

STUDY OF URBAN MORPHOLOGY AND LAND USE IN THE FRINGES OF PIMPRI CHINCHWAD, PUNE - MAHARASHTRA

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Abstract:

Urban Morphology approaches human settlement over the long period of time with formation and transformation. It is a continuous building process of successive generations with land subdivision, building construction and infrastructure development. Analysis of physical form which focuses on building pattern, street pattern collectively referred as urban grain.

This paper aims to study the effects of haphazard fringe development in Pimpri-Chinchwad, Pune on various services like transportation, road network, plumbing, electricity, accessibility etc. It also addresses the present morphological structure of the city fringe with its positive and negative aspects in terms of planning. Design methodology for this research will be based on examining secondary literature in the form of development,

planning reports, surveys, analysis and findings, context analysis to understand the haphazard development in the periphery of Pimpri Chinchwad, Pune. Cartographic analysis will be done to understand/observe city boundaries and its development. This Research found significant development in and around the boundary of Pimpri Chinchwad, Pune.

Research limitations will be to understand the development pattern in the fringe area, research will be restricted in the periphery from the PCMC (Pimpri Chinchwad Municipal Corporation) boundary, Pune. Practical implications would help to do futuristic planning development in the urban areas with the help of positive and negative aspects from the study.

Keywords: Urban morphology, land use, fringe area, services, formation, transformation, settlement, Pimpri Chinchwad, Pune.

1. Introduction:

The term Urban morphology are subject to a variety of different forms of investigation. While almost all of them concentrate on the physical structures of urban environments and their growth patterns on the fringes.[1] Urban morphology is the study of a city's physical structure. It consists of street patterns, sizes and types of building construction, architecture, population density, patterns of residential, commercial, industrial, and other uses. Morphology studies deal with the development of forms and behaviors of the current city or other urban areas over time in short with evolution. It includes studying and analyzing the effects that the development of fringe areas exerts on the city's social and economic systems, its economic structure, building patterns and land use. [13] Whatever approach to urban analysis is taken, in terms of their geometric shape, cities are typically visualized at some point. In spatial terms population, fringe growth, urban economy, transport, and social structure are predicated, and therefore the implications of such theory are always expressed by geometric notions concerning the form of urban land use and the way it spreads.[9] The space syntax relationship between different spaces or interaction between space and society. These beliefs promote the idea that human social interactions are profoundly influenced by spatial layout or structure. Space syntax, from its roots in urban science, offers a vocabulary of space that is of interest to many fields of study and implementation involved in the definition and analysis of the city's spatial patterns.[8] City designers can gain a greater understanding of the development of urban environments and gain further knowledge through the structural study of an urban environment to assist with the design of future urban layouts.

All these researches appear to be focused on the premise that in urban settings, spatial patterns or structures have a great effect on human activities and behaviors. [8] The importance of space syntax has been demonstrated for the modelling and understanding of urban patterns and existing structures.[5],[6] Cartographic redrawing, a geographic information system (GIS) is

the based tool able to support the analysis of the urban form of large cities, throughout long time periods. [11] Gospodini, A. (2004) In his paper, he explores the ways in which unique aspects of urban morphology, such as constructed heritage and creative spatial design, can contribute to identity placement in European cities. First, it develops a theoretical assumption that in post-modern multi-ethnic and multi-cultural societies, innovative space design can function effectively as a place identity generator in the same way that modern, culturally bound and nation-state-oriented European societies have performed.[4]

