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Urban growth and its impact on land use in Jorhat Town, Assam, India

Kakoli Acharyya[1] and **Pradip Sharma**[2]

1. Department of Geography, Cotton College, Guwahati, India.
2. Department of Geography, Cotton College, Guwahati, India.

Abstract

Jorhat Town has been under constant pressure from the rise in population and this has led to the haphazard expansion of residential, industrial and commercial areas. Once a planned town Jorhat has turned into such a haphazard mix of these activities and merged into one another such a way that it leaves hardly any scope for demarcating specific land use areas. This is largely due to the absence of a planned demarcation of the urban area to regulate the expansion of development activities of the town. The effects are well reflected on the growing urban issues like water logging, unscientific garbage disposal, traffic congestion, shortage of drinking water etc. Based on these underlying facts, an attempt has been made to observe the impact of urbanization on the land and to analyze built-up area as indicator of urban growth considering the magnitude and direction of expansion. An emphasis has been made on the availability of green belt area to focus on a sustained urban development. The study is primarily based on secondary data and application of GIS and Remote Sensing technologies, which have been used in analyzing the facts along with other conventional statistical methods. The study further embodies the results that a 6 sq.km buffer area of the existing municipality boundary, which leaves some scope for preserving the green belt for a sustained urban development and direction of urban growth for future planning.

Keywords : Green belt, Built-up area, Land use, GIS and Remote Sensing.

1. Introduction

Developing countries of the world have been experiencing a rapid rate of urban growth, thereby changing the landscape scenario. The process of urbanization takes into account expansion of urban areas with respect to the economic activities, service, infrastructure, commercial areas and public buildings. This in turn, gradually leads to the outward growth of the city centre to the outlying suburbs.

In India, the percentage of people living in cities and urban areas has almost doubled to 27.8 per cent in 2001 from 14 per cent at the time of independence. This is expected to accelerate even further, and by 2021 over 40 per cent of people to be dwelling in the urban areas.

To accommodate the ever increasing urban population, the city centers tend to expand resulting in encroachment of surrounding natural land parcels such as agricultural fields, forestlands or wetlands. Conversion of these lands into impervious built-up lands can put significant impacts on the ecosystem, thus affecting the hydrologic system, biodiversity and micro climate of the urban areas. Moreover, the most discouraging aspect of this type of urban development pattern is the poor state of basic infrastructures which could not keep pace with high intensity land development (Cho, Jaeseong, 2005). Thus, there is a strong need to monitor the present physical growth of the area with respect to the changes over a time and so as to understand the

Corresponding author : kakoliacharyya25@yahoo.co.in

dynamic aspects of urban growth and subsequently its controlling factors. This would, again, help in addressing the future needs of a city (Sudhira, *et al.,* 2003).

Looking at these observed facts, a study on the Jorhat town has been taken into consideration with the perspective of expansion of urban growth over time, the impact of such changes on the land use and magnitude of present urban growth.

2. Study area

The study area comprises the Jorhat town situated between 94°7′ 34.538″ E to 94°17′ 43.87″ E and 26°41′ 6.887″ N to 26°49′ 38.311″ N. The existing Jorhat Municipality Boundary (JMB, 2011) has been taken as the base and a buffer area of 6 sq km of the JMB considered which covers a total area of 209.19 sq. km consisting of about 100 villages (Fig. - 1).

