

Application of Remote Sensing and GIS in studying Landuse changes (A case study of Laitumkhrach, Shillong, Meghalaya)

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Abstract: *The chosen study area, contained 90-95 percent of residential area till 1990's. But after the 90's the Ward witnessed a gradual change from residential to commercial land use. The growth of this phenomenon was caused by certain rules that changed the land use. Thus the present work seeks to investigate and analyze the prominent changes in land use land cover of Laitumkhrach as well as the functional changes, utility and the pace that has taken place at a rapid rate particularly after 2009 with the aid of Remote Sensing and GIS application.*

Keywords: Land use land cover, changes, remote sensing, GIS.

1. Introduction

FAO defines land as "a delineable area of earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface. Land use concerns the function or purpose for which land is used by the population; it can be defined as the human activities that are directly related to land, making use of its resources or having an impact on them. Whereas land cover refers to the type of vegetation that covers the land surface, other aspects of the physical environment such as soils, biodiversity, surfaces and groundwater as well as to human structures, such as buildings or pavement.

Changes in earth's natural land cover have been taking place since times immemorial and have been associated with both natural phenomena and human interference. Since 1700 however land cover changes have been reported as being human induced changes and these have caused diverse, mostly adverse impacts on both society and the environment. Land cover may change under the influence of biophysical conditions only but most frequently it results from human induced land use change. Moreover land use changes are common symptoms in city development process, which can happen within and or outside the city. Most often, residential areas are a susceptible to

land use changes due to characteristic of the neighborhood, accessibility, renting/business factors and government policy. The tendency of most of these changes began at first as a penetration process of commercial activities, which then continued to increase and dominate within the area. However in recent years, large cities have experienced rapid growth and majority of these cities are facing uncontrolled developments at the densely populated areas and changing of residential land use into mixed land use.

Over a period of time City Corporations and Urban Development Authorities allow change in making street as Commercial Street due to increase pressure for commercial activities. With a result of this, many streets in the residential areas have altered to commercial, public and semi-public activity and also apartments and there is increase in functional changes over the years. Thus, the residential areas are affected by the changing dynamics of land use by increasing the density of the area. Very recently, these changes have been recognized by introducing the concept of mixed land use in residential areas in many of Indian Master Plans namely Delhi, Mumbai, Bangalore etc. The size and pattern of mixed land use today are closely related to the location of activities, movement patterns and densities in the settlement.

2. Objective

The goal of the research is to describe and analyze the existing transformation process of residential area into commercial places in the study area. Thus in this connection the following objectives have been kept in mind:

To study the change in land use/ land cover between two periods of time (2009 & 2015).

To identify the pattern of functional changes-development from residential into commercial.

To investigate the factors influencing functional changes in the study area.

3. Methodology

A. Study area

Laitumkhras ward is situated on the Laitumkhras-Mawkhar east of the European ward extending from 25° 30' 07.6" north latitudes to 91° 58' 47.6" east longitudes with a total area of 183.23 hectares. In 1930, Laitumkhras Ward became a part of Shillong Municipal area comprising of four wards- ward 1(Nongrim Road, Nongrimbah, Nongkynrih, Lumsokra, Nongrimma and Demseiniong), ward 2(Upper & Lower Colony and Bhagyakul), ward 3(Upland Road, Upper Lachumiere and Lower Lachumiere) and ward 4 (Lummawrie upto Nongthymmai Bridge, Laitumkhras Main Road (Ktieh) and Jowai Road). From then onwards, this area grows in size especially with the setting up of numbers of educational institutions by the Catholic Missionaries. At present Laitumkhras is one of the most important commercial centres in Shillong after Iewduh with a local market which provides all the needs of the people in the areas around it. Currently along Laitumkhras the national highway NH44 runs near St. Edmunds College.