The Pimpri-Chinchwad Municipal Corporation (PCMC) comprises the study area, is a sister city of Pune and is located on the Mumbai-Pune National Highway (Part of NH 4). Established in 1982, it covers an area of approximately 87 square km. This was the wealthiest municipal corporation in Asia some time back, and the reason behind it is that it has an industrial belt of both small and large national and multinational companies.[3] Pimpri-Chinchwad is 160 km from Mumbai and is located north-east of Pune. The east-west ridge running halfway between the rivers Indrayani and Pavana separates this area into two sections from the mean sea level. The northern part slopes towards the river Indrayani, while the southern part slopes towards the river Pavana. Since the study area has witnessed considerable urban and industrial development, it will prove useful for environmental management and urban planning to estimate and map LULC (land use land cover) changes for this area. Remote sensing data from the satellites are used to chart land use shifts in the PCMC over the 14-year period from February 1997 to 2011 in order to achieve this objective. [15] The future growth of every city usually spreads to fringe areas and incorporates haphazardly developed areas into the centre of the city. The question of "Ineffective Land Use Patterns" resulted in radial growth in land use on the fringes of the city and transport system. [12] On the neighbourhood scale, using GIS and RS technologies, the spatial relationship of energy demand is examined in built environments. The land-use types, the Normalized Difference Built-up Index (NDBI), the Normalized Difference Vegetation Index (NDVI) and building details (building height, plot area and building volume) are used for spatial regression modelling. [2] The spatial relationship between urban morphology and urban energy demand is the main focus of the researcher's study.[2]

In view of all of the above, there is a need to research urban morphology and land use on the outskirts of Pimpri Chinchwad, Pune, as it is a rapidly expanding city on its outskirts and therefore needs to be fitted with all of its basic amenities and to improve the living standards of its citizens.

2. Area of study: Pimpri Chinchwad Municipal Corporation (PCMC):

This research aims at undertaking a study of the development pattern in the fringe area of the PCMC (Pimpri Chinchwad Municipal Corporation) boundary, near Pune. Pimpri Chinchwad is a newly built urban area on the outskirts of the city of Pune. It is a sister town of Pune and is located on Mumbai-Pune National Highway (NH 4 part). Pimpri-Chinchwad is located north-east of Pune, and is 160 km from Mumbai, covering an area of 171,59 sq. Kilometer.[3] The east-west ridge which runs midway between the rivers Indrayani and Pavana separates this area into two parts. The northern portion slopes towards river Indrayani while the southern portion slopes towards river Pavana. [3]

Since the study area has seen tremendous urban and industrial growth, it will prove valuable for environmental management and urban planning to estimate and map the LULC (Land Use Land Cover) change for this area.[3] To achieve this goal, satellite remote sensing data are used to chart changes in land use in the PCMC over the 14-year period from February 1997 through 2011. Historically, the PCMC area was chosen as the area to resettle refugees from Pakistan post Partition. The establishment of the Maharashtra Industrial Development Corporation (MIDC) in 1961-62 and its focus on Pimpri Chinchwad led to the area evolving into a major industrial belt. The corporation encouraged the setup of units of large industrial conglomerates as well as development of new ancillary manufacturing units around them. Over the last few decades Pimpri Chinchwad has evolved into a large major industrial centre in western India developing complete ecosystems and supply chains supporting multiple industrial sectors. This ecosystem coupled with good infrastructure has helped it attract significant foreign direct investment in the manufacturing sector. Today it is home to large home-grown industrial names such as Tata, Bajaj, Mahindra among others and many global manufacturers such as Volkswagen and Mercedes Benz.

As a result of this growth in industrial activity the area has become a major human capital hub providing employment to both skilled and unskilled labour and attracting workers from not only nearby areas but also from different parts of the country. It has also become a major educational and training hub with many educational institutes setting up shop to cater to the different human capital requirements of the industrial units in the area. The result has been a significant migration of people resulting in significant increase in human population in the area. Due to rapid growth and expansion in the area, PCMC limits were extended by merging 18 fringe villages within the corporation limits. These villages are Talawade, Chikhali, Moshi, Dudulgaon, Wadmukhwadi, Dighi, Dapodi, Bhosari, Sangavi, Pimple Nilakh, Wakad, Punawale, Kiwale, Mamurdi, Choviswadi, Charoli BK, Bopkhel and Ravet.

