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Dynamics of Urban Sprawl and Landuse Change in Imphal of Manipur, India

Joseph Zamchinlian Tungnung[†] and Dr. Subhash Anand[*ĭ]

Abstract

Urban areas are expanding and cities are becoming more compact due to population growth and migration. Cities in India have experienced rapid growth of population. Physical landuse change has been observed today especially in the developing countries that led to shrinking of precious land, where the impact is mostly felt on agriculture land. The growing population was the main driving force of landuse change. The study focused on monitoring urban landuse change over a period of 45 years (1970-2015), and to assess its impact on agriculture in Imphal city and its surroundings. The study is based on secondary data and intends to identify the process of landuse/landcover change over the different time period with the help of GIS imageries. The study found that the build-up area of the city had increased from 22.07 sq.km to 74.16 sq.km while agriculture areas shrank from 54.18 sq.km to 14.26 sq.km during the study period. Without proper planning and management, the excessive population growth will result to unplanned physical expansion towards the fringe areas in all direction.

Keywords: Urban, Sprawl, IMC, Remote Sensing, Landuse Change, Imphal, India

[†]Research Scholar, Department of Geography, Delhi School of Economics, University of Delhi, Delhi -110007, India, Email: liantungnung@gmail.com

[*]Corresponding Author

[ĭ]Associate Professor, Department of Geography, Delhi School of Economics, University of Delhi, Delhi - 110007, India, Email: sanandpv@yahoo.co.in

Introduction

It is generally assumed that urbanisation has both direct and indirect impacts on landuse transformation. Urban sprawl is one of the most noticeable effects of urbanisation on landuse (Jagadeesh et al., 2015). Urban sprawl is a phenomenon of spatial expansion with a disordered development as a result of the urbanisation in the fringe area with impacts such as loss of agricultural land, open space and ecologically sensitive habitats (Feng and Li, 2012; Singh and Nath, 2012). The sprawling process of expansion is disordered, unplanned, often leading to inefficient and unsustainable urban expansion patterns (Travisi and Camagni, 2005). Today, rapid urban growth is a worldwide phenomenon, especially the developing countries experience an unprecedented growth of cities. The outward urban expansion is mostly experienced in Indian cities. However, as most of them are unplanned urbanisation, it affects the land-use pattern of the region. The impact is mostly felt in the form of changes in urban land-use pattern and loss of prime land of the areas. Urban sprawl had a negative impact on agriculture land where build-up area encroach agriculture land leading to the reduction of its size, density and productivity (Atu et al., 2012, Bhalli et al., 2012, Shalaby et al., 2012). Sprawl generally deduces to some type of expansion with brunt such as loss of agriculture land, open space and ecologically insightful habitats (Sankhala and Singh, 2014). This problem has led to gaining the attention of researchers in the different fields—urban geography, environmental studies, regional planning, agriculture (Bhalli et al., 2012). Landuse and landcover are interrelated. Changes in landuse affect the landcover of an area and vice-versa. However, a change in either landuse or landcover is not necessarily a product of the other (Riebsame et al., 1994). Landuse change is important for monitoring, management for sustainable use of natural resources. Landuse change detection is the process of identifying differences state of land phenomenon by observing it at different times (Singh, 1989). Human activities have modified the environment with significant population increase, migration, and accelerated socio-economic activities (Kiio and Achola, 2015). In addition, it reflects the dimensions of human activities in a given environment. The dynamics of landcover change processes can be investigated taking a temporal series of remote sensing data and by analysing change trajectories (Hall et al. 1991; Alves and Skole, 1996; Guerra et al. 1998; Mertens and Lambin, 2000).

Geographical understanding of landuse change is a key aspect of urban dynamic research in urban studies (USGS, 1999). There are many determinants of landuse change but the most important is the anthropogenic indulgence, which shaped and reshaped the environment within space and time. Human actions are altering the terrestrial environment at unprecedented rates, magnitudes, and spatial scales (Turner, Meyer and Skole, 1994). Indian cities, today, experience rapid urban expansion and outgrowth of its boundary to its fringe areas. The development of suburbs along the transportation nodes promotes some economic activities like establishment of shops and within no time, it further develops as a centre for business and industrial activity zone. In-migration takes place from the city as well as from the rural areas within this zone of activity. The suburbs have become a home to the low-income group who could not afford the high cost of living at the city centre, as it becomes more expensive (Hanes, 2011). The older suburbs become a point of dispersion for the newer suburbs and the process goes on. This type of growth can be mostly observed in most metropolitan cities and as it was unplanned urbanisation, the subsequent results will affect the landuse of the region. The impact is mostly felt in the form of changes in urban landuse pattern, which results to loss of prime land. Urban growth and development have changed the landuse pattern resulting in loss of many prime lands particularly, agriculture, and wetland. As Imphal city is the only big city in the state, it attracts migrants from both within and outside the state for better socio-economic opportunities like employment, education,

health care facilities, etc. (Singh and Devi, 2012). Notwithstanding, most parts of North East India including Manipur continues to be a disturbed area. Despite being a disturbed area, the migrants continue to arrive in Manipur. Nevertheless, they are mostly confined to Imphal city and are largely businesspersons, semi-skilled or unskilled labourers. Meitei (2013) argues that newly arrived migrants are engaged in several business pursuits such as retailers, dealers, running street or established vendors, hawkers, saloons, cobblers, repairing works etc. (Meitei, 2013). The next section is an attempt to discuss the review of literature and address the gap in the research.

Literature Review

The most difficult part while discussing sprawl is to define what sprawl actually is. No universally accepted definition of sprawl exists right now; different scholars have given different definitions. It is even debatable today because any single definition cannot be superimposed on any region as different region bear different social and physical settings. However, the common aspect of urban sprawl that can be pointed out from various definitions - it is an outward expansion of cities which is normally unplanned and uncoordinated physical development, non-contiguous leapfrog development, and low density single land-use in the absence of urban infrastructure. Many scholars reveal that the term 'urban sprawl' as a recent phenomenon. Until the 1960s, the problem of urban sprawl was not documented. It started gaining attention from different field of academics (of course from the economically advanced countries) because of the ongoing expansion of cities. The problem gained importance only in the late 1960s and 70s, mostly in the USA and Western Europe, but today, the study gained importance in the developing countries too (in Asia, Africa and Latin America) and since then, there has been significant research and debates on this topic (Stomp, 2013). In India, the problem and magnitude of urbanisation is more evident after 1990s. In India, research based on urban sprawl is still in the preliminary stage (Feng and Li, 2012) and perhaps, lacks behind when compared with that of China. However, the present trend of urban growth signals that it will gain the pace and importance in the coming years.

