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Research Article

Urban Green Space Analysis and Change Detection Using Geoinformatics

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Abstract: Green areas are vital in determining the quality of urban environment as they influence physical health of citizens and for instance, some are also used as recreational areas. In the process of land use planning for almost all cities, allocation of urban land to green space has become an important policy issue. More specifically, urban green spaces as a class of land use is defined as places within the extent of an urban area that provide opportunities for outdoor recreation and enjoyment or simply pockets of vegetation in the city environment. Mapping and monitoring of urban green spaces is a prerequisite for effective management and protection of urban environment. Change detection is a technique used in GIS and Remote sensing techniques Landsat ETM-7 and OLI - 8 images used for change detecting Supervised maximum likely hood classification LU/LC which have may occur between a time interval (2000 to 2015) in Thrissur corporation The LU/LC of both years has been delineated using and classified maps were crossed to generate an urban green cover changes Normalized difference vegetation index (NDV1) has been employed for detection of change area and quantification of the amount of decline or increase in urban greenery 2000-2015 The analysis showers an overall decrease in the total green space of the study area from 54 2% (2010) to 48.1% (2015). The land use analysis showed that there is a substantial increase in built up and other non-green areas Zonal wise analysis was also carried out to know delineate the most effected localities in terms of green space conversion as a part of development.

Key words: Remote sensing, Green areas, Thrissur, Normalized difference vegetation index

INTRODUCTION

Urban green spaces have become indispensable elements of ecological, aesthetic and recreational values. Establishment of urban green space systems has become a necessity in modern era. Urban green areas were not established for recreational needs and were actually for ecological needs[1]. The management of vegetated areas by urban planners relies on detailed and updated knowledge of their nature and distribution. Ground survey mapping provides outputs of high accuracy and detail[2] but it is very time consuming and in some cases such detailed information is not called for. The use of remote sensing data in recent times has been of immense help in monitoring the changing pattern of vegetation. Using remote sensing and image processing techniques vegetation condition can be assessed and monitored at a range of scales from site specific to regional or even larger depending on one's goals[3]. "Change detection" in remote sensing image analysis is a process which observes the difference of an object or phenomenon at different times[4] and quantifies the change through analysis of variation in spectral response of vegetation or other cover type which occurs at a given location. GIS has emerged as a powerful tool in analysis of spatial and non-spatial data. The comparison of potential vegetation type, cover type and structural stage layers in to an integrated vegetation classification is efficiently accomplished using GIS [5].

Extracting and identifying vegetation from satellite images is a major topic in remote sensing and GIS. Several techniques have been developed by scientists worldwide. This study aims to evaluate the approaches to extraction of vegetation from satellite images and to examine environment. Several studies have addressed the use of GIS and remote sensing in the management and control of vegetation worldwide[4]. The reviewed digital change detection techniques that used remotely sensed data [6] to monitor green space destruction. Applied remote sensing and GIS in how to identify changes that may occur in the green areas, focused on how to use remote sensing in the management natural resource including natural grass land. Urban sprawl is currently occurring at an unprecedented rate that is having a marked effect on the natural functioning of the immediate environment[7]. Urban green space connecting people and nature [8] the influence of enlightened green space planning. Urban green space also plays an important functional role in urban landscapes providing ecosystem services such as the mitigation of flooding and erosion, the collection of airborne and waterborne contaminants, and provision of wildlife habitat.

