing imagery, GPS and GIS techniques to assess LULC changes, examining urban expansion, agricultural shifts, deforestation, wetland alterations, and other transformations over time. The studies emphasize the importance of accurate classification techniques, demonstrating how different algorithms yield varying results in land cover mapping. The studies also deals in into classification techniques for LULC change detection, comparing methods such as maximum likelihood classification, support vector machines, artificial neural networks, and pixel-based approaches. These investigations underline the significance of algorithm selection and optimization for achieving accurate classification results. Moreover, the study highlights the need for effective spatial analysis and ground truth verification to enhance classification accuracy. Monitoring land use and land cover changes in a timely manner is of utmost significance. This enables the implementation of appropriate control strategies aimed at safeguarding the environment and preserving our natural resources. The study was facing with great challenge's due to lack of relevant work.

Keywords: Land use and land cover, Remote sensing, Change analysis & Geographic information system.

INTRODUCTION

The analysis of land use and land cover changes using geospatial techniques has become a vital tool in understanding the dynamic transformation of Earth's surface over time. This approach involves the integration of remote sensing, geographic information systems (GIS), and various classification methods to monitor and assess shifts in land use patterns and land cover types. By utilizing satellite imagery and spatial analysis, researchers are able to track alterations in natural landscapes, urban expansion, agricultural development, and other significant changes that impact the environment and human activities. Through a combination of remote sensing data and advanced classification algorithms, studies have been conducted in different regions across the globe to investigate land use and land cover changes. These investigations provide valuable insights into the extent and impact of various factors such as urbanization, deforestation, agricultural practices, and other human and natural influences on the Earth's surface. The ability to detect and quantify these changes contributes to informed decision-making, sustainable land management, and environmental conservation efforts. This paper delves into various methods employed globally by different researchers for Land Use/Land Cover (LU/LC) classification and change analysis using Remote Sensing and Geographic Information Systems (GIS) approaches. The following different research workers provide an in-depth of these techniques.

Sumathi *et al.* (2011) analysed land use / land cover using remote sensing techniques in Pudukkottai district of Tamil Nadu. The study aimed to determine the LU/LC in the Pudukkottai District. The District has a total area of 4,663 square kilometres. The LU/LC of the study area were determined by using satellite images. The Pudukkottai District's LU/LC divisions were marked out using Arc-GIS software. The District has been divided into five Level I classes and eleven Level II subclasses. 1,691 sq. km. (39 percent) of the land is primarily used for agriculture. Water bodies make up 321 sq. km (6.88 percent), built-up land usage 1,292.65 sq. km (27.72 percent, and waste land 1,079 sq. km (24.32 percent).

Sharma *et al.* (2012) analysed land use and land cover of Jharkhand using satellite remote sensing. LU/LC classes were identified using visual interpretation techniques using IRS P6 LISS III data. The most crucial elements for understanding various objects were found to be tone and texture. 42 types of various LU/LC categories were interpreted altogether. Jharkhand's geography is dominated by forests, which make about

30 percent of the state's total land area and 49 percent of agricultural land that is now fallow. 5 percent of the total geographic area was made up of built-up (urban and rural) areas with industrial and mining areas. In terms of overall geographic area, wasteland and forest scrub area was 9 and 5 per cent, respectively. According to the study, it is possible to plant trees in the forest scrub and open scrub classes of the wasteland category to increase the area that is covered by forests. Agriculture production may be increased by increasing rabi crop production through enhanced irrigation facilities by construction of dams and rain water harvesting. LU/LC map generated in the study may be useful for decision makers, planners, academicians and researchers.

Srivastava *et al.* (2012) studied classification techniques for LU/LC change investigation. The major goal of this study was to compare three Lands at image classification tools—maximum likelihood classification (MLC), support vector machine (SVM), and artificial neural network (ANN)—in order to choose the most effective approach. In the case of SVM, the classifier algorithms are well tuned for the gamma, penalty, and degree of polynomial, while for ANN, the minimal output activation threshold and RMSE are highly optimised. Overall analysis demonstrates that the ANN outperforms the MLC, kernel-based SVM (linear, radial-based, sigmoid, and polynomial), and SVM. The best tool (ANN) is then used to identify the area of Walnut Creek, Iowa that has undergone LU/LC modification. The multitemporal pictures' change analysis reveals an increase in metropolitan regions and a significant change in agricultural practices.