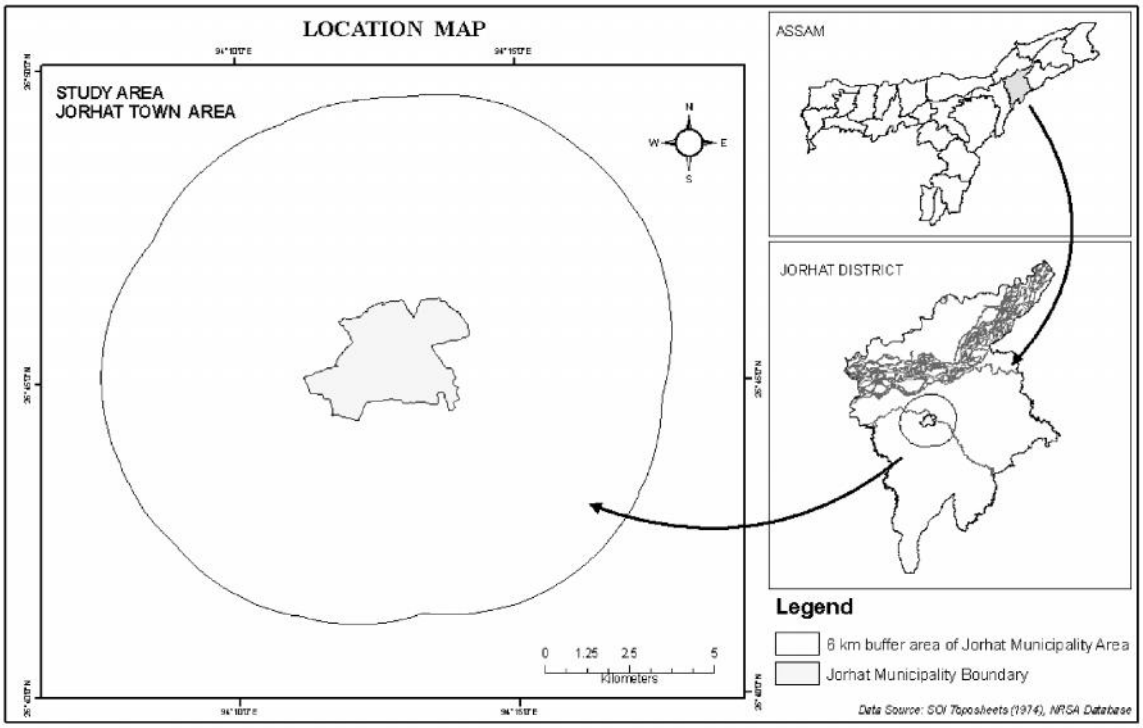


Fig. - 1 : Location map of the study area

3. Objectives

The study has been undertaken with the following objectives :

- to study the impact of urbanization on the land use and
- to analyze the magnitude of urban growth as indicated by built-up area

4. Database

The study is mainly based on secondary data collected from different sources viz. statistical handbook of Assam 2006, Census of India 1991, 2001 and 2011, and reports of the Jorhat Municipality Board etc.

Various maps have been used to highlight some issues of the study. The maps have been extracted from SoI toposheets, satellite data of LISS III-Jan-2006 and Google Earth, 2010. Maps collected from Jorhat Municipality Board and Jorhat Master Plan Map have been used as per the needs of the study.

5. Methodology

The methodology adopted for the study is as follows :

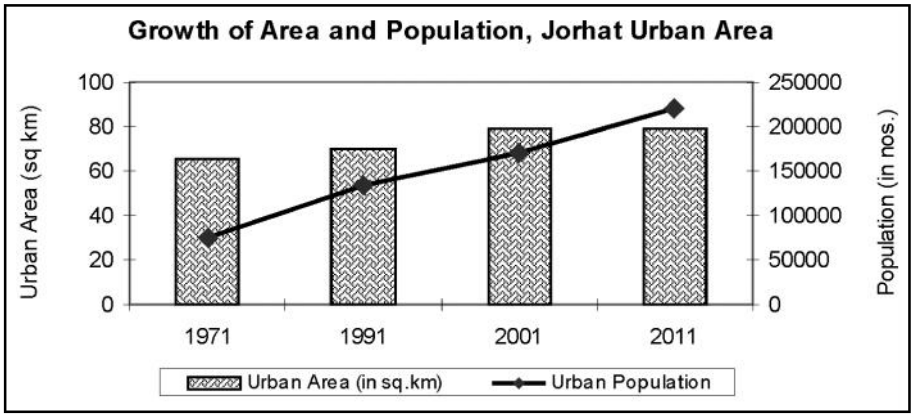
i. Databases have been extracted from Survey of India (SoI) toposheets for preparing the base map for the study. Municipality ward maps have been incorporated and analyzed with relevant co-lateral data.

ii. Data from secondary sources have been analyzed using conventional statistical methods.

iii. Theme wise final maps have been prepared with the help of GIS software for the purpose of analysis.

6. Analysis

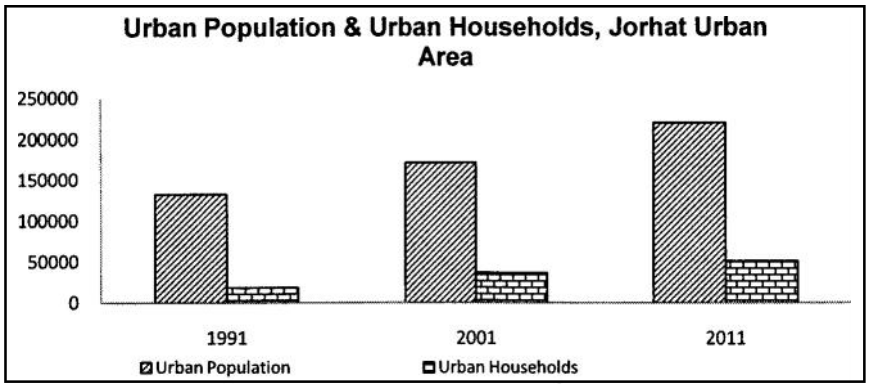
The study area Jorhat Town has been under constant pressure from the rise in population (Fig. - 2 & Fig. - 3), and invariably their different types of innumerable socio-economic demands. It has been observed from the figure 2 that while the expansion of the spatial extent of the town was insignificant over the four decades (65.39 sq km in 1971 and 78.85 sq km in 2011), the population increase was nearly three times more during the same decades (75,728 in 1971 and 219,565 in 2011).