Terzi and Fulin (2009) used data linked to the build-up areas from the year 1975 to 2005 of Istanbul and used this data to study the density score and distance using the sprawl index = density score - (strength of centre × distance to the centres score) where lower sprawl index indicates more sprawl. The scores allowed them to compare values of sprawling spatially through the incorporation of GIS. They found that Istanbul metropolitan area has been sprawling since 1975. The sprawl areas turned into compact areas one period after another and initiated another sprawl in the adjoining areas and the process continued.

In 2010, Bhatta seemingly discussed the causes and consequences of urban growth, sprawl, and argued that the analysis of causes and pattern of urban sprawl is different from analysing pattern and process. The causes of urban growth and sprawl are interlinked and highlighted that the causes of urban growth may result to sprawl. Gupta (2011), while monitoring the spatial urban growth of Jaipur city, revealed that the population growth was the driving force behind the land-use change in the region. Based on satellite imagery, change detection shows build-up areas expand extensively into the nearby agriculture and open areas, which were unplanned development. Most of the fallow land and agriculture land had been converted into commercial, residential land-use. However, forestland is not affected. Urban expansion is influenced by the topography and the economic development such as infrastructure and industries in the region. The presence of mountains in the north ceased urban expansion while it spread in the plain areas towards the western, south and south-eastern part. The impact of the presence of mega cities like Delhi and developed infrastructure such as transportation trigger land-use change. While evaluating urban sprawl pattern in the tribal-dominated cities of Jharkhand, Kumar et al.,

2011 considered urban land-use transformation as a negative impact of urban sprawl. The population in these areas entirely depends on agriculture and its allied activities. Any changes in the environment will affect the livelihood of the area. They found that there is a negative relationship between build-up areas and agriculture land, while the build-up increases, the agriculture land decrease. The build-up in the region is indeed unsystematic or unplanned and follows the transportation nodes representing a ribbon sprawl (Kumar et al., 2011), to 32% during the study period. Other land-use classes like grassland, water bodies, forest decreased minimally. It was predicted that by 2021, the build-up areas would increase by 52 % and agriculture land will lose 27% of the area to settlement areas. Sen (2011) seemingly studied the effect of urban sprawl in human habitation in the urban fringe and peri-urban areas of Kolkata metropolitan areas. It reveals that the increasing demand of land, houses and the increasing value of land in different parts of the city influence the direction of sprawl. Sen (2011) argues that the lands in the fringe areas are the destination of the poor people who cannot afford to reside within the city, yet, nearer to their work place. The land areas within the fringe areas are the areas of attraction for the private developers. In the process, large tract of agriculture land and farmlands had been lost.

Using remote sensing and GIS tools, Rahman et al. (2011) analysed the urban sprawl in the twin city of Hyderabad and Secunderabad. They found that the build-up area of the city had increased from 135 sq. km to 370 sq. km within the period of 1971 and 2005. There is a remarkable sprawl in and around the city within the period because large tract (215 sq. km) of agriculture land had been lost to build-up. This study also indicates that Shannon`s entropy method is useful in measuring urban sprawl as it indicates the spatial dispersion and land development. In another similar study, Singh and Kumar (2012) analysed the impact of urban growth of Rohtak city with the help of satellite imageries and GIS, which found that the build-up areas increased four-fold in the city mostly into residential areas during the study period (1983-2010). The breakdown of joint family (large undivided family where more than one generation live together in a common house) into nuclear family, high population density, and demand for more land for housing are the major factors of urban expansion identified in the city. Hence, large track of agriculture land and open land had been converted into residential areas having low density. Infrastructure developments - industries, roads, etc. attract people and especially roads networks encourage the development of sprawl. The residences sprawl along the state and national highways. These observations bear resonance to the findings of Shalaby et al., (2012) who also use remote sensing and GIS to analyse the urban sprawl and agricultural land in Qalubiya Governorate in Egypt. These scholars argue that the key cause of urbanisation in the area is the rapid population growth and internal migration. They found that due to encroachment of build-up areas into agriculture land, the areas of high capable soil decreased from 683.20 sq. km to 618.50 sq. km. The moderate capable soil decreased from 100.50 sq. km to 93.80 sq. km, whereas the marginal capable soil decreased from 209.10 sq. km to 198.30 sq. km. The pattern of urban sprawl occupied mostly the non-capable areas of soil. In the same year, Bhalli et al. (2012) seemingly used remote sensing and GIS to monitor and assess on urban sprawl in Faisalabad city (Pakistan). In their findings Bhalli et al. (2012) found that, the pattern of urban sprawl leads to amalgamation of villages into cities and loss of agriculture land leading to higher value of arable land. The build-up of the region increased from 102 sq. km in 1980, 168 sq. km in 1998 and 213 sq. km in 2010. This was made possible with the growth of the private sectors and the improvement of transportation modes and industrialisation.

Now turning on to analysis of land-use/landcover change of Delhi, it reveals that there is a rapid land-use/land-cover change, particularly in north-west part of Delhi (Rahman et al, 2012). The population grows very fast in urban areas due to migration of people mainly from rural areas and also from nearby smaller

cities and towns and of course other states of India, which in turn leads to pressure on all existing resources of bigger and metro cities like Delhi. The population density of Delhi is 11,320 persons per sq. km while it was 9,340 persons per sq. km, in 2001 (Census of India, 2011). This high population growth, rapid urbanisation and the demand for housing and other developmental activities led to the encroachment of large tracts of land and development of new settlements colonies in Delhi. Sharma and Joshi (2013) quantified the urban expansion of Delhi from 1998 to 2011 using urban landscape analysis tool from Landsat TM/ ETM satellite data; they found strong positive trends for urban built-up, suburban built-up and urbanised open land.

