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Archives of Applied Science Research, 2016, 8 (12):13-17
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Scholars Research Library
ISSN 0975-508X
CODEN (USA) AASRC9

Land use land cover of Agra tehsil: A comparative study from 2002 to 2015

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ABSTRACT

Land use and land cover of a region is affected by man and his socio-economic activities. Man has always altered the natural fabric through his capitalistic consummation of natural resources. Land has been an immediate recipient of this approach due to immense population practicing agricultural activities on it. Such information on the pattern of land use and land cover helps planners and environmentalists in analyzing and monitoring land use in accordance with the growing population. Keeping this in view the present study focuses on the nature of land use and land cover of Agra Tehsil (Agra) of Uttar Pradesh State between the years 2002 and 2015 using remote sensing and GIS techniques. Along with finding out the LULC of the study area for 2002 and 2015, a change detection analysis was performed to understand the nature and rate of increase and decrease in land use/land cover of the study area. Further through change detection matrix, the area transformation amongst the various classes in the span of 13 years was also studied.

Keywords: Agra, Population, Land use/Land cover, Remote Sensing, GIS.

INTRODUCTION

Land use and land cover is an important component to understand global land status; it shows present as well as past status of the earth surface. Land use and land cover are two separate terminologies which are often used interchangeably (Dimiyati et al. 1994). Land cover is a basic parameter which evaluates the content of earth surface as an important factor that affects the condition and functioning of the ecosystem. Land cover is a biophysical state of the Earth surface, which can be used to estimate the interaction of biodiversity with the surrounding environment. Nowadays, land use land cover analysis plays an important role in the field of environmental science and natural resource management. Pressures on forest especially in the tropical world to provide economic resources have been increasing rapidly as a consequence of burgeoning population in the region. This has led to unabated deforestation, which has been recognized as one of the major drivers of biodiversity loss as well as a threat to the existence of the global ecological lung. Agra is a historical land with three world heritage sites. Once the area along the river Yamuna hosted dense mixed forest. The beauty of the Taj was enhanced by both the river and the forest. Singh (1989) has described change detection as a process that observes the differences of an object or phenomena at different times.

Study area

The present study has been focused on Agra tehsil which comes under Agra district having a total area of 528.64 km². It has semi-arid climate continental type of climate with low monsoonal rains. It has a population of around 33,99,042 with literacy rate of around 70%. The study area which is a uniform upland falls in the doab of Yamuna and Utangan rivers. Ravine land along the Yamuna & Utangan river is a common feature of this study area making the land unsuitable for agriculture. Loamy soil is predominant in this area. A reservoir covering an area of 764 acres having a holding capacity of 290 million cubic ft is the only irrigational facility of this area. However this fails to quench the irrigational thirst of the study area for the better part of the year (Figure 1).