The main sectors of economy in the area are:

- a. Auto and auto ancillary industries
- b. Higher education centers
- c. Large services industry around IT
- d. Emerging biotechnology (BT) hub
- e. Growing agro and food processing Industry

The vision of PCMC aims at ensuring the 'economic development of the region' one of the pillars is its ability to attract quality talent. It aims to achieve it by improving the quality of life of the citizens of Pimpri-Chinchwad. It aims to do so by focusing on the following points:

- a. Providing universal access to the urban poor
- b. Improving the standard of education
- c. Providing an efficient administration

Additionally, PCMC is focused on turning itself into a leading digitally regulated organization through smart governance, resulting in quality control and enhanced service delivery. It has put in significant resources in building up infrastructure to meet these objectives. This study focuses on the infrastructure PCMC has developed in the recent past with a view to comprehend its strengths and weaknesses. The study will look at following areas

- 2.1. Population and Spatial Growth of the Municipal Corporation
- 2.2. Growth Management and Land Use
- 2.3. Urban Transport
- 2.4. Roads and Street Lighting

2.1. Population and Spatial Growth of the Municipal Corporation

Since PCMC (Pimpri Chinchwad Municipal corporation) was established as a colony to resettle refugees after partition, the municipal corporation and the region it manages have come a long way. It is a thriving industrial hub catering to multiple sectors of the economy attracting both skilled and unskilled from near and afar. Due to the growth of the economy migration has been a major reason for the growth in population. [15]

The growth of the municipality has been in phases, each phase being driven by a new set of economic activity. Pimpri Chinchwad New Township Development Authority (PCNTDA) was established in 1972 which helps to create a planned environment for the working population. The municipal corporation Pimpri Chinchwad was established in 1982 with inclusion in municipal council of seven villages i.e. Sangvi, Rahatni, Sangvi Pimple Nilakh, Pimple Gurav, Pimple Saudagar, Thergaon, Wakad (Partial). In 1997 the area of PCMC became 86 Km², 18 villages were added to PCMC with a gross surface area of 84,51 Km². PCMC covered an area of 171,56 km².

After 1990 the new form of industry called IT industry began to emerge mainly within the PMC and PCMC fringe regions. Migration of skilled people increased and the regions around these industries started to develop as residential areas, and also a commercial area. [15]

In 15-years period time the total 38 fringe villages counted within the PMC and 18 villages in the PCMC region and the total urban area was nearly doubled i.e. 669.3 Km². The process of fusion of villages in the fringe zone continues to extend the metropolitan area to 669,3 Km², in which Pune city has occupied 430 Km², and PCMC has occupied 171.51 Km². [15], [14]

The growth of the population was so strong that the area expansion of PMR continues till the recent past. In 1981 the population growth of PCMC was 178.82% which declined to 95.8% in 2001. This may be because of inclusion of 18 villages in PCMC region. [15]