Source : Statistical Hand Book, Assam, 2006; Census of India 2001, 2011

Fig. - 2 : Growth of area and population in the Jorhat urban area

The increase of population subsequently led to an expansion of residential, industrial and commercial areas in a haphazard way (Fig. - 3). This made the earlier planned Jorhat town to a haphazard one without leaving the scope for demarcation of different categories of land use. This is largely due to the absence of a planned demarcation of the urban area to regulate the expansion of development activities of the town.



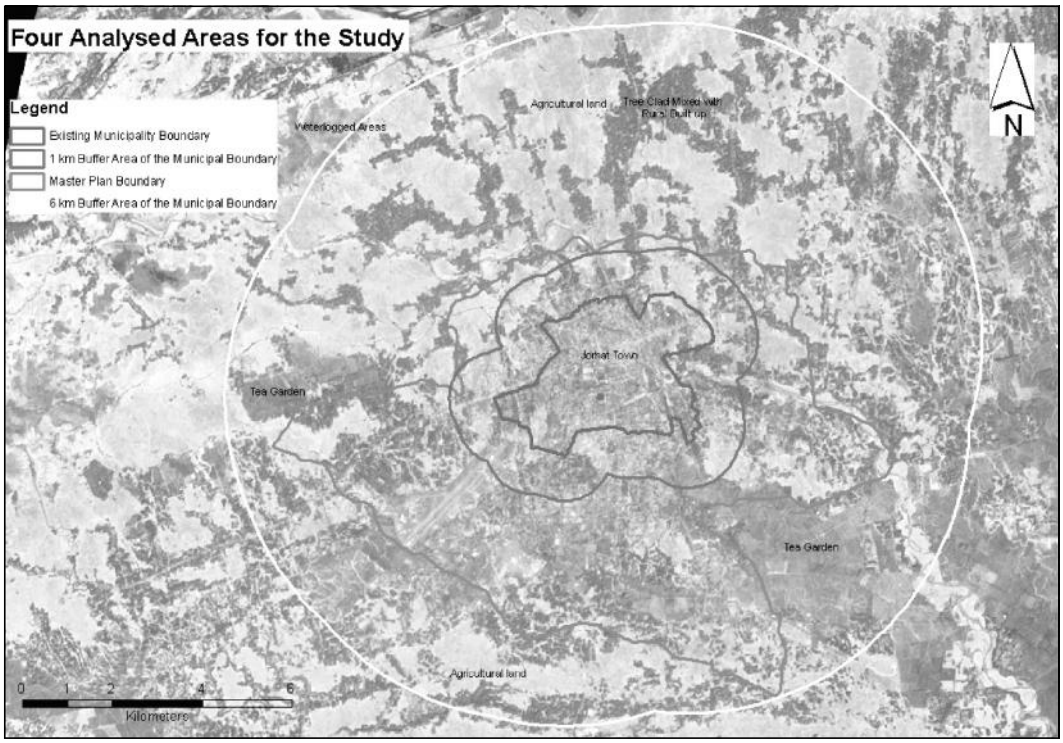
Source : Census of India, 2001, 2011

Fig. - 3 : Urban population and urban households, Jorhat urban area

6.1. Municipality Boundary and Master Plan Boundary exhausted with urban expansion

An attempt has been made here to have an understanding of the land use especially the green belt extracted from satellite image LISS III, 2006. The land use maps drawn from this source could be considered as the base information in the sense that they are generalized by first hand examination of direct evidence of land use patterns, rather than by compiling from secondary sources as it has been tried in other urban areas (Taragi, R.C.S. *et al.*, 1997). Here, four areas have been taken into consideration for the study (Fig. - 4). They are :

i. Existing Municipality Boundary
ii. One sq. km buffer area of the Municipality boundary
iii. Master plan boundary
iv. Six sq. km buffer area of the Municipality boundary



Source : LISS-III, Jorhat Municipality Board,Town & Country Planning

Fig. - 4 : Four analyzed areas of the study

The analysis has been attempted to observe the availability of agricultural lands as these provide ample scope for preserving the green belt which is so important for the following:

- Protect natural environment,
- Improve air quality within urban area,
- Ensure urban dwellers to access the countryside, with consequent educational and recreational opportunities,
- Protect the unique character of rural communities that might otherwise be absorbed by expanding suburbs, and
- Sustained urban development.