Dalil Musa *et al.* (2016) studied land use and land cover change detection and analysis in Minna, Nigeria. This study aimed to identify LU/LC changes in Minna, Nigeria. Landsat ETM 1990, ETM 2000, ETM+ 2005, and ETM+ 2015 imagery spanning the area between 1990 and 2015 were gathered in order to examine the change. A ground truth observation of the study LU/LC was done in order to understand and confirm the correctness of the satellite imagery. The area was divided into built-up, vegetation, agriculture, water body, and bare surface using supervised digital image classification with Arc GIS 10.1 and ERDAS Imagine 9.0 software. The results indicated changes in the LU/LC classifications between 1990 and 2015; the built-up area changed rapidly, growed by 38.66 km^2 while the vegetation decreased by -5.32 km^2. Farmland, aquatic bodies, and bare surface all decreased by 1.95 km^2, 0.05 km^2 and 32.78 km^2 respectively.

Nayak *et al.* (2017) studied land use land cover changes using remote sensing and gis technique: in Navsari District, Gujarat Two time (January, 2000 and 2011) Landsat satellite imageries (TM) were acquired from United States Geological Survey (USGS). The unsupervised classification methodology had been employed using the software ERDAS imagine 2013. In the present analysis images of the study area were categorized into eight different classes namely Built up area, Forest, Orchards including other vegetation, Agriculture field with crops, Open field without crops/vegetation, Water bodies, marshy area and barren land to highlights the changes of the land use pattern. It was also found that the overall classification accuracy is more than 80 percent where as the overall kappa statistics is more than 0.74 per cent for both the years.

Prasad and Ramesh (2018) conducted study using spatio-temporal techniques for land use/land cover changes in an Alappuzha District, Southern Kerala (India). This research focuses on a spatiotemporal analysis of the LU/LC features of study area, using geospatial technology, which creates an audited account of the adjustments in each class of LU/LC. According to the results of this study, the built-up land area expanded from 6.59% in 1973 to 18.16% in 2017, while the area of mixed vegetation increased from 620.27 km^2 to 774.01 km^2 in 2017, a 10% increase. The study also found that the paddy field area decreased from 17.35% in 1973 to 11.96% in 2017, the uncultivated land area decreased from 10.41% in 1973 to 1.77% in 2017, and the waterbody and the waterlogged areas increased from 100.65 and 78.07 km^2 to 106.21 and 81.14 km^2, respectively.

Arulbalaji (2019) analyzed land use/land cover changes using geospatial techniques in Salem district, Tamil Nadu, (India). They used a combined approach of remote sensing and GIS tools to delineate the land use/land cover dynamics of study area. The changes in LU/LC were assessed using lands at thematic mapper data from 1992, 2001 and 2010, as well as operational land imager data from 2015 and supervised classification was used. The accuracy of this investigation was determined using the error matrix method. According to the findings, deciduous woods, croplands, agricultural and plantation lands, and water bodies fell by 398 km^2, 250 km^2, 45 km^2, and 16 km^2 between 1992 and 2015. Likewise, the areas covered by evergreen and semi-evergreen forests, mines, and developed areas had expanded by 288 km^2, 293 km^2, and 128 km^2 respectively. In 1992, 2001, 2010, and 2015, the overall accuracy of classifying land use and land cover was roughly 88 per cent, 95 per cent, 93 per cent, and 93 per cent, respectively

Kangabam *et al.* (2019) analyzed land use and land cover changes in Loktak Lake in Indo-Burma biodiversity hotspot using geospatial techniques. The goal of this study was to employ digital change detection methodologies to examine changes in land use pattern in study areas during the last 38 years from Landsat TM and IRS LISS III images on February 1977 and 2015. The result revealed that a shift in the Loktak Lake's land use profile. Overall, open water bodies, settlement and agricultural land increased by 10.94 percent, 2.23 percent and 10.26 percent, respectively, whereas Phumdis with thick vegetation and Phumdis with thin vegetation dropped by 3.48 percent and 28.89 percent, respectively. Changes in land use patterns were discovered to be damaging the Loktak Lake's fragile environment and posing a major threat to the aquatic ecosystem.

