

Land-Use and Land Cover Analysis and Dynamic Modelling: A Case Study of Imphal East District, Manipur

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Abstract: Mapping and monitoring of land-use and land cover (LULC) at a regional scale has its wide significance in understanding the field of urban planning and land debasement. In this study, the Imphal East's LULC classes, are being recognized for three points of time such 1988, 2003 and 2018. Performing Maximum likelihood supervised classification, the LULC classes are being classified and the accuracy assessment and overall classification accuracy are also carried out for each of the respective classified images. Additionally, Shannon Heterogeneity Diversity Indices (SHDI) and Landscape Shape Indices (LSI) helps in understanding the pattern and checked the planned and unplanned nature of the study area. Markov Modelling succours in the forecast of LULC classes in not so distant future. Among the LULC classes, built-up land enlists the biggest expansion which is seen in the northern and southern side of the study area.

Keywords: LULC, SHDI, LSI, Markov Modelling, Imphal East

1. Introduction

Among the dynamic features on the surface of the earth, land holds a specific phonology in the way of being. However, it's dynamism with advent of time has been disturbed by the anthropogenic forces keeping in mind the end goal to fulfill his physical and social need. This notices to functionalization and enhancement of land for some reasons viz. forest might be changed over to agricultural land, wetland to built-up land, etc. (Helen, 2003). Built-up might be additionally urbanized, sub-urbanized or deurbanized. Most importantly, the land-utilize data assumes an essential part in the investigation of worldwide change and condition (Sellers et al, 1995). Land-use as expressed by Froody (2002) is a major parameter in portraying the world's surface. In this manner, accurate monitoring of land-use and land cover (LULC) is of most extreme significance in many fields.

The huge development of populace in a wild way is felt in Imphal East district. The increase in per capita income of the general population as wells as the change in the interconnectivity of road likewise assumes a huge job in the fast difference in LULC classes in the study area. Hence, mapping of LULC classes at the regional scale is of most extreme significance for a full scope of use, such as, land degradation, planning etc. (Reis, 2008). In malevolence of all, LULC change is far reaching, quickening and noteworthy process driven by anthropogenic process and furthermore create alteration that effects people (Agarwal et al, 2002). The expansion in urban populace correlates with LULC change from the city centre towards the fringe frames the linchpin of the study. In this way, the fast urbanization and the land-utilize change in the outskirts are essentially described by an expansion in built-up grounds.

Remote sensing offers a few points of interest. It is a moderately economical and quick technique for securing a vast data over a large land territory inferable from its concise inclusion and tedious estimations. Remote-sensing

information typically gained in advanced frame are simpler to control and dissect; they can be procured from obvious as well as from unearthly ranges that are undetectable to human eyes; they can be obtained from remote regions where openness is a worry; and they give an impartial perspective of land utilize/arrive cover (Giri, 2012).

Among the decent diversity indices, such as Shannon Heterogeneity Diversity Indices (SHDI) and Landscape Shape Indices (LSI) help in the translating the forms and pattern and spontaneous nature of present LULC classes over some period of time. Above all, among the prescient demonstrating Markov Modelling (MV) place a huge advantage in foreseeing the difference in a place after a specific timeframe, in this way giving a space to design so as to dodge promote creation in the disturbance on the eco-friendly condition.

Among the antecedent in the field of the classification of land Harold Bartholomew (1955) was the trend-setter. Be that as it may, in view of land-use and land-cover, Anderson (1970) characterizes the land into 4 levels. Utilizing Anderson's scheme, the features in the study area are being distinguished and grouped into 6 classes for 1988, 2003 and 2018 viz. Agricultural land, Barren land (Waste land), Built-up land, Forest land, Water and Wetland. In this way, the built-up land other than barren land (waste land) enrolled the biggest change in these classifications. Indeed, even so there is little change in the development regions in the city area, yet there is a tremendous change at suburb. The northern and southern part of the Imphal East region has a biggest expansion of built-up land.