B. Database and Methodology

The current work is entirely an empirical study involving both primary and secondary data. Primary data was collected through field work in the form of groundtruthing and verification through GPS points, questionnaires and interviews. Secondary data was collected through multi date satellite data of 2009 and 2015 Google images from Google earth and also from published books and other official publications. The methods used for the first objective include-digitization and identification of LULC classes of both 2009 and 2015, ground truth and verification through GPS points, LULC layout maps of 2009 and 2015, change detection map of LULC using spatial

analyst tools and overlay method. The second objective has been fulfilled through the methods of-digitization of buildings for 2009 & 2015 images, simple random sampling of 181 samples, identification and verification of building's usages through GPS points and questionnaires, building layout maps and usage maps of 2009 and 2015 and change detection map of building's usage and function by overlaying both 2009 & 2015 building usage maps. The third objective has been fulfilled through the methods of- accessing the past records with verification from the rangbah shnong, support taken from published books, and other official publications and questionnaires and interviews. Out of all these methods, tables and figures have also been prepared to get the final results and findings.

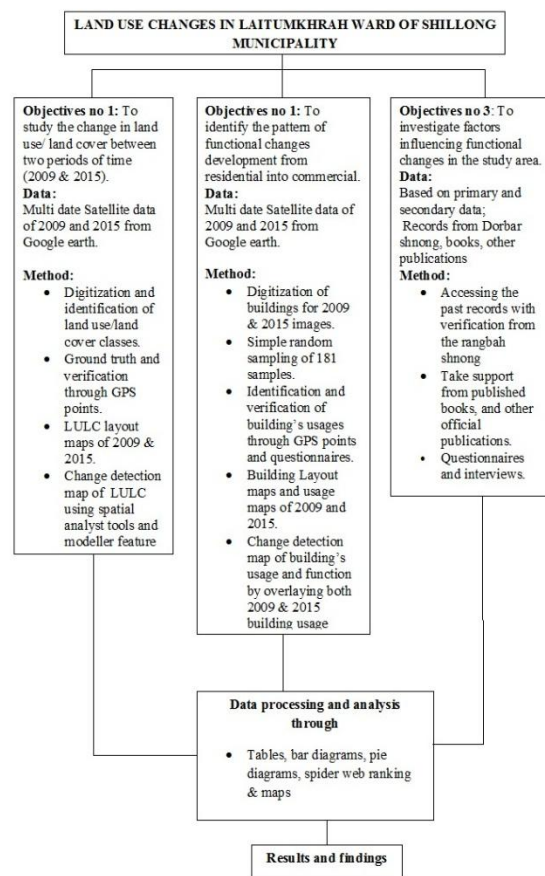


Figure 1: Database and methodology.

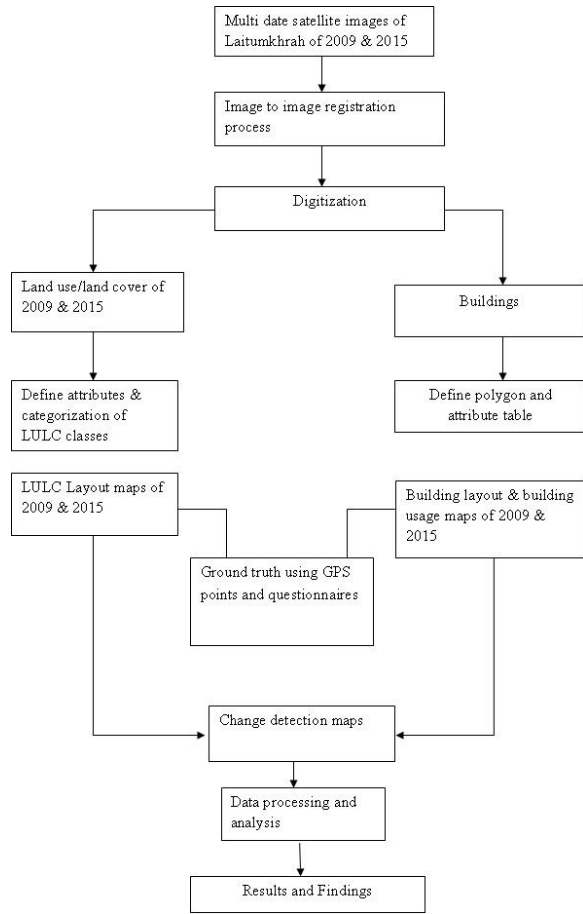


Figure 2: Methodology flow diagram.

