Urban Sprawl and Density Optimization in India

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Abstract—*Land is a very important resource and it is limited. Land is used for various purposes and it also plays a big role in ecological balance. But with the growing urban sprawl there is a very big change in the land cover, which is giving rise to various environmental and ecological problems. Also there is decrease in the forest and agricultural areas creating scarcity for various resources and food.*

So in order to maintain this ecological and environmental balance, and for sustainable use of resources it is very important to control the urban sprawl. But as there is a continuous growth in the population it is not possible to control urban sprawl without density optimization. Density optimization focusses more towards the vertical growth of the city than to the horizontal growth. The use of this concept of density optimization can be seen in the compact cities. The concept of compact city is used by various developed cities for the efficient use of land while controlling urban sprawl, reduction in the transport network and provision of various public transport systems like BRTS and MRTS, energy conservation, providing better social connectivity to the people and creation of better social environment.

This paper focusses on the various ways that can be used to control urban sprawl and creation of compact cities in the developing countries like India. It also highlights the problems of existing dense cities of India and various solutions that can be used to solve out these problems. These methods includes provision of mixed land use, enhanced infrastructure facilities, less strict rules and byelaws for the provision of high-rise buildings etc. With the use of these type of techniques we will be able to control urban sprawl and to create compact cities in developing countries like India and also to solve out the problems of existing dense cities.

1. INTRODUCTION

India is a developing country and around 70% of its population lives in rural areas. But when we see towards trends we find that there is a continuous change in the ratio of urban and rural population. This is due to the high rates of migration from rural to urban areas. There are various reasons responsible for this migration like employment, education, attraction of city glamour etc. However the main reason behind this is search for employment. So, why the need for employment is arising. This is due to the change in the occupational pattern of the country.

Basically India is an agrarian economy based country. But due to continuous decrease in the agricultural land, the people are shifting from agriculture to other areas. What are the reasons behind this decrease? The main reason responsible for decrease in the agriculture land is urban sprawl. All the cities are expanding outwards due to high rates of urbanization. This give rise to conversion of agricultural land into residential. And creates shortage of agricultural land, ultimately forcing people to migrate people from rural to urban areas in the search of employment which gave rise to urban sprawl. So, we can see that this is a cyclic process and this population will continue until we remove any element from this cyclic process.

There is also a big change in the forest area of the country. This is also due to the urban sprawl, which requires cutting of forests for residential purposes. The removal of trees from cities periphery is unbalancing the ecological balance and also giving rise to various environmental concerns. So here we can see that how urban sprawl is affecting the sustainable growth of the cities and there is a strong need to solve this problem.

2. URBAN SPRAWL

Before solving the problem of urban sprawl it is very necessary to make a basic understanding of this concept. Urban sprawl can be defined as the unbalanced, unplanned growth of a city in its outer periphery and fringe area due to high rate of migration from rural to urban areas. These areas lacks of basic human, social, and environmental needs and have characters of low density, single land use, and lacks accessibility.

As we have already discussed about the various reasons responsible for the urban sprawl, so now we will discuss about the how to control this urban sprawl. We know that there is continuous growth in the urban population and we are not having the space in the core areas of the city so how we will control this urban sprawl. Here comes the concept of density optimization and compact cities.

The one basic thought behind these concept is to promote vertical growth of the cities rather than the horizontal growth. This will decrease the urban sprawl as there will be sufficient resources available within the city and will promote the sustainable growth of the cities. This concept will also a play a big role in the formation of smart cities, as sustainability is one of the major focus areas of the smart cities and smartness cannot be achieved without sustainability. So in order to make

a smart city sustainable we have to make them compact smart cities to control urban sprawl and for provision of better transport facilities within the city.

3. CONCEPT OF COMPACT CITIES

The compact city is an urban form which have opposite meaning to urban sprawl. It is more energy efficient due to small trip lengths and less polluting as there is low rate of carbon emission and less use of motorized vehicles.

However there are also various problems related to compact cities like crowding, formation of concrete jungles etc. there is also a paradox between different planners about the sustainability of compact cities (Neuman, 2005)[3].There is also a lot of problems related to the dense cities of developing countries like India. If we compare the density of India with other countries, we find that there is a huge difference as Indian cities are very dense.