2. Study Area

Imphal East, one of the valley locale of Manipur with its spatial degree 24°39'49.09" N and 24°51'19.64" N and longitudes 93°3'39.6" E and 94°8'42" E is portrayed by uncontrolled and unforeseen geometric development of populace. This makes a substantial change on LULC classes. The non-flexible and unincreased land is subjected to

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colossal change particularly in agricultural and forest land to meet the ever expanded process in populace. Loss of arable land especially the change of agrarian land to non-farming area is ordinarily observed. The expanded in the number of towns additionally makes a zone of vicinity over the Imphal East regarding LULC change too. The issue of supremacy makes a force factor applying in the overabundance fascination in different assortments of financial exercises which results in the substantial change in LULC classes

Objective

To analyse and predict the LULC change.

3. Methodology

Data used, technique employed and software used.

Being downloaded the georeference Landsat 5 TM and Landsat 8 TIRS/OLI images of 1988, 2003 and 2018 are from USGS site, they are being stack in Erdas 9.1 to get a composite image expect panchromatic image(for 2018) and thermal images. The dates of both the images are been as about as conceivable in a similar vegetation season. The subsets of the study area are being reckoned from the composite images.

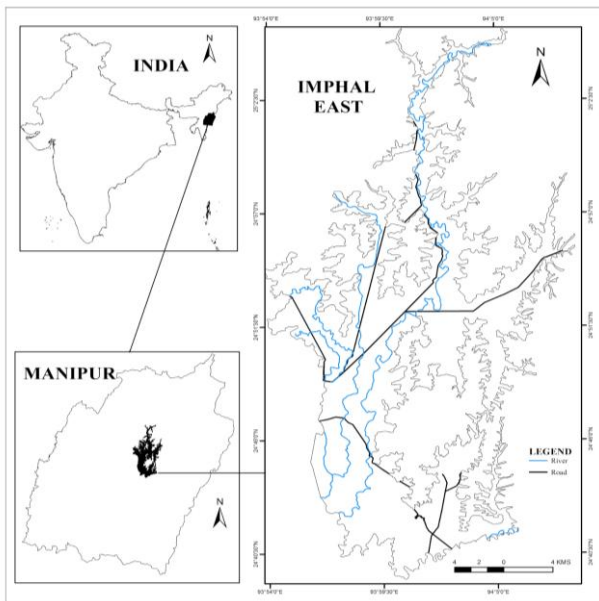


Figure 1: Study area

Before the image classification, image enhancement procedures, for example, histogram equalisation, radiometric correction are done keeping in mind the end goal to enhance the perceivability and interpretability of the images. The accessible auxiliary wellspring of information including research articles, government publication, books are being gathered. To access and check the uncontrolled and impromptu elements of LULC classes in scantily or inflexibly and demonstrate scientifically a few lists, viz. Shannon Heterogeneity Diversity Indices (SHDI) and

Landscape Shape Indices (LSI) are being ascertained at class level in Fragstats 4.2.1.

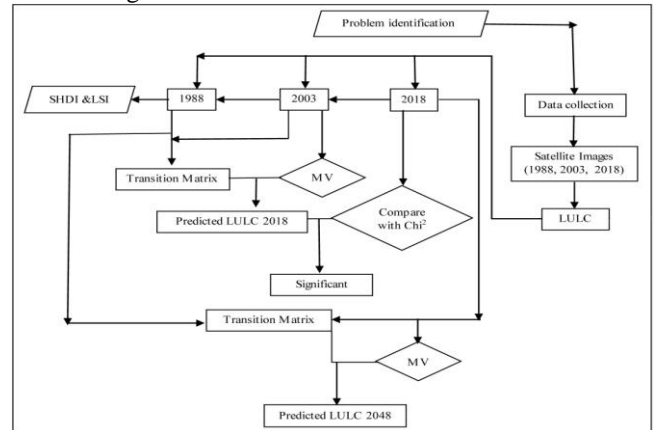


Figure 2: Flow chart of the methodology

Image classification and accuracy assessment

Each distinctive features are identified by using different band combination methods among which the Standard False Colour Composite (Std. FCC) is the most efficient. Out of which, 6 features for 1988, 2003 and 2018 image are identified and classified such as Agricultural land, Barren land (waste land), Built-up land, Forest land, Water and Wetlands. The subset images are compared and classified using Interactive supervised classification on Erdas 9.1 independently. Accuracy assessment such as the error matrix of both the classified images is used to prove the accuracy assessment. Overall, user’s and producer’s accuracies are also derived from the error matrices.