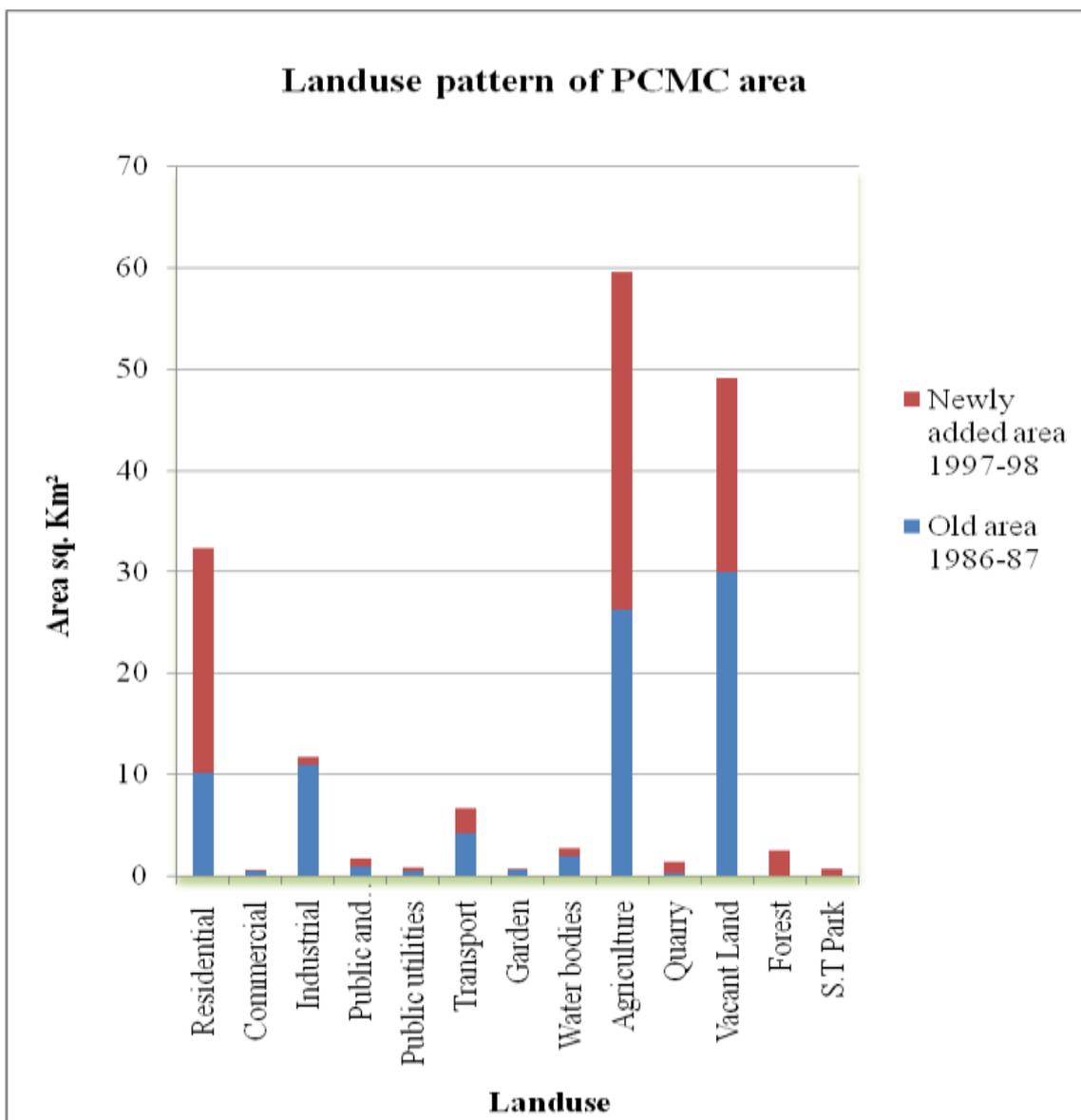


Fig. 1. Bar Chart
(Source: PCMC Development Plan)

2.1.1. Growth in Population within Municipal Corporation – A statistical perspective

As per the 2011 India statistics, Pimpri-Chinchwad had a population of about 1,729,320. Talking about population, in order to check out the population of Pimpri-Chinchwad in 2017, we need to have a look at the population of the past 5 years. They are as per the following:

2012 – 1.75 Million 2013 – 1.78 Million 2014 – 1.82 Million
 2015 – 1.84 Million 2016 – 1.86 Million

Taking a look at the population of Pimpri-Chinchwad from the year 2012-16, it has been noticed that there has been an increase of 1.1 Million in the past 5 years. Therefore, it has been seen that every year the population increases by 0.22 Million. Hence, the population of Pimpri-Chinchwad in 2017 is forecasted to be 1.86 Million + 0.22 Million = 2.08 Million. So, the population of Pimpri-Chinchwad in the year 2017 as per estimated data = 2.08 Million. (India Population 2017)

The increase in population has given rise to its own set of challenges. It has led to the growth of urban sprawls. Sprawling neighborhood residents continue to emit more emissions per person and experience more fatalities in traffic. Sprawl is problematic with proponents saying Consumers prefer neighborhoods of lower density and that sprawl don't automatically raise in traffic. [17], [14]

As regards spatial development, by the end of the last millennium the municipality has expanded from about 64 square kilometers to over 170 square kilometers.[15] Table 1, Fig. 2., Fig.3.