6.1.1. Existing Municipality Boundary

An analysis of the land use, land cover of the existing Municipality boundary shows that 95.45 per cent of the land is under built-up category consisting of residences, retail establishments,

educational institutes, public places and roads. Agricultural land occupied 4.36 per cent of the land and water bodies constituting only 0.19 per cent keeping little or no scope for preserving green belt. (Fig. - 5 & Table-1)

Table - 1 : LULC categories covered by existing Municipality area

Sl. No.	LULC Category	Area (%)
1	Agricultural land-crop land	4.36
2	Built up-mixed built up area	95.45
3	Water bodies-river/stream-perennial	0.19
	Total :	100.00

This scenario clears the picture of an overcrowded municipality area with 14,508 households giving shelter to 67,588 populations (Census, 2001). A total of 5,750 shops of 97 diversified trades constituted the commercial hub of the municipality area (Jorhat Municipality Board, 2010). It is seen that the township has crossed the existing boundary of 9.25 sq.km area with 19 wards demarcated by the Municipality in 1989.

6.1.2. One (1) sq. km buffer area of the Municipality boundary

To validate the fact, an analysis is attempted by taking into account 1 km as well as 6 km buffer of the Municipality boundary. In the first case, it has been seen that built-up area constituted 83.4 per cent and thus leaving 15.48 per cent for agricultural crop land and 0.84 per cent to tea plantations (Fig. - 5 & Table - 2).

Table - 2 : LULC categories covered by 1sq. km buffer area

Sl. No.	LULC Category	Area (%)
1	Agricultural land-crop land	15.48
2	Agricultural land-tea plantation	0.84
3	Built up-mixed built up area	83.4
4	Water bodies-river/stream-perennial	0.29
	Total :	100.00

6.1.3. Master Plan boundary

As a matter of fact, the first master plan of the district with an area of 75.52 sq. km prepared in 1990 done by Town and Country Planning department has not been implemented, whose term has already been expired in 1991. The Master Plan boundary, which surpassed the 1 km buffer of the Municipality boundary (29.24 sq. km) is also exhausted with urban expansion. The master plan boundary (75.52 sq. km) itself exhibited devoid of proper zoning with ever expanding town where built-up is around 78.66 per cent only (Fig. - 5 & Table - 3).

Table - 3 : LULC categories covered by Jorhat Master Plan Area

Sl. No.	LULC Category	Area (%)
1	Agricultural land-crop land	16.02
2	Agricultural land-tea plantation	4.88
3	Built up-mixed built up area	78.66
4	Water bodies-river/stream-perennial	0.43
	Total :	100.00

In absence of the Master Plan which provides guidelines in carrying out the developmental activities, the demarcation prior to the Master Plan has been crossed with expansion of commercial and residential areas into the adjacent countryside. This has turned once a planned town into a chaotic area of residential, industrial and commercial zones. Consequently, green zone of the town almost lost its identity.

6.1.4. Six (6) km buffer area surrounding the Municipality boundary

Further in the analysis, another 5 km was added to the one (1) km buffer area of the existing Municipality Boundary (total 6 km). It has been observed that the total area coverage is approximately 209.19 sq km. Of the total, 29.04 per cent is the urban built up area, whereas tree clad area mixed with rural built-up covered 22.36 per cent to total. It is found that more than half of the total area is covered by built-up area. Agricultural land covers 34.30 per cent and an area of 13.05 per cent is covered by tea plantations (Fig. - 5 & Table - 4).

Table - 4 : LULC categories covered by 6 sq. km buffer area of Jorhat Municipality boundary

Sl. No.	LULC Category	Area (%)
1	Agricultural land-crop land	34.30
2	Agricultural land-tea plantation	13.05
3	Built up-mixed built up area (Urban)	29.04
4	Tree clad area-open (mixed with rural built-up	22.36
5	Water bodies-river/stream-perennial	1.24
	Total :	100.00

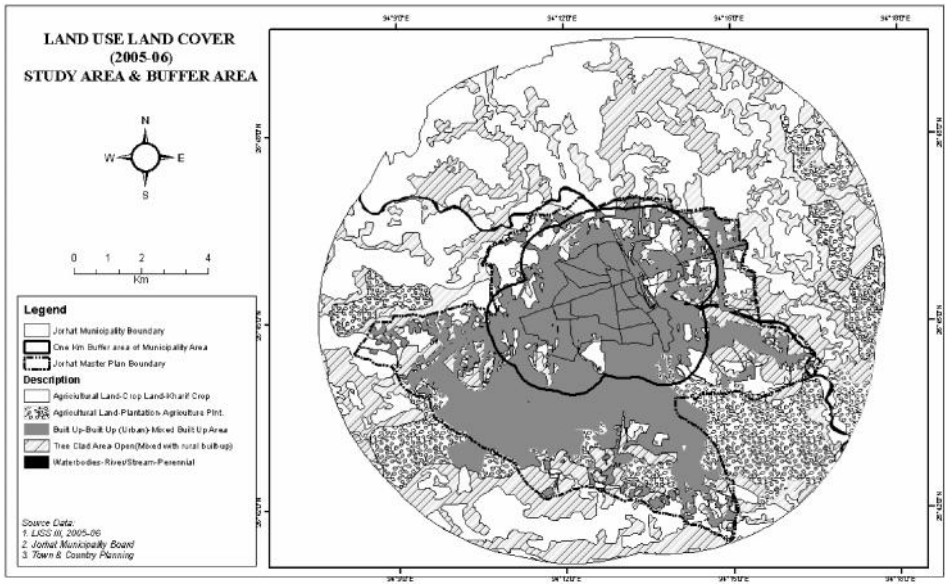


Fig. - 5 : Land use land cover with the buffer area for the study

The availability of green belt in the analysed four areas shows how it has been affected by the expansion of built-up area in the face of urban growth. The open and green areas are losing their identity with the take over of land by the built-up area in the course of urban expansion.