Table 1: Status of urban India with relation to the world

Continent/country	Average(persons per hectare)	% of world's urban area	% of world's urban population
World	43	100	100
Africa	70	11.2	10.3
North America	16	13.4	13.5
South America	57	7.7	8.5
Australia	14	0.7	0.7
Europe	28	9.3	7.4
Russia	32	4.2	2.6
Asia	70	51.3	56.0
India	120	10.1	10.6

So if we add our both the points discussed above, we come to a conclusion that Indian cities are overcrowded and there is a high rate of urban sprawl in these cities. So how to handle these two problems together, as one is related to the high density and other one to the low density.

The solution lies in the pattern of urban structure of India. The high density of Indian cities is not due to the high rise buildings, it is due to the narrow roads, unavailability of sufficient open spaces, and household structure of the cities. So, when we are talking about compact cities it does not mean that we are going to make cities overcrowded.

One other major point related to the compact cities, is transportation. Compact cities always promotes effective use of public transport systems, non-motorized traffic movement, pedestrian movements and minimizes vehicular movements (Arika Ligmann-Zielinska)[1]. However, there is paradox related to the use of public transport system. Some people have a thinking that small travel length will promote the use of private vehicles like bike and cars.

The answer to this paradox, is very simple that use of public transport systems depends upon various factors like travel time, travel cost, travel length comfort level, accessibility etc. so depending upon one factor we cannot predict whether there will be use of public transport system or not. So from above discussion it is clear that compact cities provides best suitable conditions for the provision of transport facilities.

4. DENSITY OPTIMIZATION

Density optimization defines to a terminology which enables us for best distribution of density within a city. It is also controls the horizontal and vertical growth of a city. So, when we are talking about controlling of urban sprawl and making cities compact, it is very important to understand the various methods of density optimization.

If we see the current growth trends of the main cities of the world in terms of densities, we will find a similarity between them. We can see that as we move away from the central business district the density reduces, as explained in the bid rent theory. This decrease in the urban density with the distance from CBD is also one of the major factors responsible for urban sprawl of the cities.
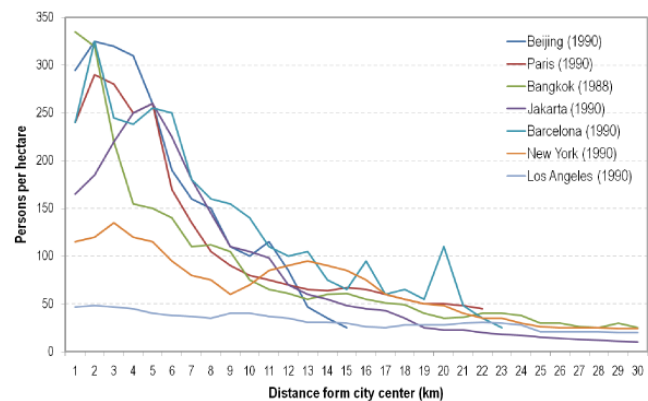

Fig. 1: Change in density with distance from CBD

We can find the same pattern in Indian cities also. However in Indian cities, there are also some secondary CBDs and transport junction which creates some peak in the graph. Otherwise it goes almost similar to the other world cities. One other major characteristic of Indian cities is that very small portion of the city have high density. The city mainly have low and medium density. We can see these trends in the density distribution map of Nagpur city (Rajashree Kotharkar, 2014)[4].

The main reason responsible for this change in the density pattern is the variation in the land values with the distance from CBD. The graph of the land value variation is almost similar to the graph of density variation. As we away from the CBD the land values decreases continuously. Due to this people buy large patches of land for future uses or creates small developments, creating sprawl of the cities towards outwards.
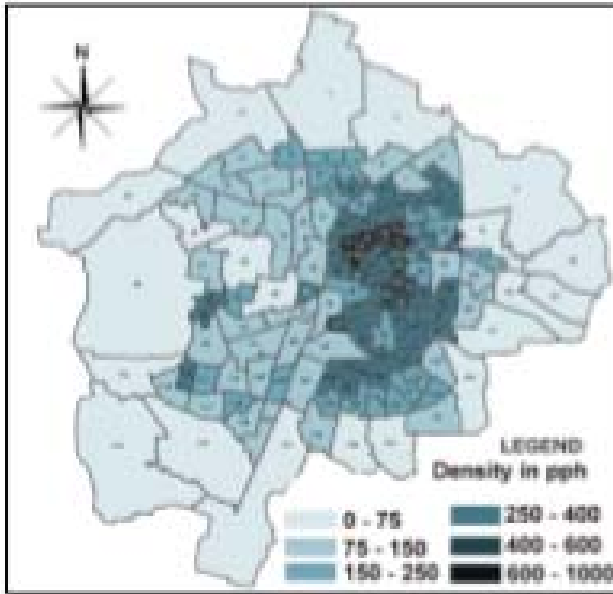
Fig. 2: Density distribution map of Nagpur city (ward wise), 2001