There is an enormous transformation of agriculture land into non agriculture uses. The build-up increased in all the direction and was more pronounced in the western and northern part of the city. The residential areas experienced a growth rate of 46.6% and agriculture land decreased by 37% during the period. Pastureland and other land-use also decreased significantly. However, ridges and forests areas remain unchanged. The land-use transformation is more pronounced along the major corridors and is the most distinguished feature of urban growth in the city (Singh and Singh, 2014). In 2015, Sharma et al. discussed the pattern of urban sprawl in Hisar city of Haryana for two years—2003 and 2012. During the period, the build-up areas increased by 4.6%. There is a little change (-0.4%) in agriculture areas. However, large track of land were lost in grassland and plantation areas. A linear pattern of sprawl is found in the region and was controlled by the direction of transportation routes as well as the presence of industries. Sinha and Shekhar (2016) while analysing the urban sprawl in Noida city, Gautam Buddha Nagar (U.P), found that there was a rapid population growth since 1991. The city had witnessed urban sprawl until 2001, which led to loss of fertile agriculture land and caused adverse impact on ecology. The pattern of sprawl like leap frogging, discontinuous and ribbon sprawl fuelled by automobile dependent growth is found in the city. They further argued that after 2001, the Noida city evolves into a compact city as the number of patch and patch density is found to be decreased. It thus transforms the city from urban sprawl to urban growth. There is however very little geographical study on urban sprawl in Manipur. Therefore, this research is an attempt to address this gap. The spatial location of the study area is described in the following section.

Study Area

Imphal city extends from 24^{o} 41` to $25^{o}$ 06`North latitude and 93^{o} 42` to $94^{o}$ 11`East longitude with an elevation of 786 metres above sea. The study area spread over an area within the Imphal Municipal Council (IMC) boundary covering areas of 34.38 sq. km. beyond the Imphal Municipal Council boundary covering and areas of 54.68 sq. km., and the whole area covering both within and outside the Imphal Municipal Council boundaries of 89.06 sq. km. As per Census of India (2011), the Imphal Municipal Council has 31 wards. It is a lacustrine fertile plain drained by two major river systems namely, the Barak and the river Imphal. It comprises of only 9% of the total geographical area of Manipur and extends about 58 km north-south direction and 31 km east-west direction (Figure 1). Imphal, the capital city enjoys the primacy keeping other towns in sluggish growth. The city is beautiful and has interesting morphology in which 'Kangla', this historical relic is in the middle city core from where roads radiate out appearing as a spider web. The state of Manipur share a boundary with Nagaland in the north, Mizoram in the south, Assam in the west and shares an international border with northern Myanmar in the east (CDP, 2010).

Imphal city witness changed in land-use pattern over the past few decades. Urban sprawl is the result of population growth, increasing urban density and development in the centre of the city. Thus, it can be conceptualised as a non-contiguous, unplanned expansion, low-density physical development in the absence of urban infrastructure. Urban sprawl is the outgrowth of city areas beyond its boundary. There is a

process, which led to a stage for the development of sprawl and there is a cause behind that process. This process began with the origin of settlement and later population concentration led to the evolution of town. These areas are more urbanised as population increases, the density also increases with the passage of time. The later stage of growth induces urban sprawl. Urban population in Manipur was 67,717 persons (8.68%) in 1961 and within a span of 50 years (1961-2011), it increased 13 times to 8,22,132 persons (31.6%) in 2011, where 41.71% of the total urban population of the state resides in the city.

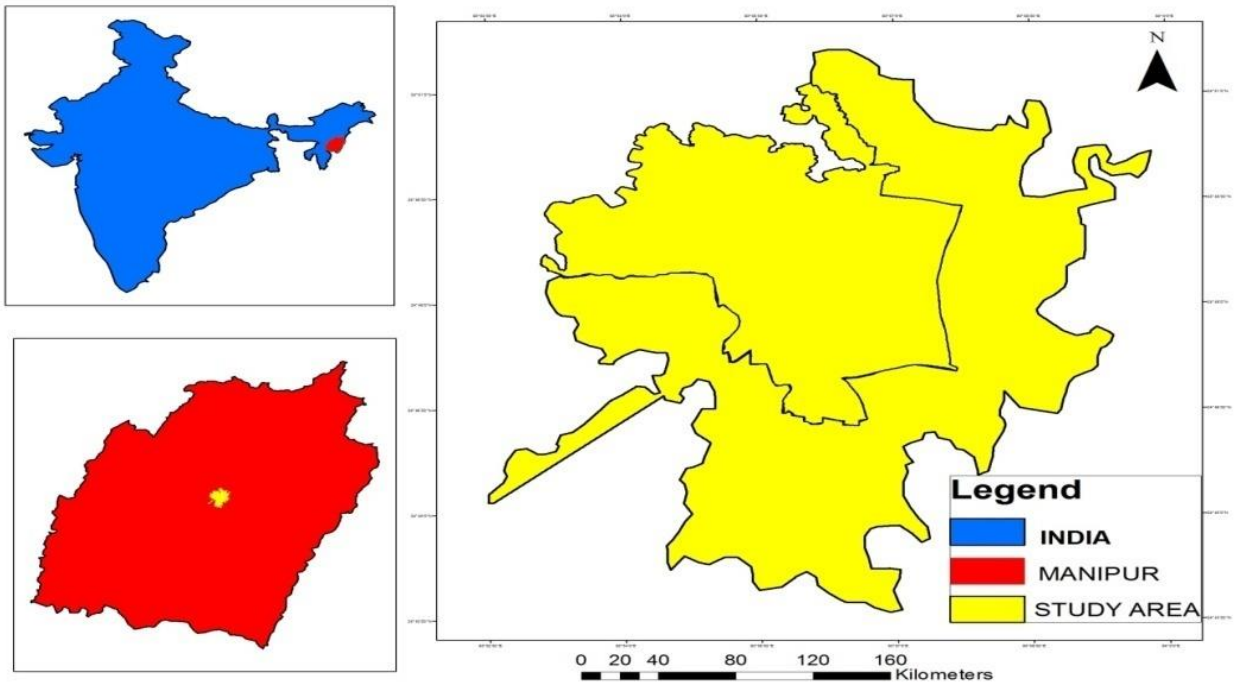


Figure 1:Location Map of the Study Area

On the other hand, the city area: that is, Imphal Municipal Council covers only 0.13 % of the total geographical area of Manipur. It accounts only 10% of the total population with a density of 7,923 persons and still continues to grow. About 80% of the commercial establishment is concentrated in the city. Thus, population pressure puts stress on the available infrastructure, which is seen to be reflected in the state basic infrastructure (CDP, 2010).

Materials and Methodology

The study involves data collection from secondary sources, to analyse the landuse changes over a period of time, remote sensing data is required. The survey of India topographical map of 1970 (Toposheet no. 83 H/13) on scale of 1:150,000 is used as a base map which is collected from Manipur Remote Sensing Application Centre, Imphal. Remotely Sensed Landsat image is used for a period of 1988-2015. Landsat TM 1988 image has been acquired from the USGS Earth Resource Observation System data centre, while 2006 and 2015 satellite image is downloaded online from the Google earth imageries. Other secondary data like population, agriculture data and landuse, etc. are collected from Census of India (1971-2011), district census handbooks, agricultural census handbook, journal (published and unpublished), e-journals, and government publications and websites.