It has been observed that only the 4th option of 6 km buffer area of the Municipality boundary leaves some scope for preserving the green belt contibuting to the sustained urban development (Fig. - 6).

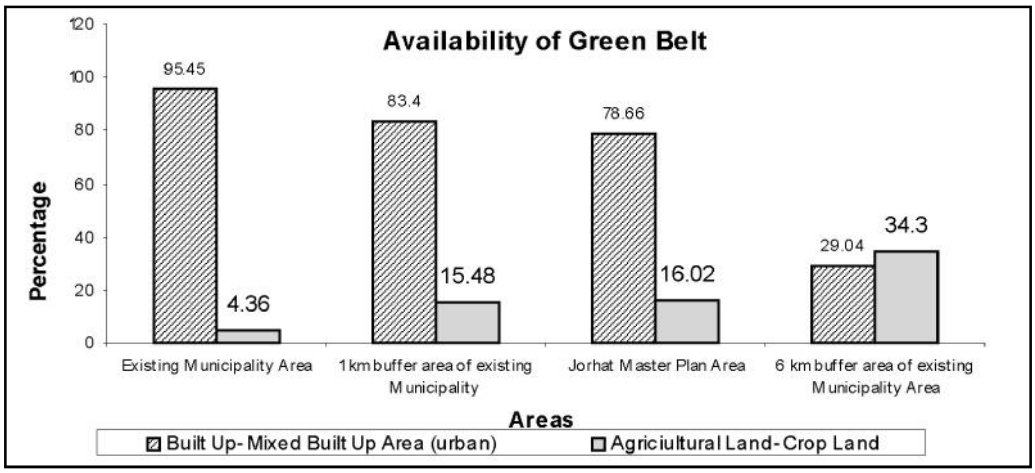


Fig. - 6 : Availability of Green belt

The above fact validates that the earlier demarcations done decades ago has lost its importance and gradually becoming meaningless. It is the need of the hour to redefine the area of the town to avoid confusion. The adverse effects of haphazard urban expansion of the town that have already started to create a bane to the dwellers of the city.

6.2. Magnitude of urban growth as indicated by built-up area

The 'Density Gradient' method has been used to make an analysis of built-up area so as to measure it as a potential index of indicator of urban growth (Kumar, J. Anthony Vinoth *et al.*, 2007).

6.2.1. Analysis of growth of built-up land over the four (4) decades

A time series analysis of the urban growth as indicated by built-up area over the four decades (1964-2006) has been attempted in the study. For this purpose, as shown in the figure - 7 the built up area for 1964, 1989 and 2006 has been mapped and superimposed for observing the expansion of their spatial extent in different periods (Sharma, H. N. 2010).

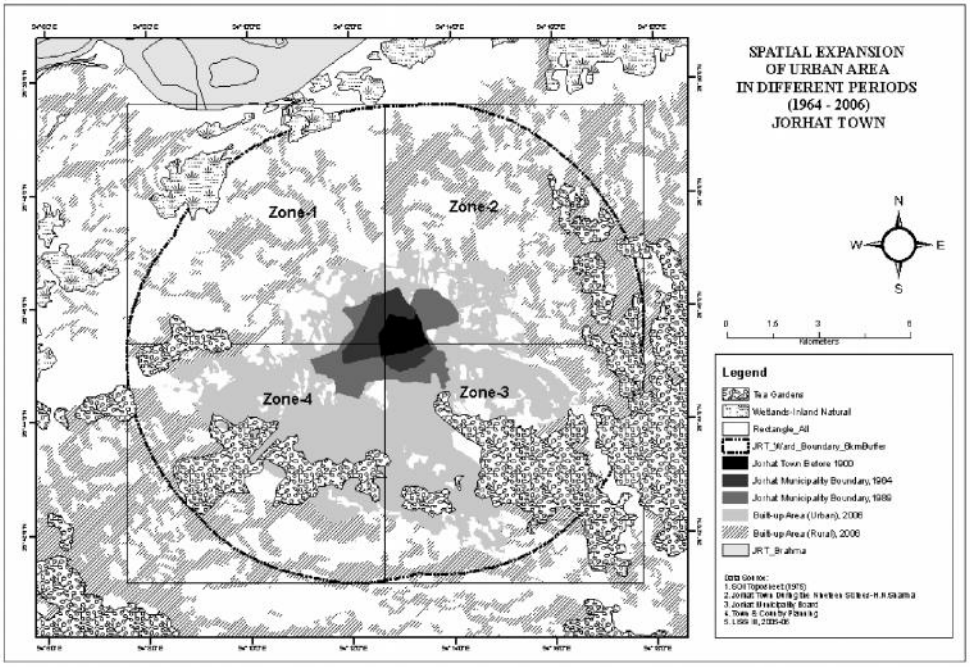


Fig. - 7 : Spatial expansion of urban area in different periods (1964-2006)