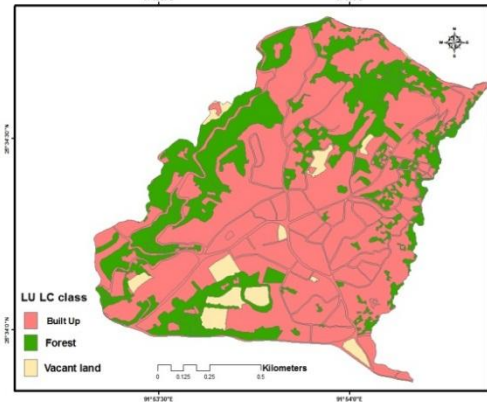


Figure 3: Landuse landcover map of Laitumkrah 2009.

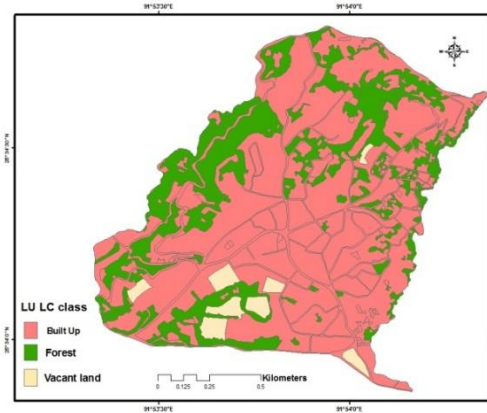


Figure 4: Landuse landcover map of Laitumkrah 2015.

4. Results And Findings

I. TABLE 1: LAND USE LAND COVER OF LAITUMKHAH

LULC class	Area (in sq. m)		Area percentage of LULC	
	2009	2015	2009	2015
Built up	1152000	1190000	67.21%	69.42%
Forest	492000	460000	28.70%	26.91%
Vacant land	70000	59000	4.08%	3.45%

Source: Constructed as per Field work from google images 2009 & 2015

II. TABLE 2: LANDUSE LANDCOVER CHANGES OF LAITUMKHAH

Land use/ Land Cover changes	Area in sq.m	Area percentage
Built up to forest	2063.89	2.81%
Forest to built up	42935.26	58.61%
Forest to vacant land	5233.90	7.14%
Vacant land to built up	14140.51	19.30%
Vacant land to forest	8876.50	12.11%

Note: Constructed as per Field work from google images 2009, 2015.

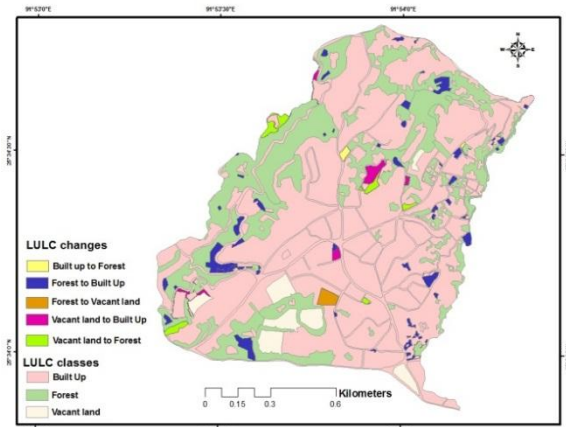


Figure 5: Change detection map of land use/cover in Laitumkhrach.

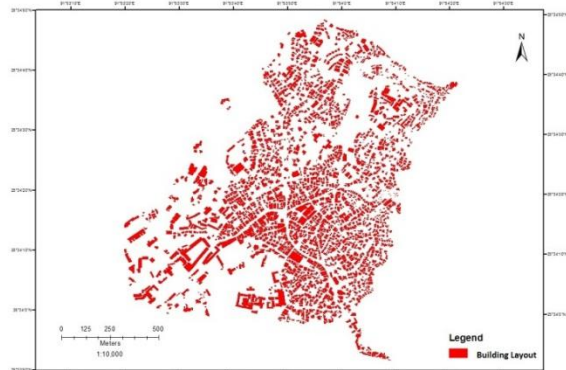


Figure 6: Building layout map of Laitumkhrach (2009).

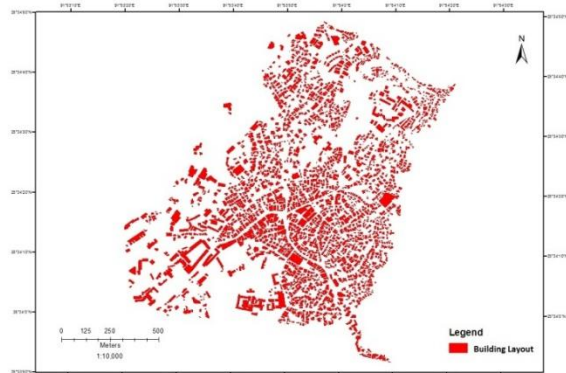


Figure 7: Building layout map of Laitumkhrach (2015).