Land use value for activity sector according to the distance from the CBD
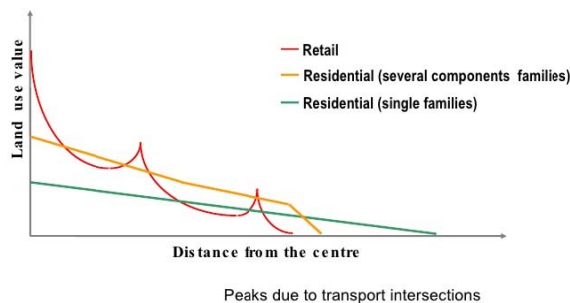

Fig. 3: Change in land value with distance from the CBD

5. METHODS OF DENSITY OPTIMIZATION AND CONTROLLING URBAN SPRAWL

There are various methods which were used by various developed countries to control urban sprawl of the cities. However we are concerned with the solutions which will be suitable in the scenario of Indian cities. We are concerned with the methods which will control urban sprawl along with the creation of healthy condition of life and provides sustainability to the Indian cities. We will discuss various methods along with their applicability in the Indian cities.

5.1 Mixed land use pattern

Mixed land use is the pattern in which the buildings have more than one land uses. These mixing may be any of residential, commercial, industrial and institutional. This type of pattern increases the density of the cities without creating any urban sprawl. It give rise to vertical growth of the city instead of creating crowding within the city or urban sprawl in the periphery of the city (Thrall, 2002)[5].

There are various benefits of mixed land use pattern in a city. It provides greater housing variety and increases density, provides affordable housing. It also decrease the travel distances between the residential areas and work places. It provides better connectivity to the people and increases their quality of social life. It also promotes less use of motorized vehicles as all the facilities lies within the walkable distance.

This type of pattern already exists in Indian scenario, but there is absence of vertical growth of the structures, which increase travel distances and creates overcrowding of the city. This method can be implemented for controlling urban sprawl in Indian scenario only along with the use of density optimization

5.2 Transit-oriented development

It also focusses on mixed use development along the transit corridors to maximize the use of public transport system. In a transit oriented development, the development concentrates around the transit station (bus stop, train station, metro station etc.).The density is maximum near the station and decreases as we move away from the station.

It also promotes the use of pedestrian and walkability as transit stations cover only a radius of half or one-quarter mile. It reduces the use of private vehicles and parking for private vehicles (Cervero, 2013)[3].

This method is applicable to the cities which have good connectivity and good network of transport corridors. It can't be applicable to old Indian cities however in the context of new cities and smart cities this method can be very effective.

5.3 Smart growth

Smart growth is a theory which covers various methods to create development and for conservation of natural environment. It provides compact land use to promote walkability concept and use of non-motorized vehicles. It is an alternative to the concept of no growth of the cities.

There are 10 accepted principles that define smart growth (United States Environmental Protection Agency EPA, 2015) [6]:
- Mix land uses
- Take advantage of compact building design
- Create a range of housing opportunities and choices
- Create walkable neighborhoods
- Foster distinctive, attractive communities with a strong sense of place
- Preserve open space, farmland, natural beauty, and critical environmental areas

- Strengthen and direct development towards existing communities
- Provide a variety of transportation choices
- Make development decisions predictable, fair, and cost effective
- Encourage community and stakeholder collaboration in development decisions

This method is more applicable in the context of planned cities, when we are going to plan for a city. It is also applicable to smart city concept, but in the scenario of existing cities it is very difficult to provide smart growth. However some of these techniques can be used to improve the present scenario of Indian cities.

6. CONCLUSION

The study concluded that urban sprawl is a big problem in the current world scenario, and there is a strong need to solve out this problem. The study indicates that urban sprawl cannot be controlled without the use of density optimization. The various trends of density and land use pattern analyzed in this study gives a description about the growth pattern of the cities and various reason responsible for sprawl of the cities.

This study shows that the major problems of Indian cities are related to density and its mix up with urban sprawl and overcrowding. It finds out the various reasons responsible for this type of growth pattern in Indian cities, and tell that the reasons are different from world scenario.

We can conclude with the above study that problem of urban sprawl is similar in all cities of the world. But the reasons are different in the case of Indian scenario. This study also concludes that we cannot adopt the same solution to the problem of urban sprawl in the Indian context. However the methods can be adopted with some changes and improvements to make them applicable in the Indian scenario.

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