

A Geographical Review of the Land Use Patterns of Kanpur City, India

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Abstract: *Land Use is a systematic study of utilisation of land resource by human society to fulfil their multiple needs. It includes various facets of economic, socio-cultural and political needs. These dynamic facets create different types of land use patterns which resulted into the development at local and regional level. Recently, more emphasis has been lead on the eco-friend production and consumption. The present study is an effort to identify and analyze the pattern of existing land use patterns in Kanpur city.*

Keywords: *Land use, Natural resources, GIS-Remote sensing, Land utilization, Imagery, Residential Area, Industrial Area, Built-up Area,, KMC(Kanpur Municipal Corporation)*

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I. Introduction

Changing Land use is one among the most important environmental challenges for environmental managers across the globe now the days. Land use is well known as the conversion of a land for a specific purposes like agricultural activities, housing, entertainment, industry and transportation like purposes in pieces or in whole in any region. Nature of land uses is dynamic and changes comes during the course of time. Land use pattern refers to the distribution and interaction of natural and man-made resources that lie on the earth surface. "Many geographers has argued that the primary aim of the study about the general pattern of land use is to portray the plan and distribution of land to various uses ranging from field to factory, forest to foundry, pasture to pond and sandy stretch to settlement" (Kumar, 1986)

Historically land is an important part of earth's physical environment having different natural and human uses. Development of human civilization bring man more wise and efficient to utilize resources and when he equipped with skill and scientific knowledge, land become most important natural resource that would be reshaped/transformed to fulfil his needs for different purposes. He started the conversion of natural landscapes into cultural land scape asnew land uses. Resultantly, variety of land use categories has emergedglobally. The reflections of interaction between man and nature deciding the composition of land uses of a particular regionin any dimension. The land-use and land-cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space Land use/Land cover change has become a vital component for natural resources management and monitoring of environmental change, for various developmental and resource planning activities at global and regional scale (Kandrika and Roy, 2008; Roth et al., 2016).

There are many categories of land use within the broad categories like physical, social and economic categories. These categories generally operate together but in circumstances they did separately also. "There are two sets of limits which determine the pattern of land use in any particular region. First, the absolute or outer limits which are set by nature and second, the relative limits which are set by culture, human attitudes and actions that determine the range of actual and probable use within the limits" (Zimmermann, 1951). Human society from its historic evolution on earth surface has been using natural resources to fulfil their basic needs. During the course of historic development of human society, they have expanded their basic needs and desires, ultimately that forced them to produce more and more foods, goods and facilities. This greedy and selfish human behaviour became fatal for nature and further produce imbalance between human being and natural resource availability. Ultimately, all this hampered naturalenvironmentmarked some problems for human society.The most common reason for the problems is rapid population growth and unplanned uses of resources, particularly these problems have high magnitude in our urban spaces, our towns and cities. Exponential population growth is putting constant pressure on natural resources; leading to over exploitation of natural resources to an alarming state in the 21st century (Crutzen & Stoermer, 2000).

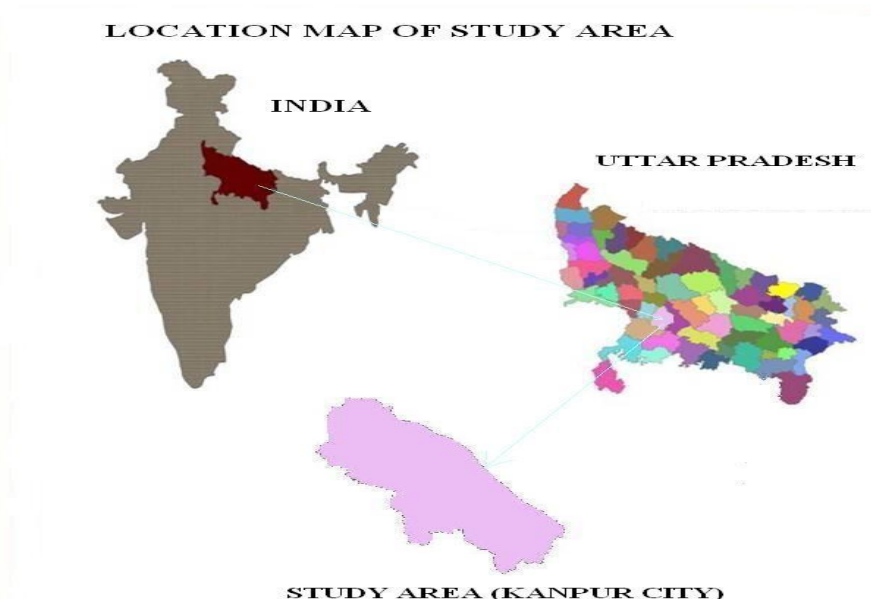
The urban areas indicate the high rate of population growth than their rural counterparts. Urbanisation in India is getting momentum after liberalization and globalisation of economy in nineties. Cities growing rapidly due to more employment opportunities, easy access to health, education and other facilities. It bring burden to