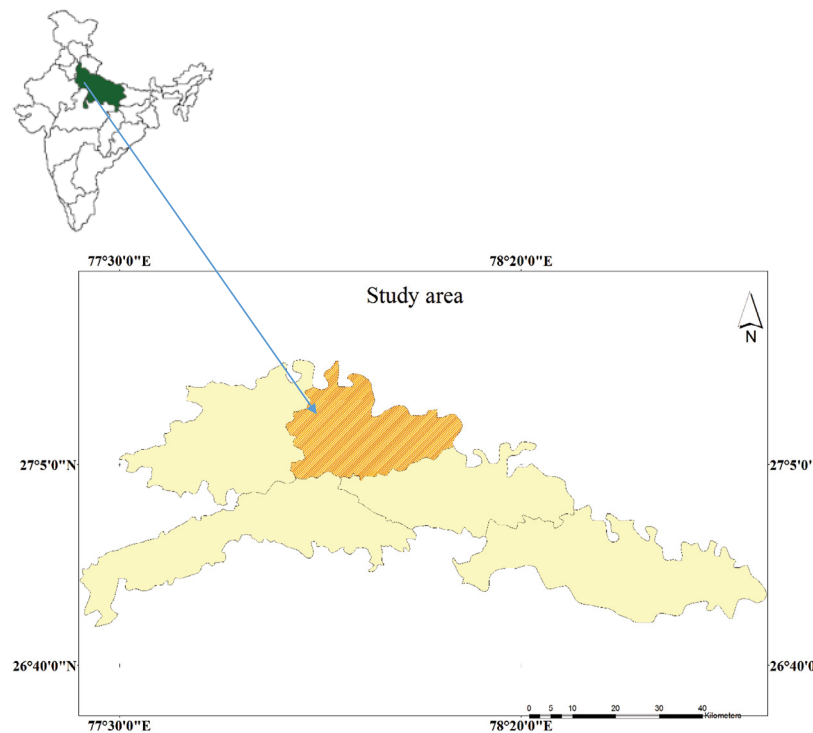


Figure 1: Study Area.

Objectives

1. To prepare the land use/land cover maps of the study area for the year 2002 and 2015.
2. To assess the spatio-temporal rate and pattern of land use and land cover change in the study area for the specified time scale.

RESULTS AND DISCUSSIONS

Analysis through remote sensing techniques of the study area having a total area of 528.64 Km² helped the authors identify and map a total of 7 land use/land cover classes (2002 & 2015). These classes include water body, built-up, agricultural land, open ravine thorn forest, moderate ravine thorn forest, open scrub and barren land (Figure 2 and 3).

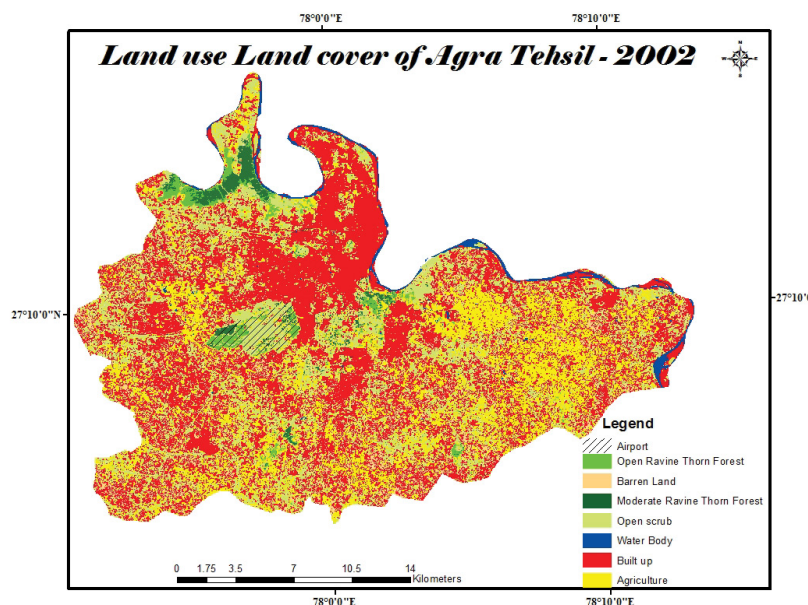


Figure 2: Land use Land cover of Agra tehsil - 2002

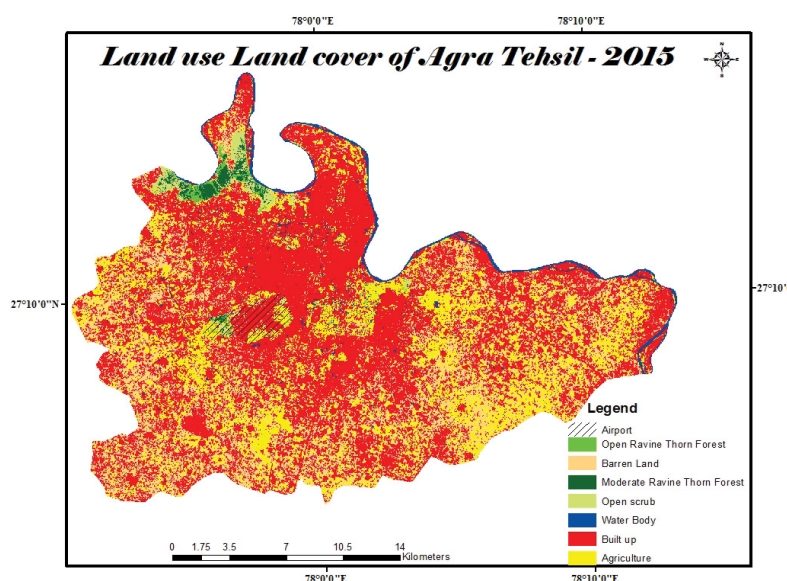


Figure 3: Land use Land cover of Agra tehsil – 2015

The statistics of the various land use/cover classes of 2002 and 2015 is given in Table 1 and class wise changes between 2002 and 2015 is shown in Table 2.