The satellite imageries of 1988, 2006 and 2015 are rectified, processed and assigned to its geographical coordinate, then geo-referenced it with the help of ArcGIS software tools. The image is then classified through visual and digital classification for detecting and analysing land-use classification for four different images. The success of change detection from imagery depends on both the nature of the change involved and the success of the image processing as well as the classification procedure (Shalaby et al., 2011). The sprawl boundary of 2015 is taken as an outer boundary of the study area. The boundary is then superimposed to the toposheet of 1970,

satellite image of 1988 and 2006. Digital classification for the entire image is made for three landuse classes, that is, (i) build-up areas; (ii) agriculture land; and (iii) 'others' landuse. Build-up area includes residential, government offices, educational institutions, recreational and cantonment. Agriculture land includes cultivated land and fallow land, while other landuse category includes wet lands or water logged areas, hills, and water bodies. For convenience and detecting the minute details of the landuse changes, the study areas is divided into two areas that is, within the IMC boundary covering 34.38 sq. km and beyond the IMC boundary which covers 54.68 sq. km. The whole study area covers 89.06 sq. km.

Land Consumption Rate (LCR) and Land Absorption Coefficient (LAC) technique is applied for measuring expansion of urban land, which is as follows:

Land Consumption Rate (LCR)= A/P,

where, A= Arial extend of the city in hectares,

P= Population.

Land Absorption Coefficient (LAC)= (A2-A1) (P2-P1),

where, A1 and A2 are the areal extents in hectares for the early and later years and

P1 and P2 are population figure for the early and later years (see, Yeates and Garner, 1976).

Results and Analysis

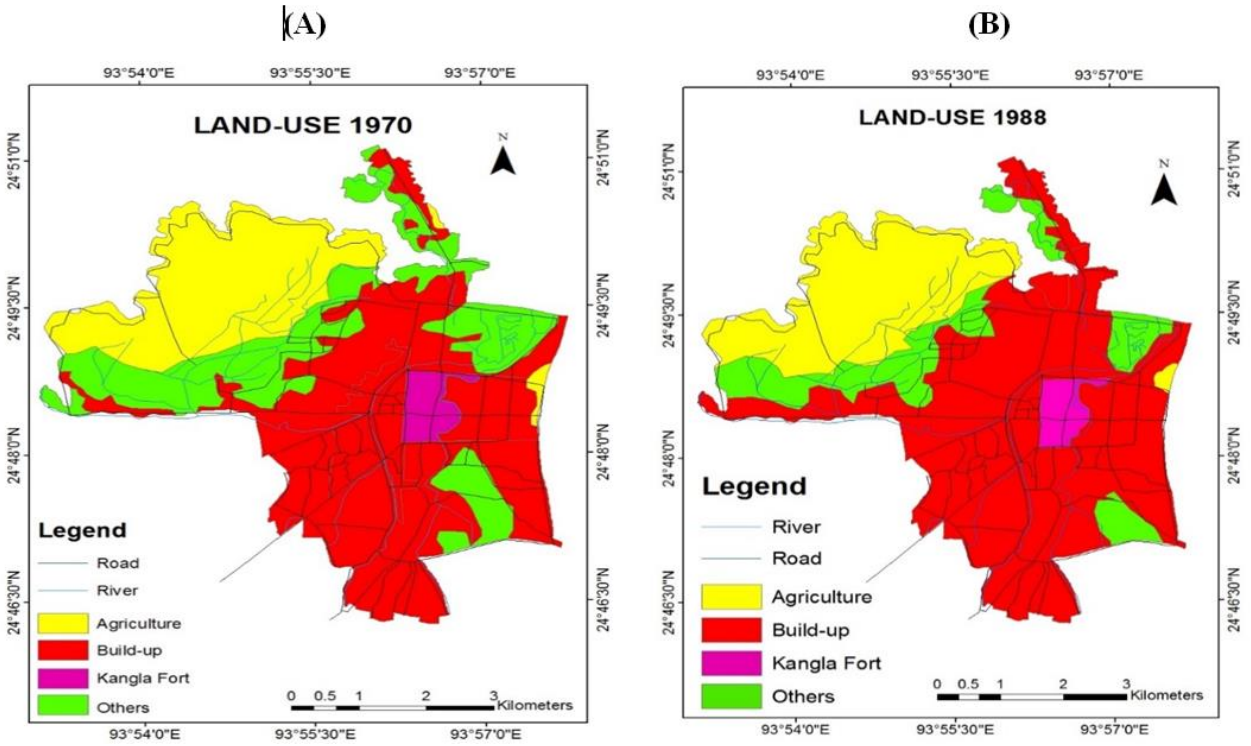
Urban growth demand more urban space, which led to the conversion of fringe land beyond the city limits to urban areas. Spatial expansion of city, in most of the cases can be explained in terms of wave of urban growth. Imphal districts experienced waves of urban growth that influence the urban landuse. Land-use classes are broadly divided into three categories - build-up, agriculture and others land-use. Figure 2 (A-D) indicates Kangla, area which is a fort in Imphal; it was the confluence point of political, military, social, cultural and economic activities in pre-British period. Imphal remain as the dominant power within the valley of Manipur and its legacy remains until today (Devi, 2013). Build-up areas experienced abrupt increase from 17.86 sq.km in 1970 to 22.05 sq.km in 1988 (23.45%) and 27.21 sq.km in 2006 (23.40%). However, it immensely dipped down in 2015 (9.80%), registering, yet, a significantly high rate of growth (67.27%) within the whole period (1970-2015) taken together. This signifies that large areas have been used for construction of houses at the cost of other landuse class and the process of urban expansion was already initiated. The agriculture land is found in the north and north-western part of the IMC above the wetlands, which experience a negative growth rate throughout the said periods. The rate of decrease was almost insignificantly low (-3.40%) in the initial stage (1988). However, it reached remarkable rate (-18.08%) in 2006 and alarmingly high rate (-35.53%) in recent stage of 2015. A study conducted by Singh and Devi (2016) too reported that an addition of 1390 hectares of land have come under built up category within a span of 21 years in Imphal city fringe areas. Farmland land area stands at 35.68% of the study area, which means this category has seen a decline in its coverage by about 5% in relation to 1989 figure (39.90%). It is noteworthy that agricultural land-use is rapidly shrinking from 8.09 sq.km to 4.12 sq.km (-48.99% in 1970-2015) in its areas. Again, 'Others' land-use class, which occupy a significant amount of areas, are seen to be decreasing rapidly throughout the period. It is seen in the northern part below the agriculture areas as well as in the west and southern part of the IMC. One can observe extremely high decrease from 8.43 sq.km to 0.37sq.km (-95.51%) in 'Others' landuse class too. The overall percentage change was recorded to be the highest decreased of all the land-use class. The regions decreased include mainly the

wetlands and fallow land. In all the landuse, it can be observed that the 'others' land-use class experience a decreased in the initial period and encroachment of agriculture land later follows {Table 1 and Figure 2 (A-D)}.