The timeline for this growth has been captured in the table below

Sr. no.	Year	Area (Km ²)	Spatial Growth
1	1970	Pimpri Chinchwad Municipal Corporation-“C” class city , formed on 04-03-1970	
2	1972	64.65	Pimpri Chinchwad New Town Development Authority was established to create a planned environment for the working population.
3	1975	64.65	Status change from “C” class to “A” class from 7 th January 1975
4	1982	86	Municipal corporation is formed. Seven villages merged in the municipal council. PCMC is formed on 05-10-1982
5	1997	171.56	Addition of 18 new villages in PCMC area. Addition of 84.51 Km ² area.

Table 1
Spatial growth of Pimpri Chinchwad Municipal Corporation
 (Source: PCMC, CDP 2006-2012)

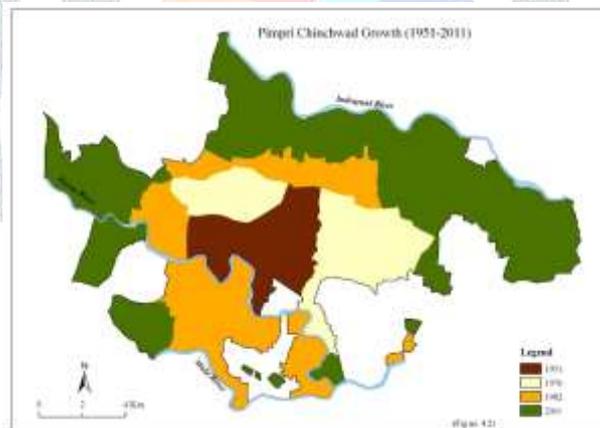


Fig. 2. The map below provides a different view on growth of the municipality over time