For the analysis, the study area of the 6 km buffer area of the existing Municipality boundary has been taken into consideration and a rectangular box has been drawn taking the center point of the Town as the mid-point. Subsequently the whole area is divided into four rectangular zones. The Zones are named as zone-1, zone-2, zone-3 and zone-4 representing all four directions- Northwest (NW), Northeast (NE), Southeast (SE) and Southwest (SW) respectively (Fig. - 7). In each zone the percentage density of built up area has been calculated for different periods (Fig. - 8).

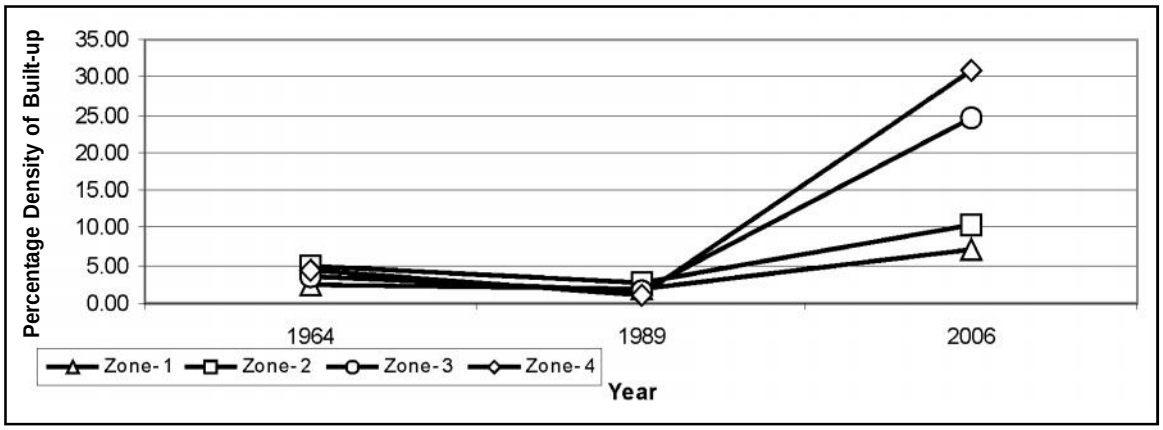


Fig. - 8 : Percentage density of built-up land in different zones

It was observed that in 2006 all the zones have experienced urban growth especially with an increase rate of built-up area in the SE and SW direction. Here, it has been observed that built up area is expanding away to SE and SW directions because of the infrastructural development shown in the Fig. - 9.

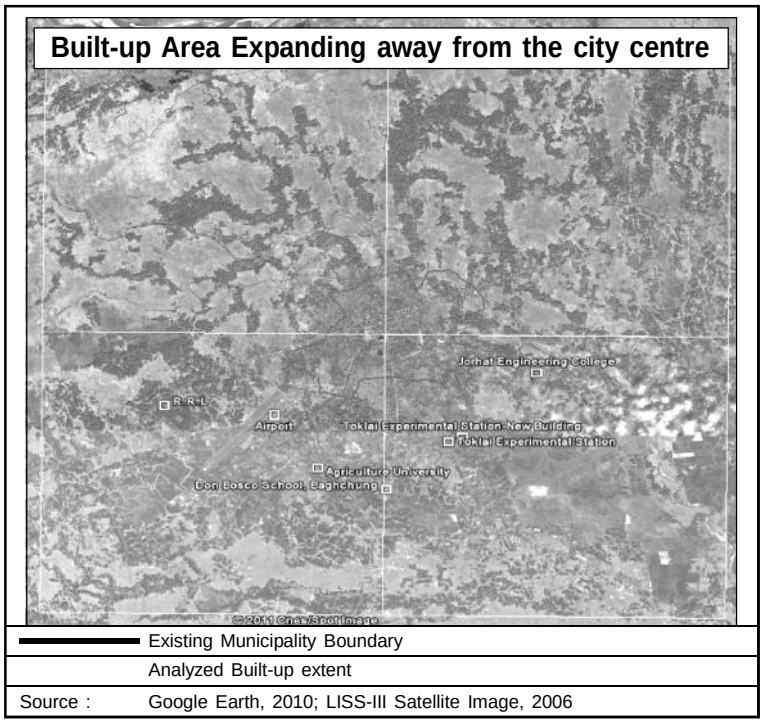


Fig. - 9 : Built up area expanding away from the city center

6.2.2. Urban growth indicated by the present built-up area

Further in the analysis, urban growth as indicated by the present or existing built-up land (2006) has been taken into consideration and the study area was divided into concentric circles of one kilometer radius from the centre of the city using GIS technique. The calculated built up density has been plotted in the concentric circles (Fig. - 10.)