Mishra *et al.* (2019) studied land use and land cover change detection using geospatial techniques in the Sikkim Himalaya, India. The study used remote sensing (RS) and geographic information system (GIS) techniques to track changes in LU/LC trends in the study area from 1988 to 1997, 1996 to 2008, and 2008 to 2017. Land cover maps were created using images from the Landsat-5 thematic maps (TM) and Sentinel 2A (Multispectral Instrument) MSI data. The watershed's LU/LC maps were created using supervised classification utilizing the maximum likelihood classifier (MLC), and the accuracy of the classified map was validated using a high resolution planet scope image. Agriculture, barren land, built-up area, dense forest, open woods, and water bodies are the six major LULC types discovered, indicating that forestry is the main land use in this watershed. The research revealed that while open forest, barren land and agricultural land have declined by 13.98% (35.59 km^2), 1.82% (0.4.64 km^2) and 2.83% (7.22 km^2) and respectively but , dense forest, water bodies and built-up area have expanded by 16.40% (41.76 km^2), 0.11% (0.28 km^2) and 2.13% (5.41 km^2) respectively.

Mondal *et al.* (2019) detected land cover and land modeling of Sagar Island, India using remote sensing and GIS techniques. This study uses two images of 1975 and 2015 to classify and map the LU/LC of study area, as well as to verify the accuracy of the classification approach. The study was divided into two sections: (1) LU/LC categorization, and (2) accuracy assessment. Change detection and unsupervised classification utilizing the non-parametric rule were carried out throughout the 40-year research period. The results indicated that 7.60 per cent of the mangrove vegetation was found to have been turned into agriculture. Similar conversions included 40.26 per cent of agricultural (mono-crop) land becoming agricultural land, 1.48 per cent of mud flats becoming mangrove swamps, 1.87 per cent of wetland area becoming aquaculture land, and 22.54 per cent of agricultural (mono-crop) land becoming settlement with a homestead orchard. Agricultural (mono-crop) land to cropland, mud flats to shallow water (40.26 per cent) (1.36 per cent), and wetlands to agriculture are some of the other LU/LC conversions (0.055 per cent). The study had a 79.53 percent overall classification accuracy and a Kappa coefficient (K) of 0.7465.

Munthali *et al.* (2019) analyzed land use and land cover change detection for Dedza district of Malawi (South Africa) using geospatial techniques. The study used remote sensing and GIS to examine LU/LC change patterns in study area during the years 1991, 2001, and 2015. On each image, supervised and unsupervised classification techniques was used. The overall classification accuracy achieved was 91.86 percent in year 1991 and 2015 The long-term annual rate of change for water bodies declined from 5.54 percent ha^{-1} to 1.74 percent ha^{-1} throughout the study period. Similarly, the yearly rates of change for forest land, agricultural land, and built up area climbed from 1.71 percent per hectare to 1.94 percent per hectare, 0.02 percent per hectare to 0.11 percent per hectare and 7.22 per cent per hectare to 9.80 percent per hectare, respectively. The classified photos revealed that about 61.48 percent of total forest land in 1991 was changed to barren land in 2015, whereas roughly 2.70 percent of agricultural land in 1991 was converted to built-up area in 2015.

Hashim *et al.* (2019) analysed land use land cover with pixel-based classification approach. The choice of remote sensing data and technique produces precise maps of LU/LC. This research study examined the classification accuracy of various classifier approaches for classifying land use and land cover in metropolitan areas. The comparison of classification accuracy for each method utilised is the main goal of this essay. The investigation was carried out in a heavily populated urban area near Kuala Lumpur, Malaysia. The multitemporal LANDSAT satellite imageries for the years 2001, 2006, 2011, and 2016 were used as the study's dataset. Software ENVI 5.3 was used for the dataset's pre-processing and analysis. For the classification procedure, five land use classes—Urban/built up area, Forest, Agricultural, Water Bodies, and Fallow Land—were identified. Maximum Likelihood (ML) and Support Vector Machine are the two algorithms used in this study's supervised classification method (SVM). Overall classification accuracy and the kappa statistic show that the maximum likelihood method was less accurate than the support vector machine algorithm for five distinct time intervals. Consequently, this classification approach is appropriate and strongly advised for mapping the changes in land cover.