their existing resources. Land resources have become of prime concern for planners because sprawling cities are eating more and more land to continue their functions to fulfil the needs and desires of their residents.

II. Study area:

Kanpur extended at 26° 26' North and 80° 19' East coordinates and known as the financial and industrial capital of Uttar Pradesh. Kanpur is situated on the banks of the river Ganga. Population of the city was 2.9 million as per the census 2011. Kanpur is famous for leather and textile goods of superior quality. It is now one of the main industrialized cities. Kanpur city is famous for leather, wool, cotton, vegetable oil mills, chemical works and sugar refineries. Formerly known as Manchester of the country. Kanpur is the biggest city of the State of Uttar Pradesh and is main centre of commercial, industrial and educational activities. The percentage of the workforce involved in the primary, industrial and service sectors are 4 per cent, 31 per cent and 65 per cent respectively. The city is bound between two rivers, the Ganges in the North and the river Yamuna in the south. It is a linear pattern of settlements developed between rivers and the railway lines. City is well connected with road and railway routes to rest of India.

Figure 1. Study Area Map



Objectives of the study:

Current paper has the following objectives to analyze the land use cover and patterns in the Kanpur city with the help of remote sensing (RS), GIS and to access the present status of urbanization with the help of Geospatial and conventional data available for the study.

III. Database and Methodology

Current study is mainly based on secondary source of information. Different sources of information have been used to collect data like census of India, Statistical abstract of the state, websites of the governmental departments, open source GIS, Google, etc. The present study used remote sensing spatial data as well as the non-spatial data. The Geographic Information System (GIS) and Remote Sensing (RS) tools have been applied to find out the residential area of the Kanpur. The satellite data consists of high resolution Cartosat – 1 and LISS–IV data. Topographical sheets and administrative boundary maps have been used to find out the city ward boundaries. To reach at the conclusion various layers of data have been superimposed with the help of geographical information system software (Arc-GIS 10 and open source GIS). Visual interpretation technique have been used to interpret the imagery data to bring results.

IV. Discussions And Results:

Remote sensing and GIS are highly capable in urban studies particularly in urban management and planning. The present study clearly demonstrates the importance and role of GIS based Information System and potentialities of Satellite Remote Sensing in urban studies. Detailed maps prepared using satellite data depicted existing different land uses in Kanpur city. Visual Interpretation of the constructed maps categorized the different land usages includes built-up urban, vacant land, built-up rural, agriculture land, scrub land,

Quarry\Brick-kilns, water bodies, drain, transportation (road poly, rail poly) and canal etc. Built-up area dominates among the all other categories. Table I and II represent the categorization scenario at glance. Study area, Kanpur MC covers a total area of 260010231 square meters. It is dominated by the Built-up urban area (Table I) that covers its 49.73%. Other features, e.g. vacant land, transportation, built-up rural, agriculture land, scrub land, Quarry\Brick kilns, drain, river\streams, canal, water body covers the rest. A detailed analyses have been curved out below under different sections.

