AN ASSESSMENT OF LAND USE AND LAND COVER CHANGES IN LAHORE (PAKISTAN) AND NEW DELHI (INDIA) USING GEOSPATIAL TECHNIQUES

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ABSTRACT: All over the world rapid urban growth was considered the key factor for change detection. It was considered obvious, widespread an irreversible form of land alteration. The two expanding urban centers like Lahore (Pakistan) and New Delhi (India), land use modifications are terrific. Thus, it was important to evaluate the major key factors of such modification. Urban environment and its surroundings have been greatly affected by temporal land use and land cover alterations. Land Sat images from 1972 to 2015 has been selected to figure out the land cover change detection in study area. The purpose of this comparative study was to detect extent of urban expansion that was main reason for change detection. Geospatial techniques have been used to evaluate these alterations. The Lahore's built up area was 62.88 square kilometers in 1972 and it was 557.38 square kilometers in 2015.Over all change detection of 494.5 square kilometers was observed in structure of Lahore. In New Delhi's built up area was 136.13 square kilometers in 1972 and in 2015 it increased up to 686.71 square kilometers. The overall change was observed 550.58 square kilometers for 43 years. It was observed that the built up have been changed substantially in Lahore and New Delhi.

Keywords: Lahore, New Delhi, Landsat, Urbanization, Temporal, Built up, Vegetation, Barren land.

(Received   25-10-19   Accepted 06-12-19)

INTRODUCTION

The term Land use and land cover (LULC) is normally applied to define the modification of the earth environment by natural and human activities all over the world (Iqbal and Khan, 2014, Hussain *et al.*, 2018). The Apprehensions about change detection are acknowledged and well accepted around the globe. Anthropogenic activities such as rapid urban and population growth as well as economic developments have significantly altered the earth's surface processes, which is the root cause to modify the environmental attributes at micro and macro scale (Lambin, 2013). Since the inception of life on earth human beings are altering the land directly or indirectly to fulfill the necessities of life and to attain livelihoods. But now a day the intensity and rate of land use and land cover modification has been increased than previous. Around the globe cities have experienced fast development due to the growth of population as well as the mass migration from village to cities. Particularly, mega cities and towns of developing countries the population growth rate has been constant. Now a day's land is becoming a scare resource due to extensive agricultural activities and rapid population growth (Tiwari, 2011). In various studies (Madvie and Perkash, 2016, Akyerk *et al.,* 2018) stated that effects of rapid population and economic growth have boosted the pace of urbanization that is considered the principal factor of change detection. In New Delhi agricultural and wet land are transformed into the built-up structure. The change detection analysis is considered significant enquiry as well as significant factor in alteration of terrersital settings globally (Zhang *et al.,* 2011). Precise and correct land use land cover is good pot rail of human-environment links and interconnections (Zhao, 2012). Due to the non-availability of the latest and accurate spatial data in the developing countries they are still relying on Space borne remote sensing data (Talha *et al.*, 2014, Khalid *et al.,* 2018). Change detection procedure is used to classify and evaluate changes in LULC by detecting in diverse periods (Butt *et al*., 2015). The fantastic areal coverage, reliable and appropriate information, viable analysis are the attributes of remotely sensed data (Muñoz and Blanco, 2008, Yulianto et al., 2018). Furthermore, the Geospatial techniques are considered the most powerful techniques to highlight patterns of change detection (Zhnag, 2011 and Michishta *et al.,* 2012).