Spatial analysis on land use/land cover from IRS-R2 LISS4 FMX data-A case study in Assam University (AUS) campus, India was done by Reang *et al.* (2019). Using very high resolution satellite data and visual interpretation techniques, the AUS campus boundary was defined, and precise mapping of all the varied land types on the AUS campus was carried out. The campus's overall size was estimated to be around 572 acres. A total of 15 LU/LC classifications were mapped, with the degraded forest area taking up the largest portion (34.56 percent). The campus' encroached area (2.06 percent) was also mapped. The information from the study may be useful to decision-makers and researchers working in this field as a starting point for more in-depth investigations into topics like management and monitoring, regulating and planning development activities on and around university campuses.

The findings of the study are useful for planners and decision makers in sustainable natural resource management and degradation mitigation strategies (Khan *et al.*, 2020).

Land use and land cover (LULC) dataset classifies images of urban, agricultures, water bodies, and others (Abd Mukti and Tahar 2021).

Remote Sensing and GIS are the best techniques for data preparation and different Weightage Overlay Analysis for Ground Water Prospect Map Generation (Varma *et al.*, 2020).

The LU/LC study done by Rahaman *et al.* (2020) was based on supervised classification of Landsat 5 thematic mapper (TM) and Lands at 8 OLI/TIRS satellite imagery for the years 1987, 1997, 2007, and 2017, as well as Land Surface Temperature (LST), Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), Leaf Area Index (LAI), Effective Roughness Length (ERL), and Surface Albedo(SA) were used to examine the various effects of land transformation on the natural environment. The study revealed that the mean annual

LST climbed by 2.91 degrees Celsius, whereas vegetation indices decreased and the water index increased. Even though pattern was inconsistent across the area, both LAI and ERL showed significant declines. Negative correlation was found in-between NDVI-NDWI and LST-NDVI and no correlation existed between NDWI and LST During study period from 1987 to 2017, NDVI had decreased, while, NDWI values showed no trend.

Isufi and Berila (2021) studied geospatial technology to analyse land use/cover changes in Prishtina (Europe), The major goal of this study was to measure changes in LU/LC in the municipality of Prishtina from 2000 to 2020. Landsat satellite imagery was classified using supervised classification-maximum likelihood and ArcMap software. The study region was divided into five categories: vegetation, water -bodies, built up area, bare fields and agriculture areas. From 2000 to 2020, the built up area augmented by 3.2 per cent, bare lands increased by 7.7 per cent, vegetation area decreased by 1.4 per cent, water-bodies decreased by 0.39 percent and agricultural land showed increase by 9.3 per cent.

Digra and Kaushal (2021) studied land use and land cover change analysis using remote sensing and GIS techniques. Detecting changes and classifying LU/LC can be done using a variety of techniques. Each method has advantages and disadvantages of its own, but no single method is best. Several national and international studies on LU/LC change analysis have been conducted around the world using remote sensing and GIS. These studies has used supervised classification, unsupervised classification, visual interpretation, GEE (Google Earth Engine), and NDVI (Normalize Difference Vegetation Index). One of the most often utilised methods was the supervised classification approach, Also, it is established that the main causes of changes (conversion of one class into another class) in the pattern of LU/LC are natural, human, and socioeconomic variables. Regular observation of LU/LC fluctuations is essential so that proper control measures can be applied to conserve environment and natural resources.

Ramanamurthy and Victorbabu (2021) studied Land Use Land Cover (LULC) classification with wasteland demarcation using Remote sensing and GIS Techniques. This study intended to produce data on land use and land cover in order to aid in the design of land use plans and strategies for the newly emerging problem in the study area. A total of 12437 hectares in the Vizianagaram Mandal of the Vizianagaram district in Andhra Pradesh, India, covering the longitudes 83°18'0"E and 83°29'0"E and the latitudes 18°2'0"N and 18°10'0"N, had been chosen as the study area. Arc GIS and ERDAS were used in this investigation to produce better results. Two Landsat TM satellite images, MSS 2000 and MSS 2010, were downloaded from USGS, and supervised classification was done to identify the classification of land use and land cover (LULC). The classification techniques have revealed the ten land use/land cover classifications.