Table: 1. Land Use Categories in Kanpur City (Ward Boundaries)

Sr. No.	LU/LC Features	Area in Sq. Meter	Area in Percentage
1	Built-up Urban	129319713	49.73
2	Vacant\layout plotting	20911225	8.04
3	Transportation (road, rail)	5950296	2.28
4	Built-up Rural	2650128	1.02
5	Agriculture Land	87570717	33.67
6	Scrub Land	8166926	3.14
7	Quarry\Brick kilns	19678	0.008
8	Drain	869523	0.33
9	River\ Stream	794464	0.31
10	Canal	737108	0.28
11	Water Bodies	3020453	1.16
	Total	260010231	100.00

Source: Satellite Images

Built-up Area: Urban

The built-up area is a good indicator to access the present status of urbanization with the help of remote sensing geospatial data and GIS techniques. On the other hand it can also help in assessing urban infrastructure development. The Built-up urban area alone covers 49.73% of total area of Kanpur MCBoundary. This area covered settlements comprising residential, transportation and communication lines, industrial and commercial complexes, utility and services etc. collectively. Urban or built up Land is comprised of areas of intensive urban land use for housing, industrial, townships, air strips along transportation corridors, areas occupied under construction activity, public/semi-public complexes, institutions, recreation and so on. The urban built up areas are generally bigger in spatial extent than the rural built up areas.

Built-up Area: Rural

This type of built-up areas are found in villages (Rural Areas) characterizing smaller in size, sparsely extended with extensive land uses mainly associated with agriculture and allied sectors and non-commercial activities with population size less than 5000 but in northern India population size sometimes reaches as high as 12,000-15,000 persons in larger villages. They are spatially discreet in distribution and have less connectivity and are surrounded by agriculture lands, forests and water-bodies. The built-up rural class alone constitutes 1.019% of total area of the Kanpur city. Low rural built-up reflect lower existence of rural settlements than counterpart urban.

Residential:

Half of the area of Kanpur city fall in this category and the residential area development between KMC boundaries found in circular form in core area, linear along with the transportation corridors extending outward the city outer from the central city and in planned & rectangular shape in sectorial & outer region of the city. The residential areas in a planned locality have a uniform size and spacing of structures unlike the unplanned with less spacing for open areas and roads.

Industrial:

Kanpur city is famous for leather, textile, wool, cotton, vegetable oil mills, chemical works and sugar refineries. Formerly known as Manchester of the country. Kanpur is the main centre of commercial, industrial and educational activities in UP. The study area consists of many industrial units, covering 11.02 % of the total urban built-up area. Major industries includes Steel Authority of India limited, The Elgin Mills, The Cawnpore

Woolen Mills, the Swadeshi, the JK and the Lakshmi Rattan Cotton Mills are heavy industries. Mostly industries are related to leather shoe making and cotton textiles. Defense Establishments like Ordnance Equipment Factory are also present there. Large number of small-scale industries have been established recently. The term mixed built-up category generally used for the Built-up areas with multiple functions such as industrial, residential or commercial or another set of functions. Here functioning like general stores, small hotels and restaurants, carpenters workshops, clothes markets, electronics market etc. are founded mixed up and cannot be separated easily. In KMC this class typically developed along with the transportation routes and also amidst residential areas. A mixture of commercial and industrial or residential and commercial occurs in urban areas are present in the studied area but small in quantity.

Table: 2 Land Use Under different Categories in Kanpur City (MC Boundaries)

	Built up Urban Area	Area in square meter	Area in (% age)
1	Residential area	86337069	50.45
2	Industrial area	18870784	11.03
3	Mixed Built up area	1267668	0.74
4	Recreational area	3232995	1.89
5	Public semi-public area	12660258	7.40
6	Communication area	232104	0.14
7	Public Utilities & Facilities	1308870	0.76
8	Commercial area	390373	0.23
9	Vacant Land	20911225	12.22
10	Transport (Road, railway, airport)	5019592	2.93
	Total		100