4. Results and Discussion

Accuracy assessment

75 points are taken for each of the 3 pre-classified images of 1988, 2003 and 2018 in order to render access the classification accuracy for the classified images. Table 1 shows the error matrices of classified images which includes Producers Accuracy, Users Accuracy as well as Overall Classification Accuracy and Overall Kappa Statistics. This creates some difficulties in the distinction and differentiation between barren land (waste land), built-up land and agricultural land as they experience the same spectral response pattern during this season. The main reason is due to which the agricultural land are left fallow during this season. Thus, the classification is not highly accurate. Even so, the classification made is the best classification among many classifications (Figure. 3).

Land use and land cover (LULC) change analysis

Imphal East is portrayed by the larger number of agricultural land (table 2) as far as spatial reach out of time. It mirrors the significance of agribusiness in the local economy which in turns mirrors the spatial example of land utilize. It likewise implies that the region is an agrarian culture which is in the embryonic phase of development.

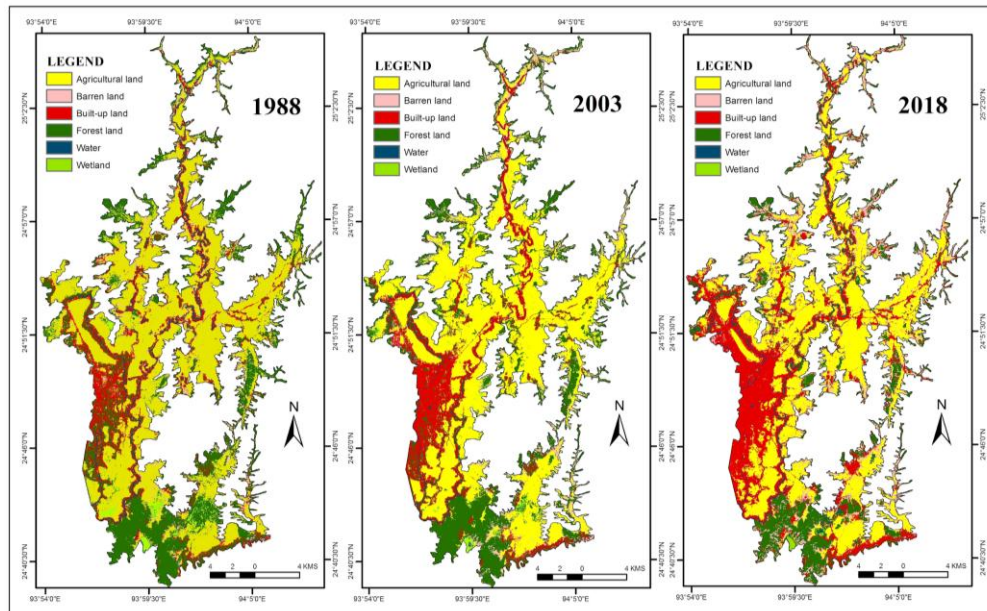


Figure 3: LULC of Imphal East

Table 1: Accuracy assessment

1988					
Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Agricultural land	43	41	40	93.02%	97.56%
Barren land	4	3	3	75.00%	100.00%
Built-up land	7	7	6	85.71%	85.71%
Forest land	19	22	17	89.47%	77.27%
Water	2	2	1	50.00%	50.00%
Wetland	0	0	0	---	---
Totals	75	75	67		
Overall Classification Accuracy = 89.33% Overall Kappa Statistics = 0.8224					
2003					
Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Agricultural land	38	40	36	94.74%	90.00%
Barren land	2	3	2	100.00%	66.67%
Built-up land	11	8	8	72.73%	100.00%
Forest land	19	21	18	94.74%	85.71%
Water	1	1	1	100.00%	100.00%
Wetland	4	2	2	50.00%	100.00%
Totals	75	75	67		
Overall Classification Accuracy = 89.33% Overall Kappa Statistics = 0.8335					
2018					
Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Agricultural land	25	24	23	92.00%	95.83%
Barren land	10	12	10	100.00%	83.33%
Built-up land	32	28	28	87.50%	100.00%
Forest land	7	10	7	100.00%	70.00%
Water	0	0	0	---	---
Wetland	1	1	1	100.00%	100.00%
Totals	75	75	69		
Overall Classification Accuracy = 92.00% Overall Kappa Statistics = 0.8857					

Table 2: LULC features over the points of time(1988, 2003 and 2018)

Feature Class	1988	2003	2018
Agricultural land	19274.06	18948.81	15390.63
Barren land	1578.44	2180.63	5012.57
Built-up land	4859.85	5798.71	9921.35
Forest land	11506	10812.06	7418.45
Water	977.36	701.6	819.832
Wetland	523.34	277.24	156.218
Total Area in Hectares	38719.05	38719.05	38719.05