Table 1: AGRA TEHSIL – LU / LC IN 2002 AND 2015

Sr. No.	Land Use / Land Cover Classes	Area in Km ² (2002)	Area in % (2002)	Area in Km ² (2015)	Area in % (2015)	Variation from 2002 to 2015 (Km ²)
1	Moderate Forest	8.28	1.56	4.35	0.82	3.93
2	Open Forest	8.71	1.64	2.24	0.42	6.47
3	Open scrub	105.4	19.93	8.95	1.69	96.45
4	Built-up Land	230.69	43.69	305.44	57.80	- 74.75
5	Agricultural Land	126.26	23.88	104.91	19.84	21.35
6	Water body	15.23	2.88	12.06	2.28	3.17
7	Barren Land	34.07	6.44	90.69	17.15	-56.62
TOTAL		528.64	100	528.64	100	-

Source: Calculated by the authors

Table 2: Class Wise LU/LC Change (2002-2015)

Sl No.	Change to	Built up	Barren Land	Moderate Forest	Open Forest	Water Body	Open Scrub	Agriculture	TOTAL (2002)
	Change from	Area	Area	Area	Area	Area	Area	Area	
1	Built up	205.83	4.55			-	0.28	20.03	230.69
2	Barren Land	27.21	4.44			-	1.29	1.13	34.07
3	Moderate Forest	0.54	0.03	4.23	0.4	-	1.83	1.25	8.28
4	Open Forest	1.09	1.57	0.12	0.9	0.17	2.1	2.76	8.7
5	Water body	0.35	2.79			11.89		0.2	15.23
6	Open scrub	35.17	33.14	0	0.8	0	2.35	33.94	105.4
7	Agriculture	35.25	44.17	0	0.14	0	1.1	45.6	126.26
	TOAL (2015)	305.44	90.69	4.35	2.24	12.06	8.95	104.91	

Source: Calculated by the authors

Built up land

Built up is an area of human habitation which has a cover of buildings and network of transport and other civic amenities (**Chaudhari, 2008**). In the present study, built-up class include settlement, commercial/industrial zones, educational, governmental offices, roads, hospital and religious categories. The study area has seen unprecedented and haphazard growth in this sector. Agra is a famous tourist place in north India. Due to tourist activities and population growth, land under residential blocks, hotels, lodges, gardens and waste dumping places have increased. Nucleated settlement is seen throughout the study area. The extent of built up has increased rapidly in the span of 13 years. Built-up area has increased from 230.69 Km² in 2002 to 305.44 Km² in 2015 (increase in 74.75 Km²). Villages and small settlements have been encompassed in the rapid urban sprawl of the study area. In general it has been observed that the settlements having scattered/dispersed built up area in 2002 has been converted to nucleated settlement whereas the urban fringe/rural areas having already dense built up area has been converted to large semi-urbanized to urbanized nucleated zones. The general trend of settlement distribution was observed in the northern and central part of Agra tehsil (Agra city and its adjoining areas – Gopal Pura, Lohamandi, Sadar etc) and the area adjoining the Yamuna river (Dayalbagh, Tajganj and Poiya Ghat area). The maximum amount of conversion to build up has occurred from agriculture over the past 13 years (Table 2).

Agricultural land

The land primarily used for farming and producing the food grains, oil seeds and other commercial crops comes under this category (Jadhav et al, 2012). Kharip and Rabi crops are grown in this area at present which includes wheat, bajra, maize, sarso, jowar etc. In the year 2002 the total area under agricultural land use was 126.26 Km² which decreased to 104.91 Km² in 2015. Thus there is an increase of 213.27 Km² of agricultural land during the period of 13 years in the study area.