Table 1: Landuse of Imphal Municipal Council area (1970-2015)

Landuse	Year							
	1970	1988	2006	2015	1970-88	1988-06	2006-15	1970-2015
	Areas in sq.km.				In %			
Build-up	17.860	22.050	27.210	29.876	23.45	23.40	9.79	67.27
Agriculture	8.089	7.814	6.401	4.126	-3.40	-18.08	-35.52	-48.98
Others	8.430	4.516	7.701	0.378	-46.42	-82.95	-50.86	-95.51
Total	34.381	34.381	34.381	34.381				

Sources: Compiled by the scholars based on Topographic Sheet 1970, Landsat TM 1988, Google Earth Images— 2006 and 2015.



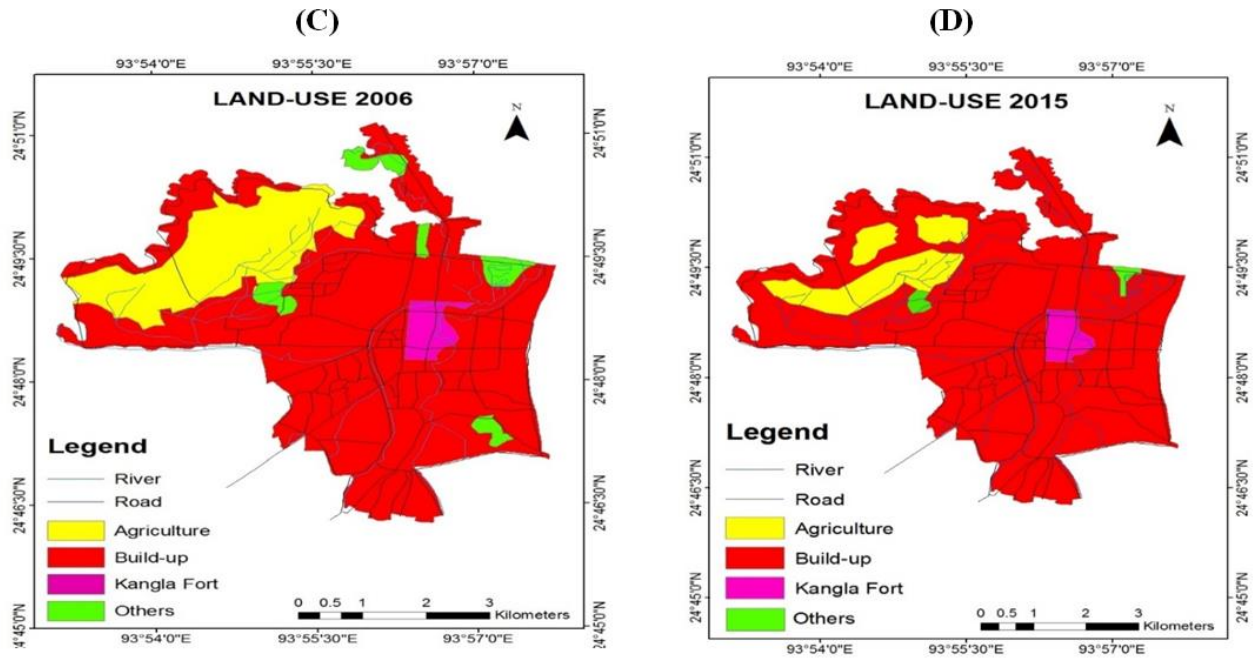


Figure 2 (A-D): Urban Sprawl in Imphal Municipal Council Area (1970- 2015)
Sources: Prepared by the scholars based on Topographic Sheet 1970, Landsat TM 1988, Google Earth Images 2006 and 2015

Land-use beyond the IMC boundaries covers an area of 54 sq. km. It is interesting to note that while registering, almost constant growth rate in the past two decades (1970-88 and 1988-06), build-up indicates declining growth rate recently (2006-15). However, the total growth rate for the decades (1970-2015) remains extremely high (201.30%), which reveals that there is a large expansion in build-up areas. Agricultural lands initially increased (16.76% in 1988) due to reclamation of lands such as wetlands and fallow lands for agricultural uses. Nevertheless, it started to decrease (-35.09%) in 2006 and further in 2015 (-47.74%). There is significantly high rate of decline in its area coverage for the whole periods (-60% in 1970-2015). The 'Others' land-use class continued to decrease (-98.21%) right from the beginning until recent times (Table 2 and Figure 3).

The overall changes occurred in both the IMC and outside/beyond IMC areas, build-up sees abnormal decadal increase from 22.06 sq.km to 74.16 sq.km (236.19%) whereas, agricultural land decreased from 54.18 sq.km to 14.26 sq.km (-73.67%) and 'others' land-use class from 12.81 sq.km to 0.63 sq.km (-95.04%), registered alarming rate of decrease (loss) in areas for the whole 1970-2015 (Table 3). Landuse and landcover (LULC) changes between 1989 and 2010 and spatial pattern of the changes in Imphal areas reflect the complex and dynamic interplay that exist between changing socio-economy and spatial processes (Singh and Devi, 2016).