At the point when examine the change over a time of 30 years, the expanded strengthening of LULC change is seen on the northern and southern part of the study area. It is apparent that among the LULC classes, barren land (waste land) and the built-up land has quickened frightfully in a wild way. The expanded in LSI and SHDI (Table 3) for 3 parts of time implies (Barren land and Built-up land) the uncontrolled extension in a scanty way. The expansion in barren land (waste land) from 1988 to 2018 supposedly is concentrated biggest in the northern and southern part of the Imphal East basically in the hilly areas. The shifting cultivation also called "Pamlou" is ordinarily found around there. Among the different causes, occasional lumbering of trees particularly for kindling is as yet polished, which is the reason of the expansion in barren land (waste land).

The built-up land demonstrates no distinction than the barren land (waste land) as far as uncontrolled and impromptu expanded in its areal broaden. The SHDI and LSI has been observed to be increase in those years. The meagre expanded in built-up isn't ordinarily found in the Imphal city. The examples of land utilize the city centre are particularly unique in relation to those at the edge. At the city centre, the tenants used their properties in the foundation of new built-up which incorporates wandered usefulness which incorporates rents, shops, and so on. The majority at the edge of the downtown area are chiefly described in cultivating, pisciculture, piggery for its bacon on the agricultural land regardless of agribusiness. The linear built-up land found on the eastern side of the study area portrays

the significance of road in attracting the settlement from the focal city (Imphal city). A similar trademark is moreover experienced in the Thongju areas. It is a direct result of the way that there is an enhance openness of National Highway, which results in the expanded view of opening for work.

Table 3: LSI and SHDI of 1988, 2003 and 2018

Features	LSI			SHDI		
	1988	2003	2018	1988	2003	2018
Agricultural land	55.70	55.86	95.33	0.15	0.15	0.16
Barren land	73.33	74.46	133.26	0.06	0.07	0.11
Built-upland	76.06	81.22	107.02	0.11	0.12	0.15
Forestland	81.22	85.98	100.98	0.16	0.15	0.14
Water	56.94	73.33	63.05	0.04	0.03	0.04
Wetland	31.53	33.83	17.46	0.03	0.02	0.01

A large portion of the forest land and wet lands that were once are presently for the most part changed over to built-upland and agricultural land for various reason. There is a reasonable change in the difference in wet lands to agricultural land in the Heingang region, particularly the Heingang Lake and additionally Kongba and Khongman regions. The alteration of wet lands in built-upland is clearly visualize in the east of Soibam Leikaii. e. JNIMS Hospital which was brought up in 1989. The new structure, for example, Khuman Lampak which was built up in 1999 additionally reclaimed the part of the wet lands. Regardless of all, with ever expanded in populace, the agricultural land are being meddled keeping in mind the end goal to see the recently emerge capacities.