Earlier (2002) Chana, Red gram, Til, were also grown, however due to decrease in water quality and quantity of canal water which has now become brackish the agricultural pattern has changed. At present agricultural land has been reduced to the eastern and southern part of the study area (Figure 3). The proportion of this land was observed on a large scale in Bamrauli Katara, Dauki, Bakalpur, parts of Shamsabad, Udar and Kiraoli villages. Rapid loss of agricultural land has occurred almost throughout the study area. The areas adjoining the river which otherwise has fertile soil has also being converted to built up. The highest loss of agriculture land has occurred towards barren land yielding 44.17 Km² (Table 2), which in due course of time will be converted to built up.

Forest

Forest is not only essential for their products, but also their role in maintaining the significant ecological equilibrium in the region (**Suryavanshi, 2010**). The study area is generally devoid of any dense forested land. However it has 05 reserved forest areas (declared in 1956)– Bainpur RF, Mau RF, Babarpur RF, Antony RF, Taj Forest Block. The total area, according to government records, is 16.11 Km². Generally ravine thorn forest is predominant in these forests with the species being local Babool, Semul, Khejri and other shrubs. Blue bull, Wild boar, porcupine, spotted deer, various snakes etc are found here in small numbers. Rapid deforestation due to anthropogenic cause and climatic factors like semi –arid condition have provided the impetus for loss of natural vegetation and biotic life. In 2002 the total area was 8.28 Km² and 8.71 Km² respectively for moderate thorn forest and open thorn forest. This includes the RF areas, adjoining areas of Yamuna, forested zone of airport area and scattered places throughout the study area. Scrub vegetation (105.4 Km²) is found in the fringe areas of the forested areas, barren lands, along Yamuna and airport area (Table 1). This category has however declined drastically to 4.35 Km² and 2.24 Km² (moderate thorn forest and open thorn) and 8.95 Km² for scrub vegetation in 2015 respectively. The area which was once home to wild animals, is now devoid of animals. Major encroachment in the form of urban sprawl, extension of agricultural activities is observed in the periphery of the reserved forest area which has shrunk its size.

Barren

Barren land includes the areas with no vegetation cover, stock quarry, stony areas and uncultivated agricultural lands. The land is associated with poor soil, heavy rainfall and instant erosion (**Vaidhya, 1997**). In the year 2002 the total area under this class was 34.07 Km² which decreased to 90.69 Km² in 2015. In the course of 13 years most of the barren land paved the way to human habitation and dry farming. Exception to this is found in the western and scattered parts of the southern part of the study region. The increase in the area of barren land is owing to the anthropogenic causes. The lands are kept fallow (which subsequently develops scrub vegetation) over a long period of time intentionally

to be converted to built up area which fetches the owners' lucrative income. This is proved from the fact that the maximum amount of barren to other category transfer has been taken place to built up (27.12 Km²) (Table 2).

Water body

Water body includes the rivers and water reservoirs of the study area. Yamuna is the main river in the study area. In the year 2002, the total area under this category was 15.23 Km² which decreased to 12.06 Km² in 2015. Various research work on the quantity and quality of river Yamuna has proved the fact that in recent years the quantity and quality of the river water is being drastically reducing. (Bob, 2015). Added to this are the various anthropogenic factors like encroachment from built up and agricultural land on the water bodies have resulted in decrease of more than 3.17 Km² during the study period (Table 1).

CONCLUSION

The above study shows an unprecedented and haphazard growth in the build up land. Significant changes were also observed in the Agricultural land use during the study period of 13 years (2002-2015). The change was tested using supervised classification technique and change detection analysis. This change can be attributed to increase in population, urban sprawl and allied commercial activities. Agra being a tourist destination suffers dearly at the hands of chain brand hotels exploiting the cities

More over the problem is escalated due to spill of population from the urban areas the fertile lands have been consumed by build ups. To suffice the needs barren and fallow lands are brought to use. Further illegal encroaching of forest land adds up to the ecological degradation. Not only forest land flood banks of Yamuna river are also encroached by the population.

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