Study area: Lahore is the 2nd largest city of the country and serves as Punjab province's capital. The district is covering an area of 1772 square kilometers (GOP, 2017). Lahore is positioned in North Latitude (31°15″to 31°43″) and East longitude (74°10″ to 74° 39″). In north, Sheikhupura is located and River Ravi is in west,

Southward is Kausar city and Wagha border is in east (District Census Report, 1998). New Delhi serves as capital of Indian Territory and it is situated at height of 213-305 meters above sea level. The total area is 1483Sq.km.The New Delhi is positioned North latitude

(28º24′17″ to 28º53′00″) and East longitude (76°45′30″ to 77º21′30″). The city lies on flood plains of Yamuna, River. In the north are Himalaya Ranges while on south west are Aravalli's Ranges lies on south western side.
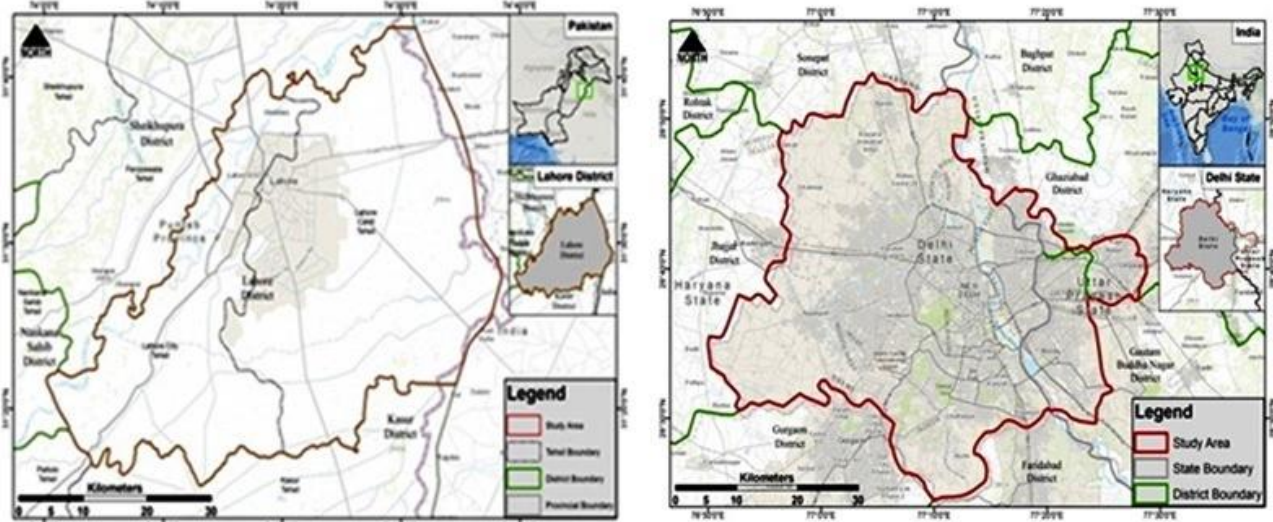

Figure: 1 Map Showing the Study Area; Lahore (left) and New Delhi (right)

MATERIALS AND METHODS

Landsat images for the years 1972, 1980, 1993, 2000, 2010 and 2015 were downloaded from United States Geological Survey (USGS) website http//www.earthexploer. For the development of land use land cover maps different bands were used like MSS (multi-temporal satellite images of Landsat Multispectral Scanner), TM (Thematic Mapper), ETM+ (Enhanced Thematic OLI/TIRS (Mapper, Operation Land imager/Thermal infrared Remote Sensor). The preprocessing of acquired satellite images were completed to get the object-based analysis of those

images. Furthermore, the NDVI (Normalized difference Vegeatation index) and NDWI (normalized difference water index) and SAVI (soil adjusted vegetation index) were used to get the temporal maps of the study area. During the selection of these images the diverse weather and atmospheric parameters were considered like; solar azimuth angle, the proportion of cloud cover and season of the image acquisition (Ali *et al.*, 2015) The satellite images were digitized by using Arc GIS software. The four-land use land cover classes were established in this comparative study e. g built up, Vegetation, barren land and water bodies.

RESULTS AND DISCUSSION

Table 1: Percentage of each land use class and change in land-cover Lahore form 1972 -2015.