Kumar (2022) analyzed remote sensing and gis-based land use and land cover change detection Mapping of Jind District, Haryana. It was reported that there are two primary methods for learning more about land cover wiz. remote sensing images and field surveys. In 2005, Jind district's LU/LC categories included settlement, agricultural land, water bodies, forests, and wasteland, with corresponding hectare sizes of 7683.73, 254348.58, 1697.03, 395.42, and 6075.25. In 2020, the LU/LC categories in Jind district were settlement, agriculture land, water bodies, forests, and wasteland, with corresponding hectare ages of 8447.21, 252730.3, 1734.98, 6863.07, and 424.42. This study contributes to the information available on how LU/LC patterns have changed between 2005 and 2020.

Macarringue *et al.* (2022) Developments in Land Use and Land Cover Classification Techniques in Remote Sensing. Studies land use and land cover changes (LULCC) have been a great concern due to their contribution to the policies formulation and strategic plans in different areas and at different scales. The LULCC when intense and on a global scale can be catastrophic if not detected and monitored affecting the key aspects of the ecosystem's functions. For decades, technological developments and tools of geographic information systems (GIS), remote sensing (RS) and machine learning (ML) since data acquisition, processing and results in diffusion have been investigated to access landscape conditions and hence, different land use and land cover classification systems have been performed at different levels. Providing coherent guidelines, based on literature review, to examine, evaluate and spread such conditions could be a rich contribution. Therefore, hundreds of relevant studies available in different databases (Science Direct, Scopus, Google Scholar) demonstrating advances achieved in local, regional and global land cover classification products at different spatial, spectral and temporal resolutions over the past decades were selected and investigated. This article aims to show the main tools, data, approaches applied for analysis, assessment, mapping and monitoring of LULCC and to investigate some associated challenges and limitations that may influence the performance of future works, through a progressive perspective. Based on this study, despite the advances archived in recent decades, issues related to multi-source, multi-temporal and multi-level analysis, robustness and quality, scalability need to be further studied as they constitute some of the main challenges for remote sensing.

CONCLUSIONS

This research study was conducted to review for demonstrating the power of geospatial techniques in analysing LULC changes. They reveal how different regions undergo varying degrees of transformation due to natural, human, and socioeconomic factors. The studies emphasize the importance of monitoring LULC changes to inform sustainable land use planning and conservation efforts. While advancements in remote sensing, GIS, and machine learning have provided valuable tools, challenges such as multi-source data integration and scalability remain areas for future exploration in the field of land cover classification and change detection. This introductory overview provides a glimpse into the diverse range of research efforts focused on analysing land use and land cover changes using geospatial techniques. From assessing shifts in agricultural practices and urban expansion to examining the effects of natural processes, these studies are crucial in advancing our understanding of how the Earth's surface evolves over time.

Acknowledgement. We acknowledge Punjab Agricultural University, Ludhiana and Punjab Remote Sensing Centre, Ludhiana, Punjab, for their support, facilities and materials required for this work which will result in good management planning of the natural resources for the future generation.
Conflict of Interest. None.

REFERENCES

Abd Mukti, S. N. and Tahar, K. N. (2021). Current Status of Classification Method for Mapping Application: A Review. *International Journal of Emerging Technologies, 12*(1), 122–128.

Arulbalaji, P. (2019). Analysis of land use/land cover changes using geospatial techniques in Salem district, Tamil Nadu, South India. *SN Appl Sci., 1*, 462.

Dalil, M., Onimisi, A., Husaini, A. and Usman, M. B. (2016) land use and land cover change detection and analysis in minna, Nigeria. *Journal of Sustainable Development in Africa,18*, 1-5

Digra, A. and Kaushal, A. (2021). Land Use and Land Cover Change Analysis using Remote Sensing and GIS Techniques. *Biological Forum – An International Journal, 13*(3b), 134-138.

Hashim, H., Latif, Z. A. and Adnan, N. A. (2019). Land use land cover analysis with pixel-based classification approach. *Indonesian Journal of Electrical Engineering and Computer Science, 16*(3), 1327-1333

Isufi, F. and Berila, A. (2021). Using geospatial technology to analyse land use/cover changes in Prishtina, Kosovo (2000-2020). *Geojournal., 87*(1), 3639–3653.