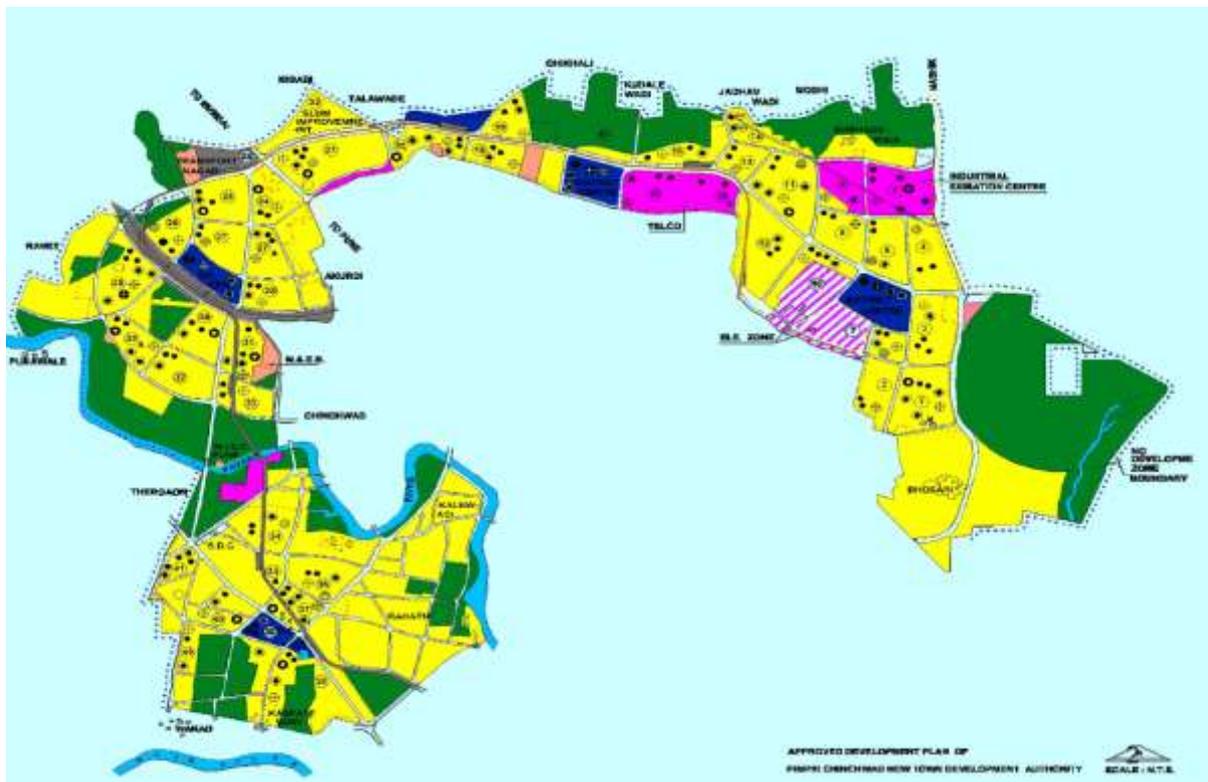


Fig. 3. Fringe area development around PCMC boundary (Pimpri Chinchwad New Development Authority-PCNTDA)

2.2. Growth Management and Land use

The town's development strategy is in the context of land-use planning. With the creation of the planning authority in 1982, a Development Plan (DP) for the 86 sq kilometer PCMC area was drawn up. State approved on 18 September 1995. For impact from 2 November 1995, the DP came into force. Within this old DP due for revision in 2007, 32 per cent of the region was built against a proposed growth of around 74 per cent of the 86.01 sq.km. Today, however, a research survey reveals that the entire 86.01 sq.km area has been established but not in line with what was envisaged in the DP. [17]

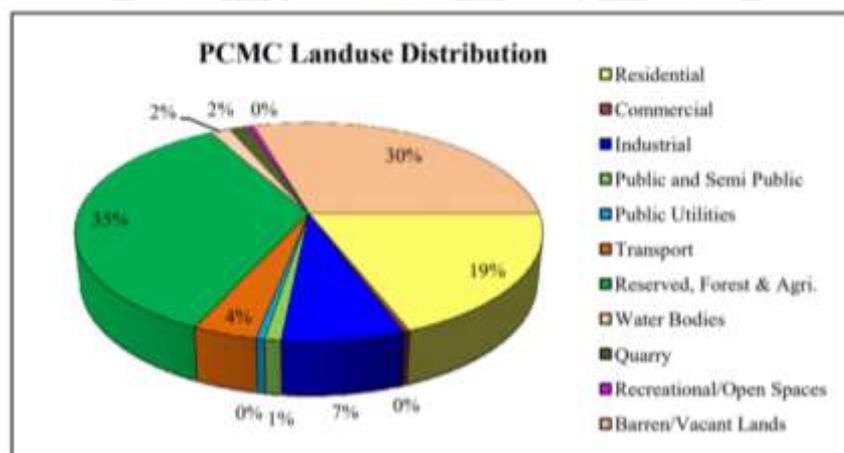


Fig. 4. The pie chart below gives a view on the land use distribution with the municipal corporation

(Source: PCMC - Land use distribution)

2.2.1. Executive Summary - Pimpri Chinchwad Municipal Corporation

Some areas which were under PCNTDA 's planning jurisdiction were integrated with PCMC in 1997. To these areas a new DP has been installed. This is in the draft stage and cannot be approved yet. The primary urban planning issue in Pimpri-Chinchwad is the time-consuming implementation of the DP, which has led to haphazard developments on the outskirts of the city. An established growth pattern as envisaged in the development plan is required for an orderly development and transformation of the city. [16]

Below Table 2 presented a description of the land through the different areas which constitute the municipality.