Classes	Land cover of each Land cover class area in sq.km (%)						Percentage of land cover change				
	1972	1980	1993	2000	2010	2015	1972-1980	1980-1993	1993-2000	2000-2010	2010-2015
Built up area	62.88 (3.64)	100.123 (5.79)	229.523 (13.28)	316.513 (18.31)	424.694 (24.57)	557.387 (32.24)	-2.15	-7.49	5.03	6.26	7.67
Vegetation	961.54 (55.62)	1191.42 (68.92)	1077.75 (62.34)	1018.91 (58.94)	862.731 (49.91)	844.365 (48.84)	- 13.28	6.58	3.4	9.03	1.07
Barren land	689.72 (39.90)	404.779 (23.41)	395.435 (22.87)	361.339 (20.90)	421.478 (24.38)	288.7463 (16.70)	16.49	0.63	1.97	3.48	7.68
Water bodies	14.6 (0.34	3242.68 (1.51)	26.0588 (1.51)	31.9842 (1.83)	19.8405 (1.15)	38.2455 (2.21)	-1.17	0	0.34	0.7	1.06
Total Area	1729	1729	1729	1729	1729	1729					

Table 2: Percentage of each land use class and change in land-cover New Delhi form 1972 -2015.

Classes	Temporal percentages of land cover of each class in sq. Km (%)						Percentage of land cover change				
	1972	1980	1993	2000	2010	2015	1972-1980	1980-1993	1993-2000	2000-2010	2010-2015
Built-up area	136.13 (7.70)	281.401 (15.92)	362.682 (20.31)	517.949 (29.30)	666.077 (37.68)	686.71 (38.84)	-8.22	-4.39	-8.99	8.83	-1.16
Vegetation	1296.05 (73.31)	1132.26 (64.05)	1033.517 (58.46)	899.283 (50.87)	735.572 (41.61)	650.99 (36.82)	9.26	5.59	9.26	4.79	4.79
Barren land	289.4873 (16.38)	331.6313 (18.76)	329.305 (18.63)	325.366 (18.40)	340.028 (19.23)	403.907 (22.83)	-2.38	0.13	0.23	-0.83	-3.6
Water bodies	46.17 (2.61)	22.5396 (1.27)	42.5396 (2.39)	25.2342 (1.43)	261.1549 (1.48)	26.2251 (1.48)	1.34	1.12	-0.05	-0.05	0
Total Area	1768	1768	1768	1768	1768	1768					

Lahore's Land use/Land cover change (1972-2015):
As table 1, Figure 2 and 3, indicates that there was substantial change was observed from year 1972 to 2015. The highest amount of change is observed in the built-up class of Lahore. Evaluation of land use land cover from 1972-2015 highlighted that due to unplanned and haphazard urbanization played a key role in expansion of built up area during study period. Comparison of built up class 1972 -2015 shows that built up area of Lahore was only 62.88 squares kilometers. The built-up class was 557.38 squares kilometers in 2015. In time span of 43 years the results indicate built up area of Lahore increased 494.5 squares kilometers. The vegetation class that mainly includes cultivated land and green spaces have been reduced due to anthropogenic activities. In 1972 the vegetation class was founded 965.54 squares kilometers but in the year 2015 it was 844.36 square kilometers. The 117.18 square kilometers net reduction is detected in vegetation class of Lahore. The barren land class is showing the reduction during 1972-2015.The total barren land of Lahore 689.72 square kilometers and in 2015 it was reduced up to 288.74 square kilometers. The temporal maps of Lahore in figure 2 (on left) indicated the urban growth of Lahore city mainly observed more in south east, southern way. River Ravi is flowing on North and North east side of the Lahore and on the eastern side Wagha border (Pakistan–India) which is considered the natural obstruction in the growth of urban expansion.