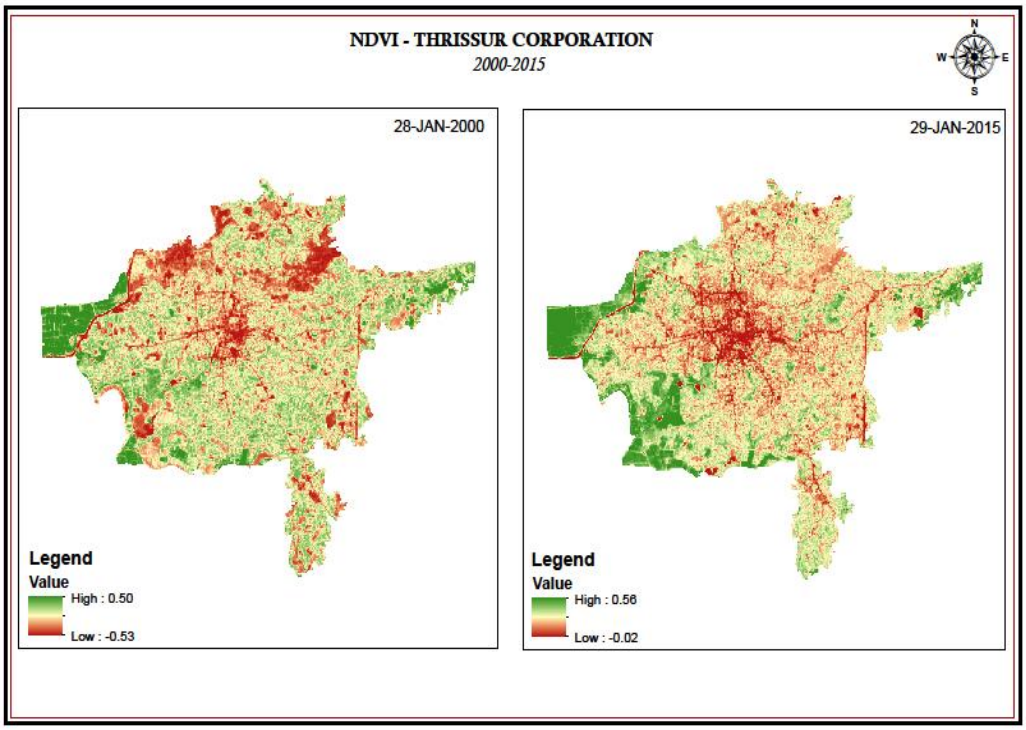
We define the term "urban green space" broadly as the range of urban vegetation including not only parks and open space, but street trees, residential gardens, and in fact any vegetation found in the urban environment. In the quest for healthy, live able and sustainable cities, urban green spaces with trees as a major component is important. Urban green spaces are relatively scarce in developing countries and such countries face challenges related to urban sustainability. They adopt an ecosystem approach to urbanization is sustainable cityscapes are possible if we adopt an ecosystem approach to urbanization. Urban ecosystems are ecosystems that combine artificial and natural elements on a region scale. Recognition of ecological and cultural services of sacred groves for managing green space in urban landscape[9]. The developing or managing urban green spaces efforts need to be made to identify land use.

The landscape undergoing unplanned growth due to various anthropogenic activities requires to be monitored to understand the rates of changes in urban land use[10]. Monitoring urban structure brings out various spatial characteristics of the land surface apart from elucidating the impacts on the surrounding environment[11, 12]. Green space studies focused on identifying changes in the urban green spaces of the

city to determine the spatial patterns and trends of changes over the period of sensing image analysis and change detection techniques. The information will help to identify priority areas for preservation of green areas of the city.

MATERIALS AND METHODS

The first stage in all the change detection studies consists of collecting of existing information and data investigation area (Thrissur corporation area). The change detection is mostly solved through the strategic methods and by adapting multi criteria analysis. It can be achieved by identifying the closely related to the problem. The voluminous data can be properly managed and analyzed with the use of Geographical Information System. The base map is prepared from SOI Top sheets with 1:50.000 scale of Thrissur projected to ETM projection with spheroid and datum WGS 84 N and zone 43 (58B02, 58B03, 58B06, 58B07), study area boundary, settlement and roads are digitized and thus the thematic layers are created from the SOI top sheets using Arc GIS software. The base map is collected from Thrissur Corporation of Thrissur District. Natural vegetation index and Landuse maps were prepared by visual interpretation of Landsat-7 ETM (28-JAN-2000) and Landsat-8 OLI (29-JAN) for the year of 2015 imagery. Normalized difference vegetation index (NDVI) classification and post classification change detection. In this analysis generate spatio-temporal change of urban green spaces different years of 2000 to 2015. Land use maps created in Landsat image for supervise classification which signature the Green space, Water body, Builup, Fallow land and other classes' signature and derived Maximum likelihood classification for the Supervise classification in the land use map.