Sr. No	Land	Area (Sq.km)
1	Old Municipal Area	32.97
2	Newly Added Area	80.88
3	M.I.D.C	12.32
4	P.C.N.T.D.A	32.57
5	PCNTDA Transfer To PCMC	11.82
Total	170.56	

Table 2
Distribution of Pimpri Chinchwad Municipal Corporation Area (2001)
(Source: PCMC, CDP 2006-2012)

The increase in population has over time changed the land usage, significantly increasing the built-up area, reducing water bodies, vegetation, hills and barren land. Fig. 5

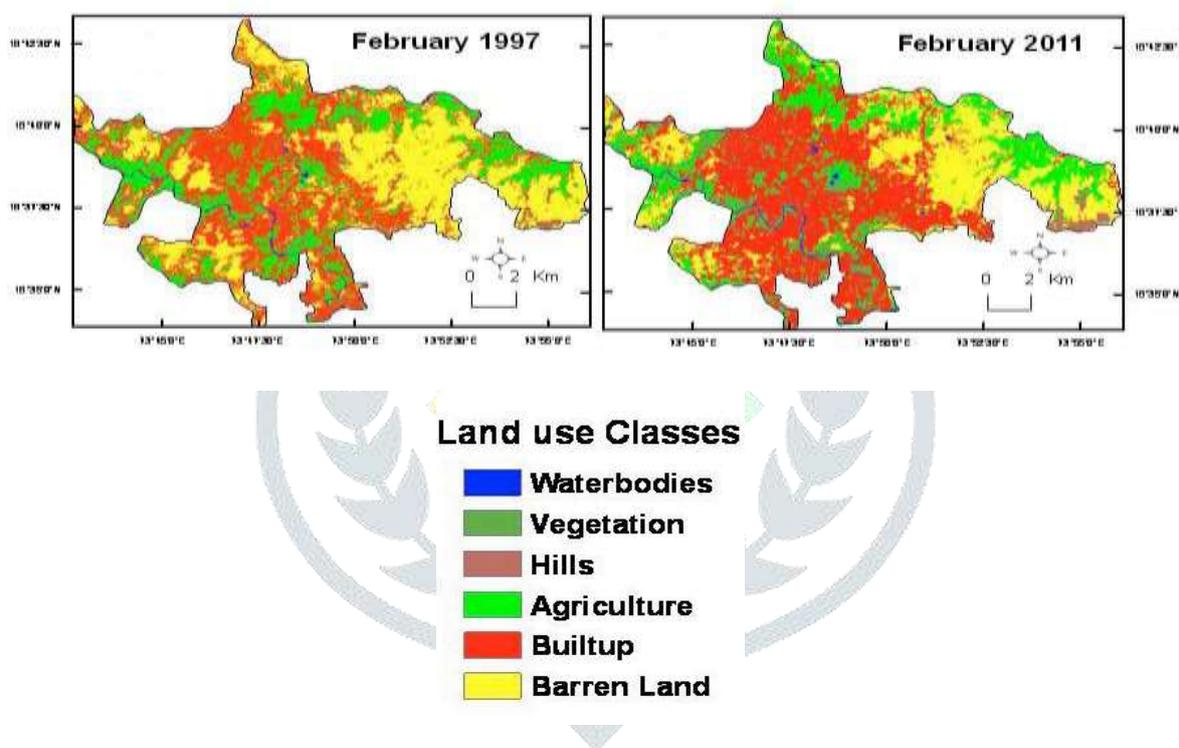


Fig. 5. The Map below shows how the land usage has changed over time.
(Source: PCMC Development Plan)

2.3. Urban Transport

As far as public transport services are concerned, Pimpri Chinchwad Municipal Transport (PCMT) is the sole provider of the service and has been in operation from 1974. The public transport network in the PCMC area is one of the CDP's most significant components and must be considered as an integral part of the Pune Metropolitan Region (PMR) consisting of Pune and Pimpri-Chinchwad. [16]

With five million residents, PMR generates 3.5 million daily commuters. For this, PCMT only serves 22 percent for commuters leaving the rest to use other modes of transportation such as three-wheelers and customized vehicles. PCMT's customer base and operating performance have declined dramatically over the years due to a lack of sufficient network upgrades. [16], [7]

PCMC includes more than 3.4 lakh vehicles registered. Their number has risen over the last five years at a rate of over 13 per cent. The biggest effect of the large number of cars on the road is the danger to the health of pedestrians / kids and the elderly.