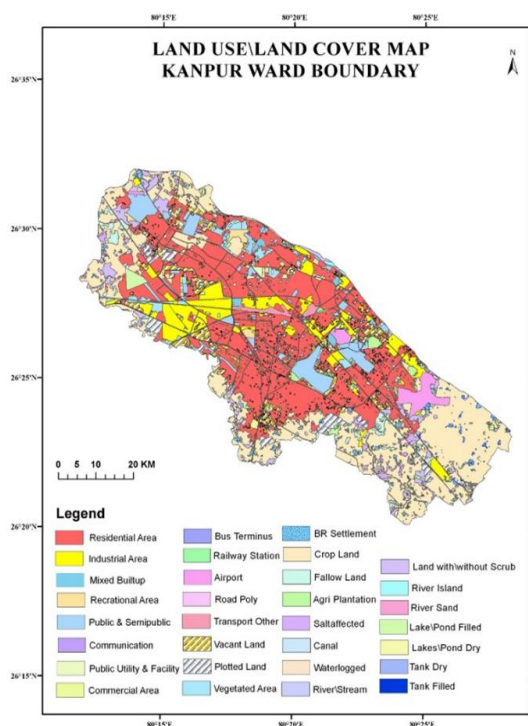


Figure 2 Land Use Ward Boundaries

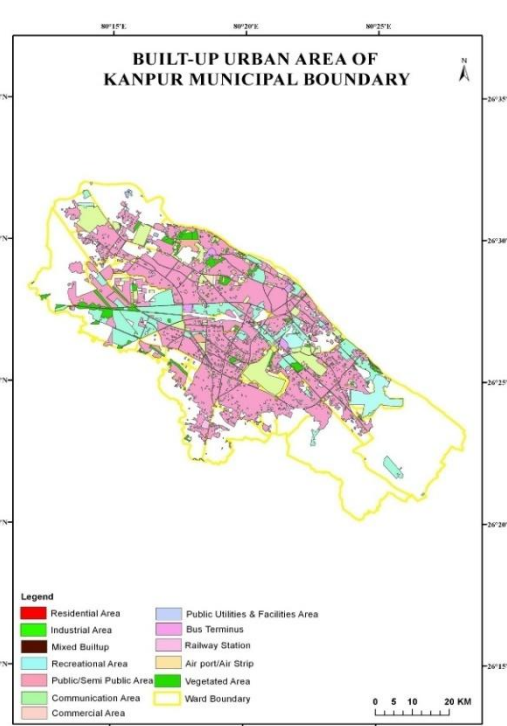


Figure 3 Built-up Urban Area (MC)

Recreational

Recreational facilities are the necessary part of the urban life. It bring people energetic and health conscious as per recent studies suggest. This category includes areas functioning to fulfil recreational needs and are basically on open land. These type of land uses comprising public parks, amusement parks (Water Park) picnic spot, view point, playground, stadium, cinema halls and in cultural and traditional features historical places, buildings and temples etc. are considered. In the study area there is a famous Green Park Cricket Ground, Kanpur Zoo, and Allen Forest Zoo (one of the best zoo of the country). Recreational land cover total 1.88% of study area. This land use category required immediate extension due to rapid population growth in last decades.

Public and Semi-Public:

Socially most important category of land use covering 7.39% of the total area under examination. This land use category used for place of work, education, religious activities, health, cantonment, social, and cultural centers. There are numerous educational institutions existing in Kanpur from a longer past, from School, colleges to IIT and now it became a major center for academic activities in Uttar Pradesh state. All buildings and grounds that are places of work are included within the institutional areas.