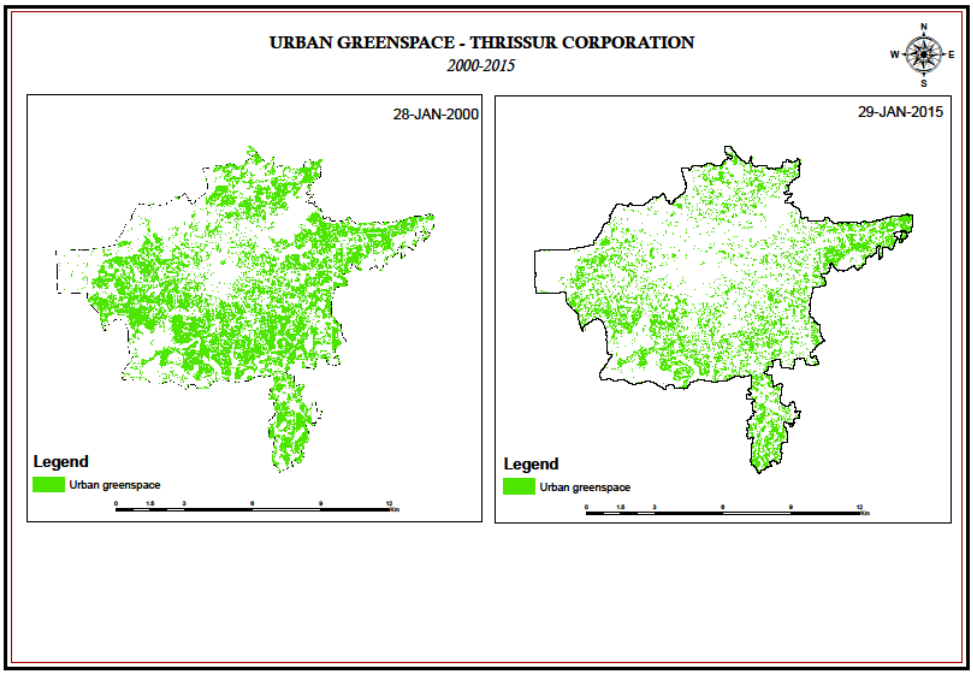


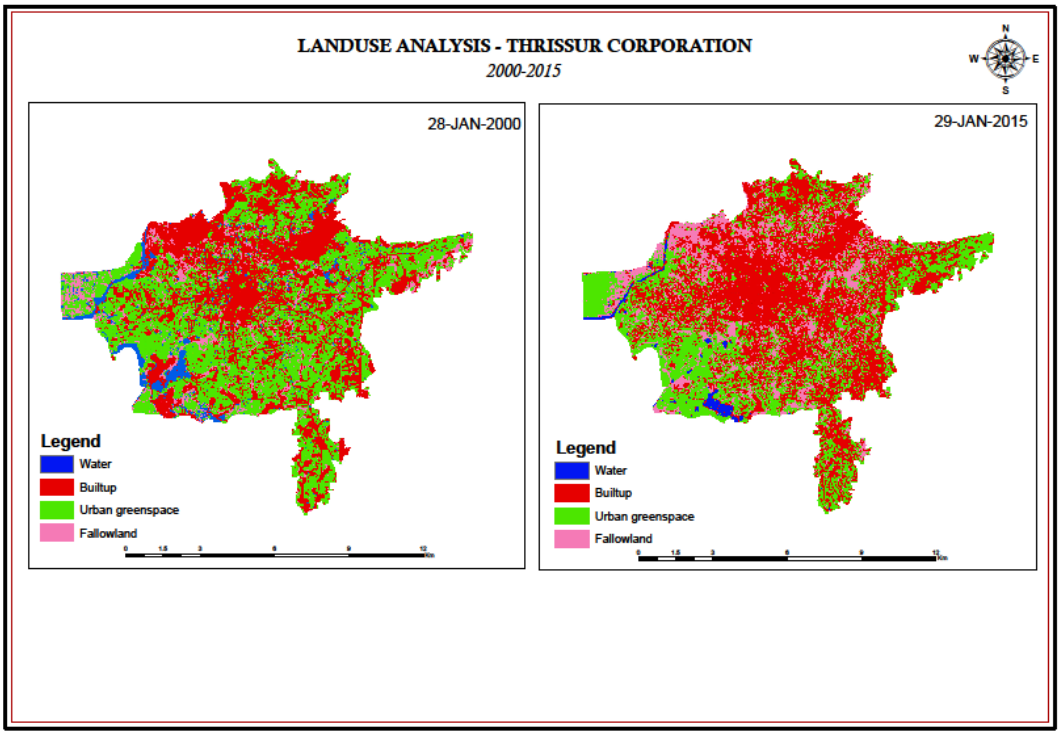
Remote sensing data can provide information on vegetation structure and amount of biomass and leaf area as vegetation cover can be estimated through various indices. Normalized difference vegetation index (NDVI) is one of the most widely used vegetation indices among other methods which have been reliable in monitoring vegetation change. For quantitative analysis based on radiometric information such as NDVI differencing, the images should be corrected radiometricallly to compensate for radiometric divergence without radiometric calibration of multi-temporal dataset false changes can occur in the classified maps. Relative radiometric correction has been performed using dark and bright pixel control set on each of the R and NIR Bands of Landsat 2000 with reference to Landsat 2015 pixel size of 30m. NDVI values range from -1 to +1. Because of high reflectance in the NIR portion of the electromagnetic spectrum healthy vegetation is represented by high NDVI values between 0.1 to 1. Conversely, on-vegetated surfaces yield negative values of NDVI. It has been calculated as the of R and NIR bands of each of the images individually as per the equation given below. This produced an NDVI image for 2000 to 2015 each, hence forth referred to as NDVI 2000 and NDVI 2015 respectively. Accuracy assessment has been done for the classified data to evaluate the performance of classifiers [13]. This done through vegetation index. Overall (producer and user) Accuracies were computed through a confusion matrix. Assessing overall accuracy and computing method on test the effectiveness of classifications.