Table 2: Land-use beyond Imphal Municipal Council Boundaries (1970-2015)

Landuse	Year				Change			
	1970	1988	2006	2015	1970-88	1988-06	2006-15	1970-2015
	Area in sq. km				In %			
Build-up	14.699	23.041	34.888	44.290	56.75	51.41	26.949	201.30
Agriculture	25.597	29.887	19.398	10.138	16.76	-35.09	-47.736	-60.39
Others	14.388	1.757	0.399	0.257	-87.77	-77.27	-35.57	-98.21
Total	54.686	54.686	54.686	54.686				

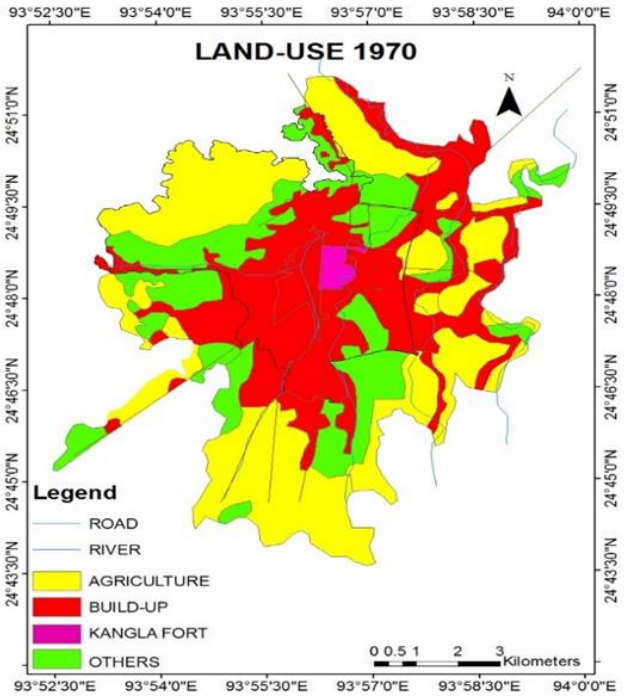
Sources: Compiled by the Scholars based on Topographic Sheet 1970, Landsat TM 1988, Google Earth Images— 2006 and 2015

Table 3 Overall Changes in Landuse (1970-2015)

Landuse	Year				Changes			
	1970	1988	2006	2015	1970-1988	1988-2006	2006-2015	1970-2015
	Areas in sq.km				In %			
Build-up	22.06	45.09	62.10	74.17	104.39	37.71	19.43	236.19
Agriculture	54.19	37.70	25.80	14.27	-30.42	-31.56	-44.70	-73.67
Others	12.82	6.27	1.17	0.64	-51.05	-81.35	-45.63	-95.04
Total	89.07	89.07	89.07	89.07				

Sources: Compiled by the Scholars based on Topographic Sheet 1970, Landsat TM 1988, Google Earth Images— 2006 and 2015

(A)



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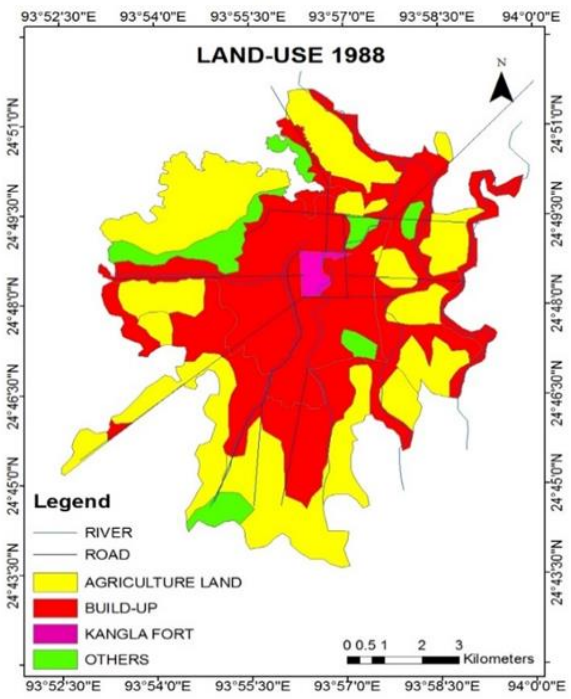

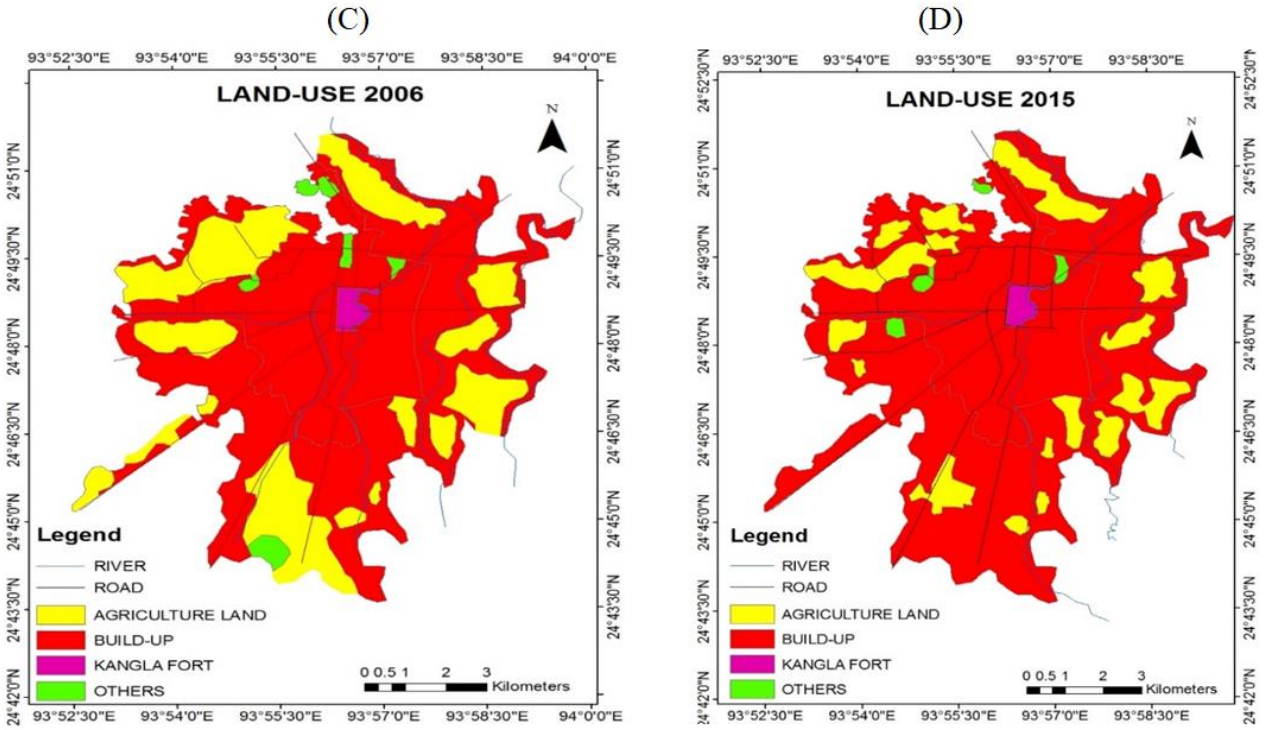

Figure 3(A-D): Sprawl beyond the Study Area (1970-2015)
Sources: Prepared by the Scholars based on Topographic Sheet 1970, Landsat TM, 1988, Google Earth Image 2006 and 2015.