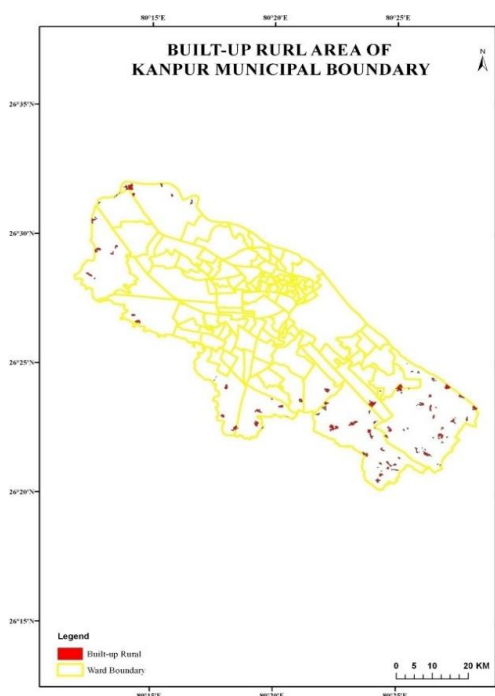


Figure 4 Built-up Rural Area

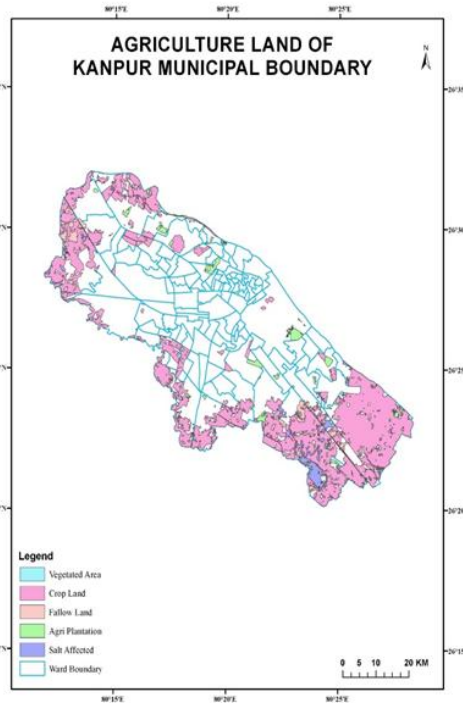


Figure 5 Agricultural within MC Area

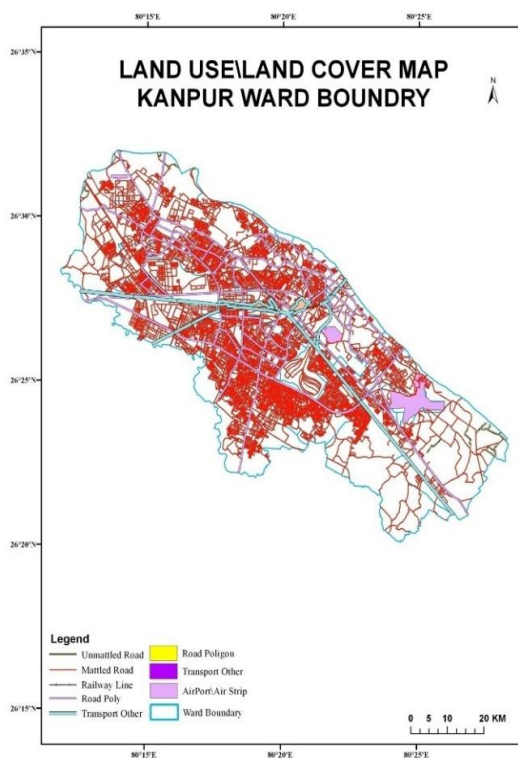


Figure: 6 Land Use Kanpur

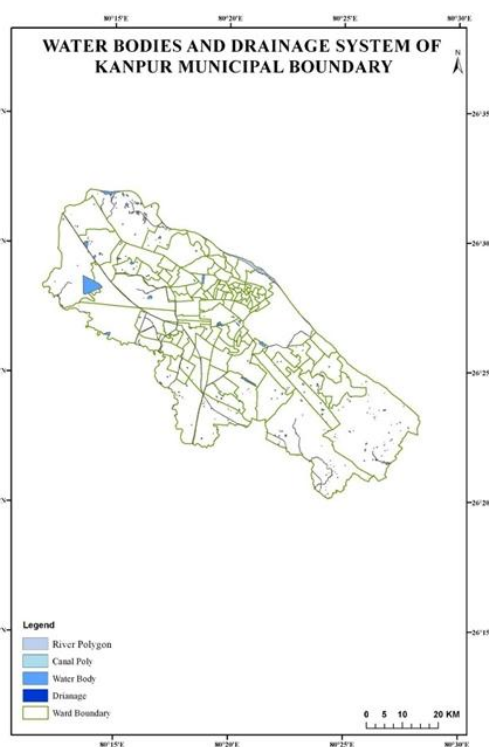


Figure5 Water Bodies & Drainage

Public Utilities and Facility:

General public utilities like water supply, sewerage, waste disposal/landfill, electric power, inland gas supply and so on. It includes water pumping and treatment plants; gas and oil storage tanks and pipelines, and power plant, transmission lines and so on. This type of land use occupied 0.76% of the total study area.