Among the different elements that influences the LULC in the study area is the increase in the number of towns is additionally a prominent one which pulls in a great deal of populace towards its centre. The increased in the number of towns in Imphal East from 2 of 1991 to 15 out of 2011) plainly demonstrates the recovery of town has expanded consequently change the LULC classes for its urbanization (Singhetal,2016).

Table 4: Validation through Chi-square test

Features	Observed	Expected	Observed-Expected	(Observed-Expected) ²	(Observed-Expected) ² /Expected
Agricultural land	39.90	48.62	-8.72	-75.97	-1.56
Barren land	12.90	5.81	7.10	50.34	8.67
Built-upland	25.62	15.67	9.96	99.10	6.33
Forestland	19.15	27.53	-8.38	-70.26	-2.55
Water	2.11	1.68	0.43	0.19	0.11
Wetland	0.40	0.60	-0.20	-0.04	-0.07
	100.08	99.90			10.93

In this process, the two points of time such as LULC of 1988 and 2003 is used to predict the LULC of 2018. The predicted values are being compared with the actual 2018's LULC. In this process Chi square test is used. This test is based on the comparison of the difference between the observed results and the theoretical results (Singhetal,2008).The null hypothesis generated in such a way that the observed and the expected has no difference at all. The calculated value of the Chi square is even lesser than the tabulated values for 5 degrees of freedom 1% level of significance. This suggest that the null hypothesis is accepted and thus the Markov values hold true is this case for future prediction.

It is discovered that the rise of urban land-use in rustic urban periphery territories carry with it the accompanying change not just in physical and morphological part of Imphal East, yet in addition contacts the socio-economic conditions. Among them is the administrative extension of built-up land is the major causal specialist in the land-utilize. It heads to high urban sprawl. The change in the land- utilize is because of the reformation in an educational scheme that acquires in come more effectively other than agribusiness. A large portion of the general population staying in the city local are outsiders from the edge. The job opportunity is the major factor for the increased in population and change in land-use form that prevails in the study area. It is additionally discovered that because of increment in populace, there is areas on able move of local locations towards the edge of the citycentre.

Assorted variety in land usage is n't exclusively confined to the city centre or its external limit. The expansion in the change of forest land arrive for recreation all and is a proceeding with process. Selloi Langmai Ecological Park close to the Nongmaijing Chingkhonghills is a significant precedent. The transformation of 12 Acres of forest land to recreational land is an issuance of land-utilize change. The change of agrarian land to recreation all ad is plainly found in the Nunghsikol Parkin Tellou Channa areas. Among there creational parks, Santhei Natural Parkin Androis the most able precedent to cite as a progress of both agricultural land and forest land of land to recreational land.

LULC change modelling

The use of Markov demonstrating for the expectation of LULC for a state of time is utilized. It is generally denoted by as:

Markov Values or Predicted values=Present State (LULC)x Transition Matrix(Inter-categorical Matrix)

*It should be in probability.

Hence, the LUL Cestimations of 1988 and 2018 are utilized for the forecast of 2048 LULC. Of course, the genuine difference in LULC is pervasive. The chart below (figure 4) expresses that there will be an uncontrolled and spontaneous development of LULC. The uncontrolled development of populace and its impedance for the most part on the agricultural land for the extension of built-up land will be predominant. As given above, the year 2048 has the most astounding built-up concerning high reduction in agricultural land. The general public which was before the agrarian culture will be totally by its non-agrarian attributes in 2048.The increase in barren land (waste land) with respect to forest land also suggest the land degradation will be very much prevalent in the near future. Another reason might be

referred to will be the expanded transformation of towns from existing towns.