Urban expansion and urban landuse change can also be analysed by application of the formula, Land Consumption Rate (LCR) and Land Absorption Coefficient (LAC). LCR is the measurement of the spatial expansion of build-up and the compactness of the city. LCR value in IMC areas continuously decrease from 0.034 in 1971 to 0.012 in 2011 shows that there was compactness in the city areas with the increase in population density. On the other hand, the LCR beyond the IMC also decreased from 0.088 in 1971 to 0.032 in 2011, show the compactness of the areas with the passing years. LAC on the other hand, measures the spatial increase in urban land with the increase in population. The LAC in the IMC was 0.007 in 1971-1991 and increased to 0.009 in 1991-2001, and further increased to 0.119 in 2001-2011. In the area beyond the IMC areas, the LAC also increased from 0.014 in 1970-1991 to 0.022 in 1991-2001 and 0.037 in 2001-2011. The reason of increasing LAC was due to the decadal growth of population is lower than the decadal add to the urban areas (Table 4). The unplanned urbanisation results into a disperse growth of population. The analysis of urban footprint revealed that there is a large scale modification of urban land-use within the city and its fringe areas due to urban growth. The city experienced urban sprawl in the form of low density, ribbon, leaf-frog development and is more pronounced in the southwest and northeast of the region. The urban development follows a concentric zone model where the rate of development in the core region is more and decreased as we move away from the centre (Ramachandra et al., 2014).

Table 4: Land Consumption Rate and Land Absorption Coefficient

IMC				Beyond IMC			
Year	**LCR**	**Year**	**LAC**	**Year**	**LCR**	**Year**	**LAC**
1971	0.034	1971-1991	0.007	1971	0.088	1971-1991	0.014
1981	0.021	1991-2001	0.009	1981	0.056	1991-2001	0.022
1991	0.017	2001-2011	0.119	1991	0.044	2001-2011	0.037
2001	0.013			2001	0.035		
2011	0.012			2011	0.032		

Sources: Compiled by the Scholars based on Topographic Sheet 1970, Landsat TM 1988, Google Earth Images— 2006 and 2015

Conclusion

From the above analysis, urbanisation results to urban sprawl, this later altered the landuse/landcover of Imphal. It is found that there has been substantial transformation of land to build-up areas. The area has seen intensification of land-use over the past decade because of perceived business opportunities available in the area due to its proximity to the airport. Most of the new built ups are educational buildings, commercial establishments and residential colonies constructed by migrants from rural parts of the state (Singh and Devi, 2016).This research is an addition to the basket of previous literature on urban sprawl (Feng and Li, 2012; Bhalli et al, 2012; Bhatia, 2010; Gupta, 2011; Hanes, 2011; Kumar et al 2011; Rahman, 2011; Sharma and Joshi, 2013; Sinha and Sekhar, 2016; Singh and Devi, 2012; Singh and Kumar, 2012; Stomp, 2012; Terzi and Fulin, 2009).

The land-use map clearly shows that build-up areas grow tremendously at the expense of agriculture and others landuse. It may continue in coming years due to population pressure. 'Others' land-use class especially, the wetland is more vulnerable to human activities because there was a rapid decreased in the landuse (wet lands) than agriculture land in the initial stage in IMC, but when wetlands are almost replaced by build-up areas, agriculture land has been encroached later on. If we closely examine the proportion of land areas and the density of population, it can be assumed that the compactness in the centre of the city encourages urban sprawl. Another potential factor in the growth of the city is the push and pull factor. Tertiary activities like services, commercial, economic opportunities and other activities attract migration from different part of the state to the city. The push factor is the lack of resources in the rural areas, which led to many unemployed youth to search for livelihood in the city. Considering the suggestions of researchers, academic community, planners, scientists, non-governmental organisations, and local people, the Government of Manipur should formulate and execute balanced inclusive urban development and landuse policy for the sustainable future of Imphal.

References

Alves, D. S., and Skole, D. L. (1996). Characterizing landcover dynamics using multi-temporal imagery. *International Journal of Remote Sensing*, 17(4), 835-839.

Atu, J. E., Offiong, R. A., Eni, D. I., Eja, E. I., and Esien, O. E. (2012). The effects of urban sprawl on peripheral agricultural lands in Calabar, Nigeria. *International Review of Social Sciences and Humanities,* 2(2), 68-76.

Basawaraja, R., Chari, K. B., Mise, S. R., and Chetti, S. B. (2011). Analysis of the impact of urban sprawl in altering the land-use, land-cover pattern of Raichur City, India, using geospatial technologies. *Journal of Geography and Regional Planning*, 4(8), 455-462.

Bhalli, M. N., Ghaffar, A., and Shirazi, S. A. (2012). Remote sensing and GIS applications for monitoring and assessment of the urban sprawl in Faisalabad-Pakistan. *Pakistan Journal of Science*, 64(3), 203-208.

Bhatta, B. (2010). *Analysis of urban growth and sprawl from remote sensing data*. Berlin: Springer Science and Business Media. 17-36.

Census of India (2011). Delhi Population Census Data, 2011. Available at http://www.census2011.co.in/states.php, Accessed on 09 Oct; 2017.

City Development Plan (CDP) (2010). *Imphal Municipal Council*. Government of Manipur. At http://jnnurm.nic.in/wp-content/uploads/2010/12/CDP_Imphal. Accessed on 22 nd May 2015.

Department of Agriculture. (1995-06, 2005-06, and 2001-13). *Report on Agriculture Census.* Government of Manipur.

Devi, M. S. (2013). *Spatio temporal analysis of environment: a case study of Imphal*. Unpublished Thesis, Jamia Millia Islamia University, Delhi, p. 50.

Directorate of Economics and Statistics.(2015-16). *Economic survey Manipur*. Government of Manipur. At http://desmanipur.gov.in/. Accessed on 09 June 2015.

Feng, L., and Li, H. (2012).Spatial pattern analysis of urban sprawl: Case study of Jiangning, Nanjing, China. *Journal of Urban Planning and Development*, 138(3), 263-269.

Guerra, F., Puig, H., and Chaume, R. (1998).The forest-savanna dynamics from multi-date Landsat-TM data in Sierra Parima, Venezuela. *International Journal of Remote Sensing*, 19(11), 2061-2075.