Kangabam, R. D., Selvaraj, M. and Govindaraju, M. (2019). Assessment of land use land cover changes in Loktak lake in Indo-Burma biodiversity hotspot using geospatial techniques. *The Egyptian Journal of Remote Sensing and Space Sciences, 22*, 137-143.

Khan, S. A. and Khan, Anisa Basheer (2020). Assessment of Land Use and Land Cover Dynamics in Shingla River Basin Using Multi Temporal Satellite Imageries. *International Journal on Emerging Technologies, 11*(1), 263–269.

Kumar, R. (2022). Remote Sensing and GIS-Based Land Use and Land Cover Change Detection Mapping of Jind District, Haryana. *International Journal of Research Publication and Reviews, 3*, 869-874.

Macarringue, L. S., Édson Luis Bolfe, E. L. and Pereira, P. R. M. (2022). Developments in Land Use and Land Cover Classification Techniques in Remote Sensing *Journal of Geographic Information System, 14,* 1-28.

Mishra, P. K., Rai, A. and Rai, S. (2019). Land use and land cover change detection using geospatial techniques in the Sikkim Himalaya, India. *The Egyptian Journal of Remote Sensing and Space Sciences, 2223*, 133-143.

Mondal, I., Thakur, S., Ghosh, P., Kumar, T. and Bandyopadhyay, J. (2019). Land use/land cover modeling of Sagar Island, India using remote sensing and GIS techniques, Emerging technologies in data mining and Information security. Proc IEMIS, pp771-785.

Munthali, M. G., Botai J. O., Davis, N. and Adeola, A. M. (2019). Multi-temporal analysis of land use and land cover change detection for dedza district of Malawi using geospatial techniques. *International Journal of Applied Engineering Research, 14*, 1151-1162.

Nayak, D., Surve, N. and Shrivastava, P. K. (2017). Land Use Land Cover Changes Using Remote Sensing and GIS Technique: A Case Study of Navsari District, Gujarat. *Journal of Tree Sciences, 36*(2), 20-27.

Prasad, G. and Ramesh, M. V. (2018). Spatio-temporal analysis of land use/land cover changes in an ecologically fragile area-Alappuzha district, Southern Kerala, India. *Natural Resources Research, 28,* 31-42.

Rahaman, S., Kumar, P., Chen, R., Meadows, M. E. and Singh, R. B. (2020). Remote sensing assessment of the impact of land use and land cover change on the environment of Barddhaman District, West Bengal, India. *Frontiers in Environmental Science, 8,* 127.

Ramanamurthy, B. V. and Victorbabu, N. (2021). Land Use Land Cover (LULC) classification with wasteland demarcation using Remote sensing and GIS Techniques. IOP Conference Series: Materials Science and Engineering, *1025*, 012035.

Reang, D., Aparajita, D. and Das, A. K. (2019). Spatial analysis on land use/land cover from IRS-R2 LISS4 FMX data-A case study in Assam University campus, India. *An international journal of environment and biodiversity, 9*(1), 134-140.

Sharma, N. K., Lamay, J. B., Kullu, N. J., Singh, R. K. and Jeyaseelan, A. T. (2012). Land Use and Land Cover Analysis of Jharkhand Using Satellite Remote Sensing. *Journal of Space Science & Technology, 1,* 1-10.

Srivastava, P. K., Han, D., Rico-Ramirez, M. A., Bray, M. and Islam, T. (2012). Selection of classification techniques for land use/land cover change investigation. *Advances in Space Research, 50*(9), 1250-1265.

Sumathi, M., Kumarasamy, K., Thiyagarajan, M. and Punithavathi, J. (2011). An analysis on land use / land cover using remote sensing techniques- a case study of pudukkottai district, Tamilnadu, India. *International Journal of Current Research, 3*(6), 304-307.

Varma, Hridayesh, Sarup, Jyoti and Mittal, S. K. (2020). Ground Water Prospect Zone Mapping in the Barkheda Nathu Basin of Kolans River using Remote Sensing and Geographical Information System. *International Journal on Emerging Technologies, 11*(2): 1047–1053.

How to cite this article: Jaskaran Singh Sohal and Arun Kaushal (2023). Analyzing Land Use and Land Cover Changes using Geospatial Techniques, A Review. *Biological Forum – An International Journal, 15*(10): 164-168.