III. TABLE 3: BUILDING USAGE OF LAITUMKHAH

Building usage	Area (in sq.m)		Area Percentage of Building usage	
	2009	2015	2009	2015
Residential	25808	16486	35.53%	22.08%
Commercial	4109	10254	5.65%	13.73%
Residential cum commercial	761	3229	1.04%	4.32%
Office	24540	26780	33.78%	35.87%
Institutions	17419	17904	23.98%	23.98%

Source: Field work, 2015

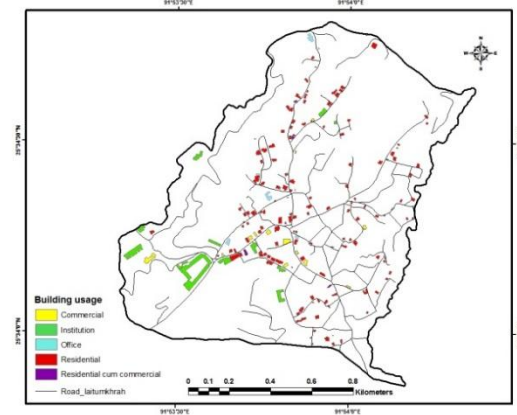


Figure 8: Building Usage map of Laitumkhrach (2009).

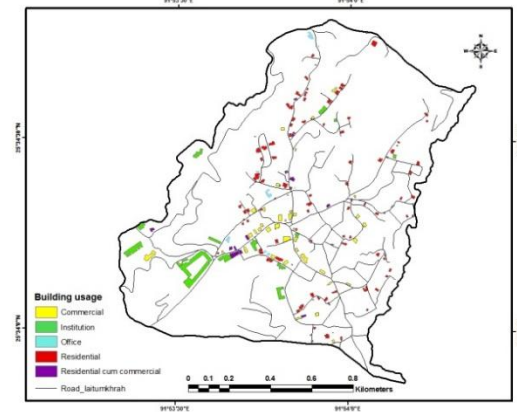


Figure 9: Building Usage map of Laitumkhrach (2015).

IV. TABLE 3: FUNCTIONAL CHANGE OF BUILDINGS IN LAITUMKHAH

Functional change	Total number of buildings with functional change	Percentage
Residential to commercial	25	58.13%
Residential to residential cum commercial	12	27.90%
Residential cum commercial to commercial	2	4.65%
Residential to office	2	4.65%
Residential to institution	1	2.32%
Office to institution	1	2.32%

Source: Field work, 2015

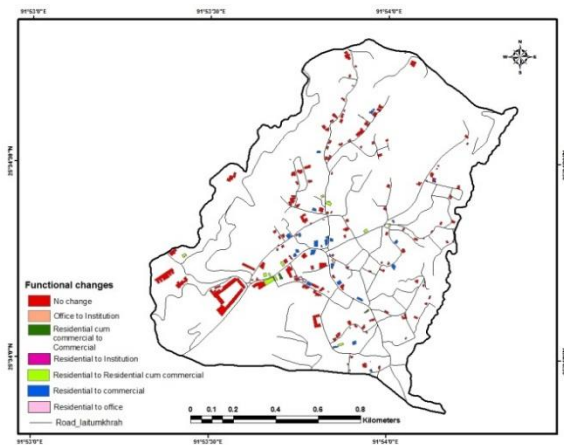


Figure 10: Functional Change Detection Map of buildings in Laitumkrah.

The study of Land Use Changes in Laitumkrah ward of Shillong shows that there have been changes in the land use land cover of Laitumkrah within a period of six years in which natural forest cover and vacant land have been decreasing in their area whereas built up has been increasing and encroaching every inch of area of Laitumkrah. Further change from forest to build up is the most prominent among all the types of land use land cover changes followed by change from vacant land to build up. In this context, it can be stated that the area’s natural landscape has been invaded by a high degree of urbanization process in terms of population growth and economic development.