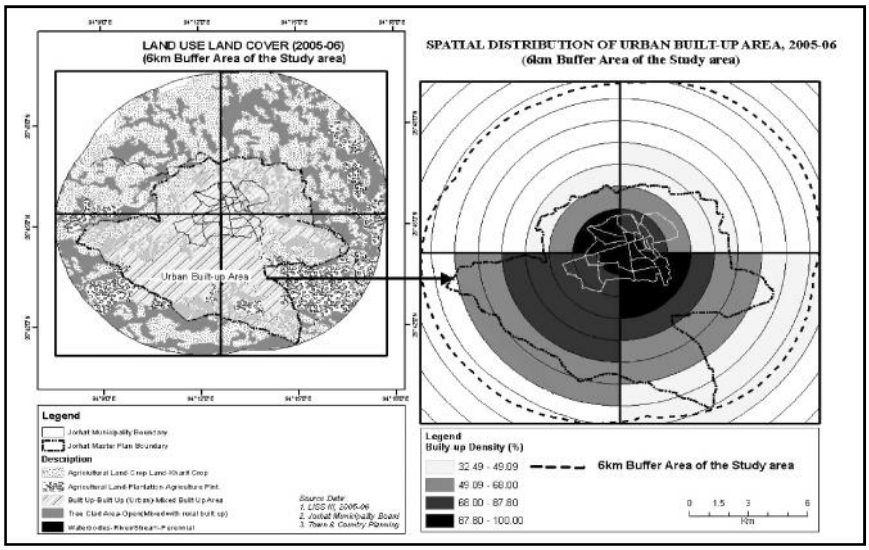


Fig. - 10 : Spatial pattern and magnitude of urban growth by Density Gradient Method

It has been seen that the density of built up area is compact in the centre in 2006 as it is exhibiting almost 100 per cent built-up area. The growth has been taking place in a linear fashion in different directions (Fig. - 10). In the year 2006, the built up area has crossed distance of 4 km for Zone-1, 5 km for Zone-2, 8 km for Zone-3 and 7 km for Zone-4 from the city centre (Fig. - 11). Hereby it is established that the SW direction is experiencing high built-up growth followed by the SE direction. The growth in the northern parts is considerable but it has been restricted by the presence of the Brahmaputra River. The spread of the town has been influenced by the road network and physical barriers present in the surrounding area (Acharyya. K. *et al.,* 2011)

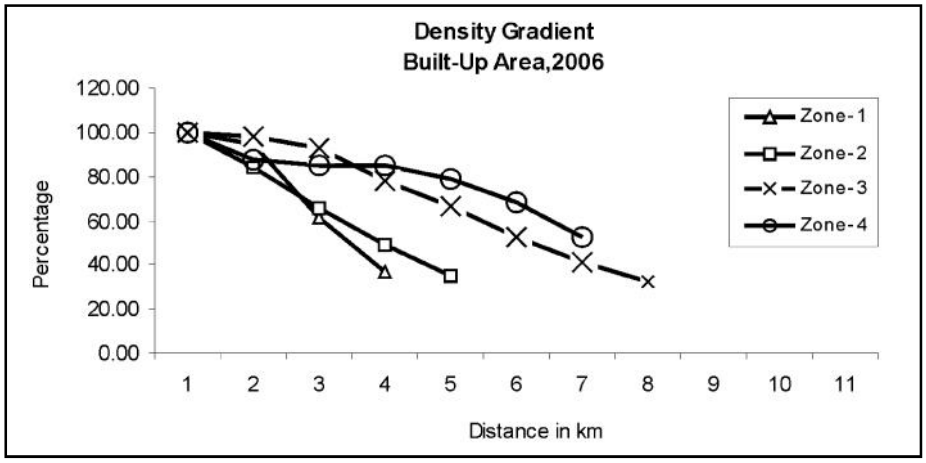
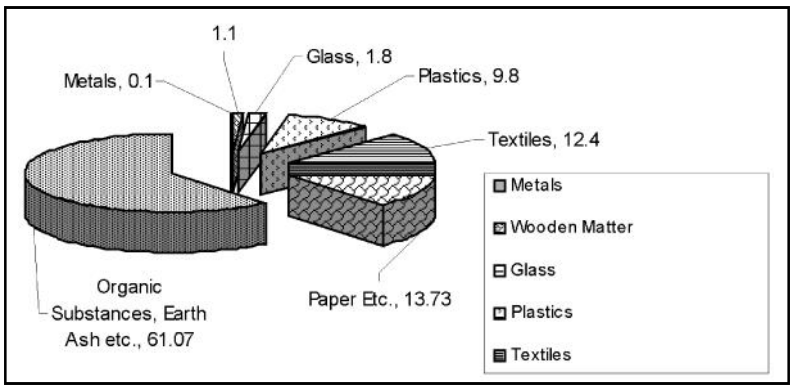