Based on this infrastructure assessment, a demand-supply gap study was conducted to estimate the level of investment needed for the city of Pimpri-Chinchwad. An infrastructure growth program had been chalked out accordingly. [7], Fig. 4

2.4. Roads and Street lighting

The role of PCMC in the city's road infrastructure involves the development and maintenance of all roads under its jurisdiction, except for roads belonging to the Department of Public Works (highways and other district-level roads). Although it is the developer's duty to build internal roads in the case of a planned development, at the time of approval, PCMC verifies adequacy with regard to the development plan. Once the layout is developed, PCMC will take over the roads and open up maintenance spaces. [7] PCMC is also responsible for implementing the plans for the master plan involving new main roads and road widening activities. The total length of the road in the town is 757 km, 89 percent of which are paved. This network spans the length and breadth of the town's-built city. Even the newer peripheral areas added to PCMC lack adequate coverage. Also, although the service reach is reasonably situated, the state of the road surface was an area of concern due to the significant rise in the number of vehicles on the city roads. This includes even the regional traffic that enters the city due to lack of bypass / ring roads. Consequently, traffic congestion was encountered during peak hours at the main roads and intersections of late. [7]

A compulsory feature of PCMC is the installation and maintenance of streetlights. The PCMC's electricity department is responsible for building, replacing, restoring, running, and maintaining streetlights in the area. There are about 37,783 street-light poles with various types of electrical fixtures in the city of Pimpri Chinchwad. High-power lamps, primarily sodium vapor lamps of different wattages — 70W, 150W and 250W are 83 percent of the fixtures. Tube lights account for 16 percent of the fixtures. Against the length of the road accessible 757 km. Within the limits of the PCMC, the maximum spacing of streetlight poles is approximately 20 meters, which rates well against the norm of 30 meters. [7]

3. Results and Conclusion

Planning for the growth of the metropolitan area demands utmost priority in the sense of urban design, on par with the city area. Since urban areas on the outskirts of the city are targeted by the cycle of urbanization, future population prediction, planning for sustainable population density growth, planning for adequate infrastructure facilities, strengthening institutional structures, monitoring and implementation of regulatory initiatives, preparation of built-in mid-course corrective measures and innovative preparation for new areas outside the metropolitan area need to be emphasized.

A shared vision of the future growth of a city area is an important for successful urban reconstruction and development. The Vision for the City of Pimpri-Chinchwad is conceived in an integrated and coherent way through continued consultation with stakeholders. The meetings focused on the strengths of the community, current issues, complaints, challenges and areas of focus for the future. Agricultural workers, especially women, are typically thrown out of agriculture because rural land is used for urban purposes; they do not have the skills needed for alternative employment opportunities. There is an increase in construction male worker numbers in urban fringe villages while it is discouraged to hire female helpers. Compensatory growth of urban linked activities has occurred in which displaced labor force could be absorbed in agriculture. Self-help groups and NGOs may provide valuable inputs here.

In this study, the primary surveys in the fringe areas show that, if land-use is methodically designed and performed, the prospects tend to be good at achieving the visualized target (not just a pipe dream). The people in the driving seat will get suitable initiative and constructive feedback from all quarters if they are sincere and articulate what they expect of the citizens of Pimpri Chinchwad, Pune.

4. Perspective and Vision for the city

"Pimpri-Chinchwad is the place to live, make investments and have fun. It will help to maintain and sustain vigorous economic growth in the region through a modern, systematized approach.

"ENRICHED ENVIRONMENT"

5. Acknowledgements

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