Gupta, R. K. (2011). Change detection techniques for monitoring spatial urban growth of Jaipur city. *Inst Town Planners India J*, 8(3), 88-104.

Hall, F. G., Strebel, D. E., Nickeson, J. E., and Goetz, S. J. (1991). Radiometric rectification: Toward a common radiometric response among multidate, multisensor images. *Remote Sensing of Environment*, 35(1), 11-27.

Hannes, B. (2011). Urbanisation and water; Some thought of urban sprawl in India. At www.waterandmegacities.org/. Accessed on 21 November 2014.

Jagadeesh, C. B., Naiklal, H. S. S., Sitaram, N. (2015). Dynamics of rapid urbanisation of Bangalore and its impact on landuse/land-cover – A case study of Vrishabhavathi sub-watershed. *International Research Journal of Engineering and Technology (IRJET)* 2(3), 1-8.

Kiio, M. M., and Achola, O.P. (2015). Landuse landcover changes and their effects on agricultural land: A case study of Kiambu County – Kenya. *Kabarak Journal of Research and Innovation.* 3(1), 74-86.

Kumar, A., Pandey, A. C., Hoda, N., and Jeyaseelan, A. T. (2011). Evaluation of urban sprawl pattern in the tribal-dominated cities of Jharkhand state, India. *International Journal of Remote Sensing*, 32(22), 7651-7675.

Mertens, B., and Lambin, E. F. (2000). Landcover change trajectories in southern Cameroon. *Annals of the Association of American Geographers*, 90(3), 467-494.

Meitei, Sougaijam Priyokumar (2013). Migration and Social Tensions in Manipur, *International Journal of Science and Research*, 5 (9), 729-735.

Rahman, A., Kumar, S., Fazal, S.; and Siddiqui, M.A. (2012). Assessment of landuse/landcovers changes in the north-west district of Delhi using remote sensing and GIS techniques, *Journal of Indian Society Remote Sensing*, 40(4), 689-697.

Rahman, A., Aggarwal, S. P., Netzband, M., and Fazal, S. (2011). Monitoring urban sprawl using remote sensing and GIS techniques of a fast growing urban centre, India. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 4(1), 56-64.

Ramachandra, T. V., Bharath, H. A., and Sowmyashree, M. V. (2014). Urban footprint of Mumbai: The commercial capital of India. *Journal of Urban and Regional Analysis*, 6(1), 71-94.

Riebsame, W. E., Meyer, W. B., & Turner II, B. L. (1994). Modeling landuse and cover as part of global environmental change. *Climatic change*, 28(1-2), 45-64.

Sankhala, S., and Singh, B. K. (2014).Evaluation of urban sprawl and landuse landcover change using remote sensing and GIS techniques: A

case study of Jaipur city, India. *International Journal of Emerging Technology and Advanced Engineering*, 4(1), 66-72.

Sen, S. (2011). Effect of urban sprawl on human habitation in urban fringe and peri-urban areas in Kolkata metropolitan area. *India Journal*, 8(4), 58-66.

Shalaby, A. A., Ali, R. R., and Gad, A. (2012). Urban sprawl impact assessment on the agricultural land in Egypt using remote sensing and GIS: A case study, Qalubiya Governorate. *Journal of Landuse Science*, 7(3), 261-273.

Sharma, R. and Joshi, P.K. (2013). Monitoring urban landscape dynamics over Delhi (India) using remote sensing inputs, *Journal Indian Society Remote Sensing*, 41(3), 641-650.

Sharma, S., Singh, P., Doi. R. D., Sharma, A., Kumar, R., Bhatti, P. (2015). Urban sprawl and spatio temporal analysis of Hisar city in Haryana using remote sensing and GIS technology. *International Journal of Science, Engineering and Technology Research (IJSETR)*, 4(12) 4388-4392.

Singh, A. (1989). Digital change detection techniques using remotely-sensed data. *International Journal of remote sensing*, 10(6), 989-1003.

Singh, A.M. and Devi, K. R.(2016). Landuse And Landcover Change Detection Of Fringe Areas Of Imphal City, Manipur, India. *IOSR Journal Of Humanities And Social Science*, Vol 21, Issue 2, Feb; pp 09-16.

Singh, B., and Singh, J. (2014). Landuse/landcover change of Delhi: a study using remote sensing and GIS techniques. *International Research Journal of Earth Sciences*, 2(1), 15-20.

Singh, N. Deva (2012). Urbanization in Changing Environment with Reference to Manipur, Regency Publications, New Delhi

Singh, N., and Kumar, J. (2012). Urban growth and its impact on cityscape: A geospatial analysis of Rohtak city, India. *Journal of Geographic Information System*, 4(1), 12.

Singh, R. B. and Nath, Rituparna (2012). Remote sensing, GIS and micrometrology for monitoring and predicting urban heat islands in Kolkata megacity, *Annals of National Associationg of Geographer, India*, 32(1).

Sinha, S.K., and Shekhar, R. (2016).Urban sprawl in Noida city, Gautam Buddha Nagar (U.P). *Annals of NAGI*, 36(1), 89-102.

Statistical Abstract Manipur.(2007). *Directorate of Economics and Statistics*, Government of Manipur, Imphal.

Statistical Handbook of Manipur.(1985). *Directorate of economic and statistics*. Government of Manipur, Imphal. At http://desmanipur.gov.in/. Accessed on 4th October 2015.

Stomp, A. (2013). An international survey of urban sprawl case studies. *Geography Compass*, *7*(7), 504-516.

Terzi, F., and Bolen, F. (2009).Urban sprawl measurement of Istanbul. *European Planning Studies*, *17*(10), 1559-1570.

Travisi, C.M., and Camagni, R. (2005). Sustainability of urban sprawl: Environmental economic indicators for the analysis of mobility impact in Italy. *FEEM Working Paper No. 102.05* Available at: http://www.feem.it/userfiles/attach/Publication/NDL2005/NDL 2005-102.Pdf. Accessed 02 June 2016.

Turner, B. L., Meyer, W. B., and Skole, D. L. (1994).Global landuse/land-cover change: towards an integrated study. *Ambio. Stockholm*, *23*(1), 91-95.

USGS.(1999). *Analyzing landuse change in urban environments*. Available at http://landcover.usgs.gov/urban/info/factsht.pdf. Accessed on 12th October 2015.

Yeates, M. and Garner, B. (1976).*The North American City*. New York: Harper and Row Publication.

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