Fig. - 11 : Percentage built-up land density in each zone for 1 km interval

7. Findings

The adverse effects of haphazard urban expansion of the town have caused several hazards for the city dwellers. They are as follows :

- Water logging has been caused due to unplanned drainage system added by the non-existence of outlets which could have helped the logged water to drain out. The conversion of former low lying areas into residential areas with haphazard constructions and unscientific disposal of waste in residential and commercial areas have been eventually blocking existing drains.
- Unscientific Garbage Disposal : Jorhat Town does not have a proper waste disposal site to dump the tonnes of garbage (Fig. - 12) that it produces every day. The garbage generated per day is 35 MT of which 31-33 MT is disposed off. The left out amount create health hazard in the town. The characteristics of the garbage generated are shown in Fig.-12. In addition to this, the absence of

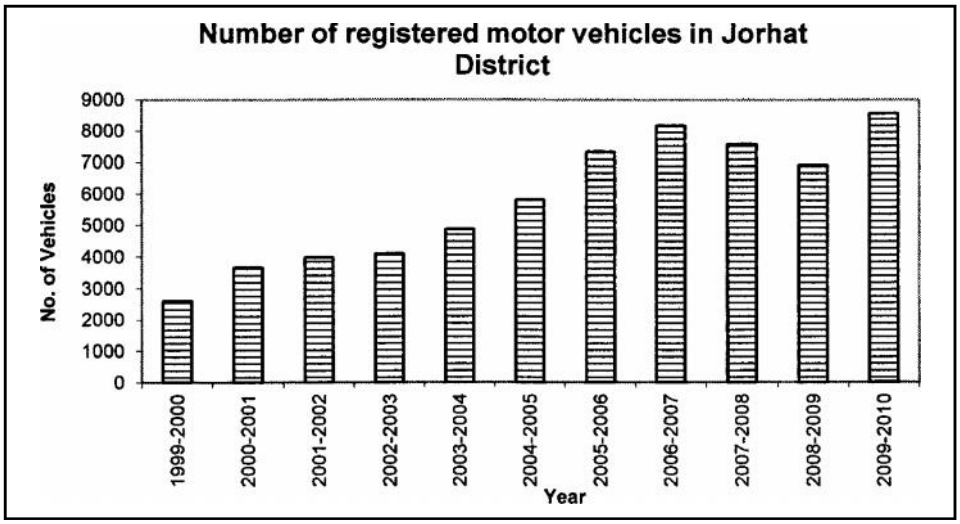


Source : Jorhat Municipality Board

Fig. - 12 : Garbage generation in the Jorhat town

proper residential and commercial waste disposal mechanism causes more damages to the urban environment as most of the waste never finds its way to disposal site.

- Traffic Congestion : The rising number of vehicles as observed from the period of 1999-2000 when the number of registered motor vehicles was only 2608 which rose to 8568 in 2009-2010, i.e. three times rise in rate of vehicles and subsequently causing an increase in the rate of emission (Fig. - 13). With no real increase in the length and size of the roads the eventual traffic congestion is imminent.



Source : Office of the District Transport Officer, Jorhat

Fig. - 13 : Number of registered motor vehicles in Jorhat District

- Shortage of drinking water : Jorhat Municipality Board is running with 5 water supply projects out of which one is depend on river water source and the remaining four are on ground water sources. The existing 5 projects cover only 45 per cent of the requirements of the total population. The projects are old enough and need immediate upgradation to fulfill the demands of the growing population.

8. Conclusion

Once a planned town, endowed with rich historical heritage despite being the major hub of economic activities in Upper Assam in the Ahom period, Jorhat town is losing its luster because of the expansion of the town in a highly unplanned way. This is mainly because of the absence of a planned demarcation of the urban area to regulate the expansion of development activities of the town.

With the increase in population, growing economic activities and infrastructures, the spatial extent of the urban area of the town has been exhausted. This has led to a haphazard mix of residential, industrial and commercial zones leaving little scope for the existence of green belt. Urban green belts which are considered to be the lungs of the cities as they act as a sink for some of the harmful gases released by vehicles and industries play a very important role in the sustainable development of the urban area. As such in this hour of the exhausted urban expansion, it is sought that a planned land use demarcation could be made considering at least 6 km buffer area of the existing municipality boundary which leaves adequate scope for preserving the green belt for a sustained urban development and to remain at a safer side from the ensuing adverse effects of the environment.

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