Commercial Area:

Commercial areas are those used predominantly for the marketing, buying and sale of products and services, having offices, shops, malls and bazaars. This land use have been often develop mixing with the residential, public and semi-public land uses or along the main roads/streets. Commercial category includes Central Business District (CBD); retail and wholesale business and hospitality outlets, shopping malls, warehouse market yards and others have occupied 0.23 percent of total land in use in Kanpur MC under the mixed built-up category.

Vacant Land:

Sometimes pieces of land remain unused due to economic, social, political or administrative reasons known as vacant land and it could be kept for future development. The availability of the vacant land in an urban area determines its future development projects and its sustainability to the some extent. Such lands may be plotted or developed as layouts under construction later. (Pradeep, 2012). Only 12.21% percent of the total area between MC boundaries lying vacant in Kanpur study area.

Transportation

Transport and communication system is one of the major aspects of development of any region from historic period to the day today. Mostly mass population uses the road network because most of the places are well connected with road in compression of the other means of transport. Major transportation routes influence other land uses in their serving areas. The roadways network include major and minor roads / streets, bridges / flyovers, expressway, ring road and traffic islands. Another transportation network available in study area are railway and air. There is a bus stand, railway station, and airport in Kanpur with notable coverage of near about 3 percent land use of total area under KMC boundaries.

Table 3 land use under transport category

Sr. No.	Transportation	Area in %
1	Road	0.911
2	Road poly	0.04
3	Bus Terminus	0.00062
4	Railway station	0.0018
5	Air port	0.0077
6	Road poly	0.22
7	Transportation other	0.036

Water Bodies and Drainage

Surface water bodies are very important not only for irrigation, drinking, domestic and industrial usages but also for natural groundwater recharge systems. It comprises areas with surface water, either impounded or in the form of lakes, ponds, tanks, reservoirs, canal, rivers and wells. Those can be clearly identified and delineated on the satellite image based on size and shape characteristics. In Kanpur city a minimal 1.16 percent area fall in this category and it fulfil the requirements of a large population base of the city. In Kanpur existence of a lake in northern eastern part and some pounds is depicting from satellite imageries. Land use under drain, river and canals comprise only 0.92 percent respectively.

Agricultural Land:

Cities are eating surrounding agricultural land rapidly due to their fast expansion all over the globe. Kanpur is not exception and expanding on the cost of agricultural area. In agriculture land use category several sub categories have been always taken into account in by scholars like vegetated area, orchard/plantation, follow land and saline land are considered in study. In Kanpur agricultural land comprises 33.67% of the total area with four percent of fallow land (lands which are uncropped during the agriculture year under consideration) and 3.14 percent land with or Without Scrub. It is the area of dwarf or stunted trees and shrubs usually growing on poor land. There is a possibility of conversion of this land use in another one or more categories.

V. Conclusions:

Unprecedented population growth in India leads to unplanned and unmanaged developmental activities. These unplanned development activities generate pressure on infrastructure facilities and slacken off the sustainability. The spreading out of land use in an urban area expand along the transport nodes and roads or such other patterns in case of different phenomena in Kanpur. With the establishment of the industries, immigration in Kanpur city takes place from various directions in search of economic opportunities. As the area develops, commercial centres and services come up to specialize in economic functions. Kanpur is among the most industrialized cities in India and it works as a pull factor of immigration in the city due to better employment, education facility and other services. These demographic and economic factors promote the spatial growth and expand the city outward to fertile agricultural land.

There is a lack of demarcation between residential area and other land uses as it has been observed in the cities of western countries by various scholars. A mix pattern of all types of land use is found in most of wards in Kanpur. It seems there is a significant requirement of residential area to accommodate the city's rapidly growing population but unplanned and irregular residential setup looking became hurdle to provide habitat to all. Dense settlement pattern indicating to reduce the burden of the city, specifically in some areas. Kanpur Development Authority has planned to develop 5000 acre Hi-tech residential land use as New Kanpur City which is located at Kalyanpur-Bithoor road and Jawaharpuram on Shivali road. City need improvement in land use under public utilities and public and semipublic categories also. Increasing population growth put pressure on existing resource base and Kanpur should have a master plan for at least next 20 to 50 years. There is a less scope of horizontal spread of the city, so the planner and city developer should think over the vertical expansion of the city.

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