An increase in the area of built up mentioned in objective 1 implies that a number of buildings have been coming up and it has been found that old buildings have been expanded and renovated and there are also those who have been completely demolished and a new one has been constructed leading to a change in the physical appearance of the whole area. The old traditional Assam type houses

have been replaced by high rise RCC buildings and these were constructed in close proximity to each other especially along the road side. This however has caused congestion and most of the building owners prefer to make a vertical expansion of their buildings rather than horizontal and this pattern has resulted in the functional change of them from purely residential to residential cum commercial (mix function) where the upper floors are usually used for residential purpose whereas the lower floors are used for commercial purpose.

The study also revealed that in Laitumkrah that was previously a fully residential area has now changed in its function. The residential conditions have changed mainly the dwellings along the road from Don Bosco Square to Fire Brigade point have been intruded by commercial use and the commercial buildings have increased. At present this transformation has gradually spread to the interior of the area far from the road side because of coming up of a number of girl’s hostels, paying guest inn, guest houses, hotels to cater the requirements mainly of the students and the working people.

Moreover it has been found that residential buildings have been decreasing in their number and area while commercial and residential cum commercial buildings show increasing figures in their area and total number within a short span of time from 2009 to 2015. Residential buildings dominated almost the whole area in 2009 but in 2015 commercial and residential cum commercial buildings have increased at a rapid rate. From a sample size of 181 buildings, 43 buildings have undergone functional change which accounted for 23% of the change percentage. Further it has been found out that the most dominant functional change at present is the change from residential to commercial followed by residential to residential cum commercial.

In connection to the pattern of functional changes mentioned in objective 2, there are factors responsible for it. It has been found that economic factor is the most influential and important factor causing the functional transformation. In other words high rate of profit return for doing a business has a big influence in land use changes for commercial in Laitumkrah. Those who have leased out their buildings for commercial purpose received a handsome return of money and because of this they are able to live a high standard of living. Further Laitumkrah is located in such an area where there is easy accessibility to good educational institutions, offices, hospitals and other businesses. Because of this, hostels, paying guest inn, hotels, big shops, malls private clinics and drug stores have been

witnessed in and around the area.

However people staying in Laitumkhrach are those having a high social position and very well off since Laitumkhrach is regarded as one of the most urbanized and civilized locality of Shillong. This has stimulated the construction of big malls, restaurants, general stores etc which can meet the luxurious needs of these elite people. It has also been found that commercialization in Laitumkhrach is accompanied by gentrification because the social prestige that it holds attracts the rich from other areas especially from Jaintia Hills as well as West Khasi Hills to move here and buy plots of land from those middle class people at a high rate of price thereby converting the old buildings into modern ones.

Moreover it has also been found that absence of detailed planning rules and regulations framed by the Government of Meghalaya has led to a decline in residential function and an increase in commercial and mix functions. The role of traditional institution i.e. the Dorbar Shnong in giving the NOC for the transformation is also an indirect factor influencing the change. The existence of private land ownership in the area is also responsible for the change as the owners can use their land and buildings as they want for whatever purposes which according to them are more profitable.

5. Conclusion

Based on the above findings it can be concluded that it is good to see that commercial buildings have been growing in size and number due to which economic development also has been accelerated promoting a high standard of living. But here there is also a disadvantage because nonexistence of planning strategies adopted by the state government has created a problem of overcrowding and congestion particularly those commercial buildings which are constructed very close to residential. Therefore it is important that land use changes need to be recognized that transformation process from residential to commercial should be regulated in proper way so that it can generate profit for the economy as well as not threaten the environment of the neighborhood. Regarding this, it is on the part of the Government of Meghalaya to properly look into the matter and to create rigorous provisions to achieve not only a better economic setting but also to make an adjustment of the space use for the future also.

Since the scope of the present study is small, nevertheless, this pilot study will perhaps paved way for further detail study of other wards of the Shillong

Municipality so that the subject matter can be expanded to look into the gradual change of residential to commercial and to have a better insight of the functional changes that has expanded drastically these days.

Perhaps the study of the whole of Shillong Municipality area can be brought out carefully particularly with the existence of a different factors like the traditional institutions and the dominance of the Sixth Schedule can give a unique study on changes of land use from any Indian city scenario which can address typical issues of land use changes that can bring a would call upon an integrated approach of the rapid commercialization of the entire Shillong Municipal area.

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