New Delhi's Land us/Land cover change (1972-2015):
According to Table 2, Figure 2, on right side showing the analysis of land use land cover class in New Delhi from 1972-2015.The results indicates the substantial change is founded in built up class of New Delhi. The built-up class comparison revealed that in 1972 the built-up area of New Delhi was 136.13 square kilometers. The built-up class was increased up to 686.71 squares kilometers. In time span of 43 years the results indicate built up area of New Delhi increased 550.75squares kilometers. The vegetation class of New Delhi is also reducing with dramatic speed because of urbanization and unplanned settlement. The results in table 2 shows that area of New Delhi covered by vegetation was o 1296.05 square kilometers. In 2015 the vegetation class was founded 650.99 square kilometers. After four decades the decrease in the vegetation cover was calculated 640.06 square kilometers because of rapid population growth the vegetation cover is altering in to built up structures The water bodies class of New Delhi is showing the reduction during 1972-2015.The total area of water bodies in New Delhi was Lahore 46.17 square kilometers and in 2015 it was reduced up to 26.22 square kilometers. In new Delhi the built-up class is showing the maximum amount of increase, on the other the vegetation and water bodies area is reducing during the study period. New Delhi has expanded in all directions from Centre. The temporal maps of New Delhi in figure 2(on right) depicted that the urban expansion/ growth is more in north, south and west ward direction. The Eastern part of New Delhi is always saturated because of boundary line.
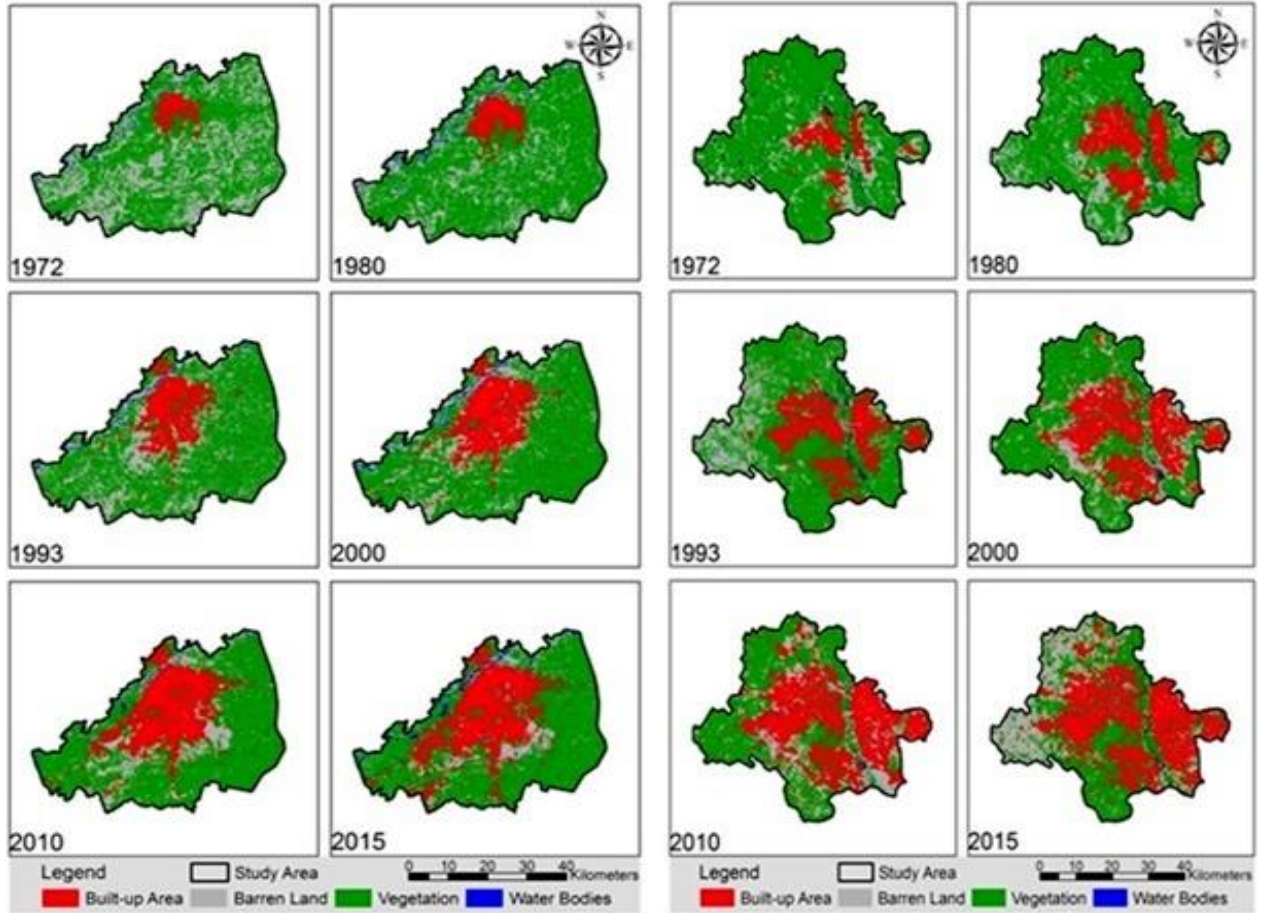
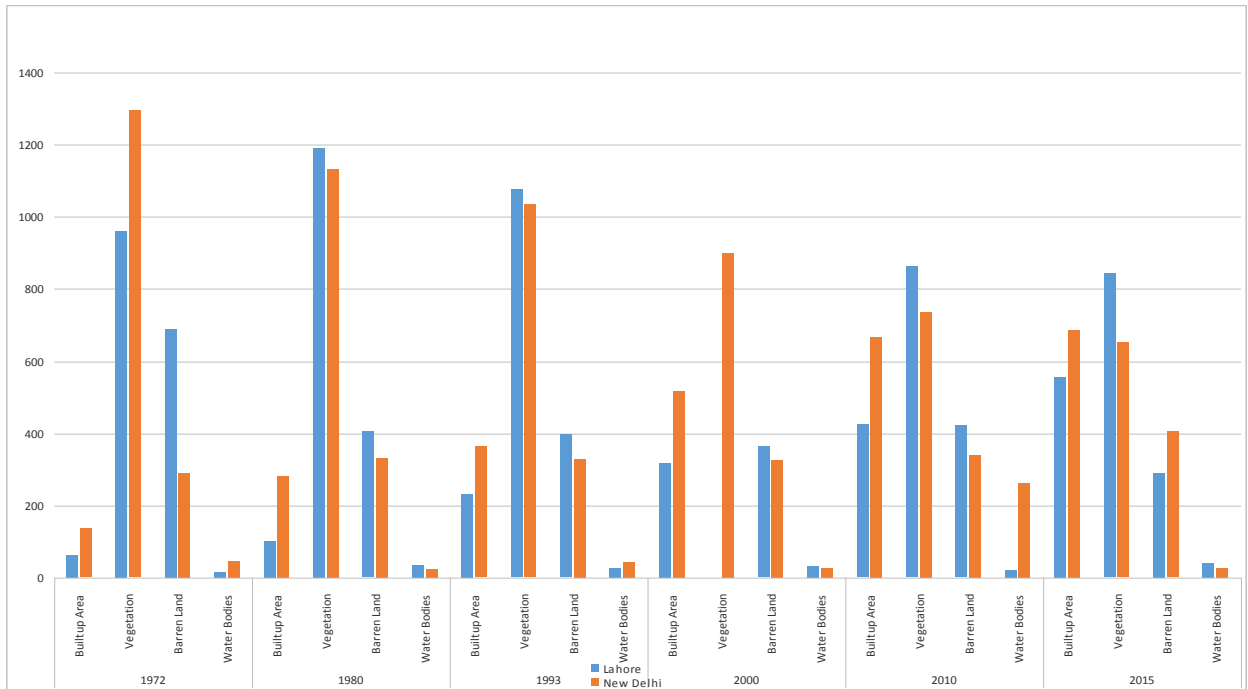**Figure 1: Change detection maps of Lahore (Left) and New Delhi (right).**

Figure 2: Graph showing the Change detection in Lahore and New Delhi

Conclusion: In the light of above results and discussion a significant change is observed in land use land cover of the study area. The land cover has been changed from natural to impermeable surfaces. The land use pattern of both cities has been drastically altered due to fast urban growth and mass migration the vegetation cover and barren land is reduced/changed into structure

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