RESULT AND DISCUSSION

NDVI analysis derived during the year of 2000 to 2015 there has been a significant reduction in vegetation as a whole which amount approximately 15.8 Sq.km. Nevertheless a decrease has also been observed in a few areas covering approximately 6.32Sqkm. With regard to the results of NDVI analysis, it is obvious that there is a major loss of vegetative cover with “high density” rank over a period of time (2000 to 2015). This is probably due to the physical development of the city in the north – western and eastern parts of the city. Which account for the maximum individual difference in 2000 with approximate variance of 55.02sqkm of total area is indicated by the green colour, the second class with approximate variance of 45.4sqkm is combination of variables indicated by red colour. In the year of 2015 the green colour implies variance of 48.7sqkm and the second class with approximate variance of 51.81sqkm is combination of variables indicated by red colour of Thrissur corporation area. Large patches of negative changes are found in the centre part of the city along the road and new construction areas. Positive changes are confined mainly to the institutional areas, new planned areas which may be attributed plantation**.** Change of urban green space in Thrissurc Corporation during the year of 2000 to 2015.

Due to human interaction for the past 15 years a vast change has occurred in the land use pattern of this Thrissur corporation area. Total built up area has expanded and it increased to 10% land use demanded by residential area which occupies more than 49% which is linked to the rapid economic transformation and emergence of secondary and tertiary activities. Nonagricultural land converted to waste land, fallow lands demand caused an increase in land values, and landowners who had previously used their land for agriculture now offered it for construction and real estate. So for fallow lands increases 9% of 2000 to 2015. The same year 3% of water reduced total of 5%. While a considerable decrease in agriculture land can be noticed. Agriculture and vegetation include urban green space decreased 16% after decade of human interaction of areas were heavily affected in this area.





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Classified maps corroborate the observations of NDVI change map while revealing the spatial patterns of class of class changes. Specific part of the area has under gone notable land cover changes of 15 years. Due to rapid population growth in the study area increased demand for built up has taken significant toll on urban green spaces. Spatial expansion of settlement has mostly occurred in the outer periphery. Maximum negative change in vegetation can be observed in center part of the city. In 2000 thick patches of trees populated the roads sides. In 2015 these have been replaced by built-up which increased significantly and become a dominant class. Further agriculture formed the predominant class in this area in 2000. The agriculture cover has considerably been replaced by rapid expansion of built up area has also led to fragmentation of previously continuous green space cover. Land use analysis reveals an increase in urban area from 39.2 % (2000)to 48.8%(2015) with decline vegetation from 48%(in 2000)32.26% (in 2015) and significant increase in 'others' (which in clued fallow land and water bodies).

CONCLUSION

Remote sensing techniques and GIS environment have increasingly been acknowledged as the most successful techniques for environment conservation and land resource management. Recently, more precise data have become available widely in digital form. These digital data can assist to protect our environment. This study reveals that monitoring land use change and change assessment urban green space by using satellite can be an extremely valuable tool for urban planners in the detection of the effects of environmental change. The area surrounding 4km buffer have been assessed using temporal remote sensing data for decades and spatial metrics. The spatial characteristics of land use features were measured using spatial metrics to explain the physical characteristics, forms and pattern of the land use. The land use analysis reveals increase urban area from 39.2% (2000) to 48.8 %(2015) with decline vegetation from 48% in 2000 32.2% (2015) and significant increase in others (fallow land and water bodies). Designation of thrissur corporation area as the rapid urbanization in the region in the last decade resulting in densification as well as expansion of built-up area to cater to the needs of increasing population. Increase in urban built-up area has primarily been at the cost of urban green spaces and agricultural land which adversely effected the quality urban environment.

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