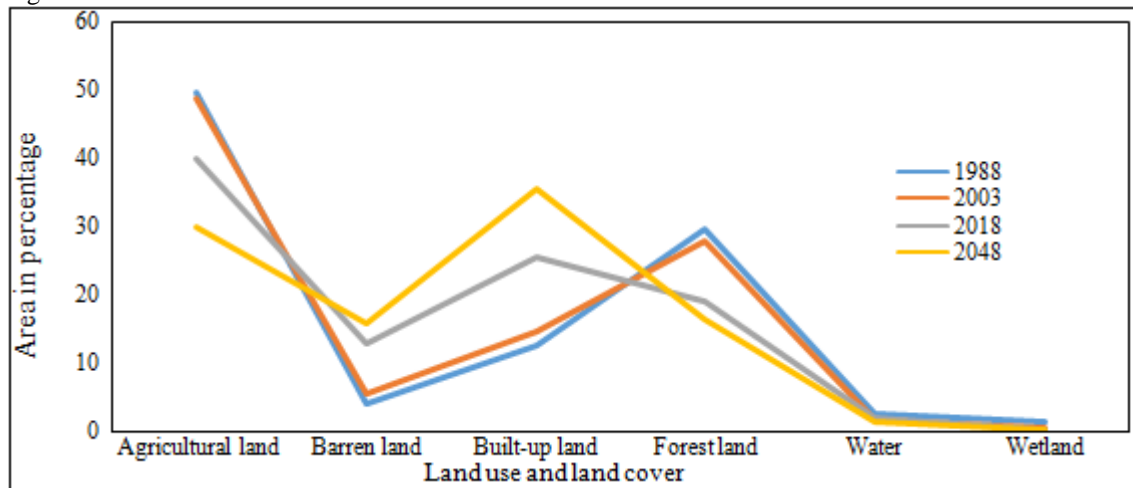


Figure 4: Prediction of 2048 LULC classes and change

5. Conclusion

It is evident from the study that the rapid increase of population in Imphal East is obtruding the fertile soils in the periphery of the urban centre as well at the outskirts. The present spontaneous and uncontrolled change in present LULC classes will have a more noteworthy devastation in the study area. On the off chance that this present state prevails, Imphal East will lose the vicinity of the eco-friendly environment. Thus, a careful planning of land use is very much needed.

[9] Singh, C., Jibanta, N., Singh, M., Kumar., 2016. Trends of urbanisation in Manipur from 1901-2011, a socio-economic analysis, *International Journal for Innovative Research in Multidisciplinary Field*, 2:181-182.

References

[1] Anderson, J.R., 1977. Land use and land cover changes: A framework for monitoring, *Journal of Research by the Geological Survey*, 5:143-153.

[2] Braissoulis, Helen., 2003. Factors influencing land-use and land-cover change, *Land-use, Land-cover and Soil Sciences*, UNESCO Encyclopaedia of Life Support Systems (EOLSS), Eolss Publishers, Oxford, UK (electronic edition—<http://www.eolss.net>, forthcoming 2003 Sample paper(1):1-9

[3] Bartholomew, H., 1955. *Land-use in American cities, Harvard city, Planning Studies*, Cambridge, Harvard University Press:196.

[4] Foody, G.M., 2002. Status of land cover classification accuracy assessment. *Remote Sensing of Environment*, 80(1):185–201.

[5] Giri, P. Chandra., 2012. *Remote sensing of land use and land cover, principle and application*, CRC Press, Taylor & Francis Group:5-6

[6] Ries, Selank., 2008. Analysing land-use/land-cover changes using remote sensing and is in Rize, North East Turkey, *Sensor*, 8:6188-6202.

[7] Sellers, P.J., Meeson, B. W., Hall F.G., Asrar G., Murphy, R.E., Schiffer R. A., Bretherton, F.P., et al., 1995. Remote sensing of the land surface for studies of global change: models-algorithms-experiments, *Remote Sensing of Environment*, 51(1):3–26.

[8] Singh, R.L., Singh, P.B. Rana., 2008. *Elements of practical geography*, Kalyani Publishers, New Delhi:216-217