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LAND-USE AND LAND COVER ANALYSIS, A CASE STUDY OF IMPHAL WEST DISTRICT, MANIPUR

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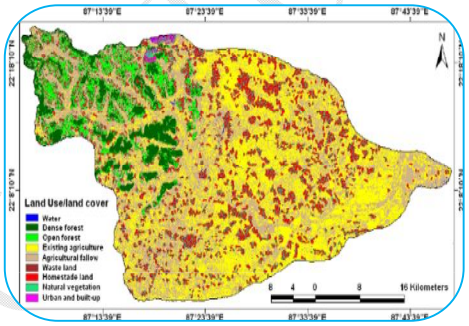
ABSTRACT:



Mapping of land use and land cover (LULC) change at the regional scale is all important for a spacious scope of analysis of geographical phenomena including, erosion, land preparation, etc. LULC alteration negatively affects the pattern of climate and socio - economic dynamics both worldwide and local scale. In this study, LULC changes are investigated at Imphal West district of Manipur. Being downloaded the 1988 and 2017 images, the supervised classification of the study area has been channelled out and the accuracy assessment such as confusion matrix (89% and 93%) and kappa coefficient (0.87 and 0.92) is reckoned. The change detection is also performed in order to identify the inter-categorical change which reflects the complex and dynamic interplay that exist between changing socio - economic and spatial process. Among the geographical features, built-up land registers the largest addition which is witnessed in the northern and south eastern part of the study area.

KEYWORDS: *change-detection, urban , inter-categorical, Imphal West, LULC.*

INTRODUCTION

As the greater part of individuals will in general adjust the land around them, the dynamism of the procedure of the change of land is a significant issue of the continuous task. It prompts functionalization and enhancement of land for some employments. Forest land might be changed over to agrarian land, wetland to built-up land , etc. (Helen, 2003). Built-up land might be additionally urbanized, sub-urbanized or deurbanized. Most importantly, land-use data assumes an essential job in the investigation of worldwide change and the earth (Sellers et al, 1995). Land-use, as expressed by Froody(2002), is a key parameter in portraying the world's surface. Therefore, exact observing of land-use and land-cover (LULC) is of most extreme significance in numerous fields.

Imphal West is described by the uncontrolled development of the populace and makes a substantial weight on LULC. This results in the extreme difference in LULC. Thus, mapping of LULC elements at the local scale is of most extreme significance for a full scope of utilizations, for example, soil disintegration, land use planning , etc.(Reis, 2008). In perniciousness of all, LULC change is far reaching, quickening and huge procedure driven by anthropogenic exercises and furthermore create alteration that effects

individual (Agarwal et al, 2002). The expansion in the urban populace corresponds with LULC change from the city center towards the outskirts frames the linchpin of the study. Along these lines, the quick urbanization and the land-use change in the outskirts are essentially portrayed by an expansion in built-up land.

Remote sensing and GIS help to accumulate precise and auspicious data on the spatial conveyance of LULC of the subject region. GIS offers an elastic environment for gathering, storing, displaying and analyzing digital information necessary (Chang, 2016). The advent of high spatial and spectral resolutions and more advanced image processing, GIS technologies result in more routine and consistent monitoring and modeling of LULC. Change detection also aims to recognize LULC change features of interest between the respective points of time (Erasu, 2017).

Harold Bartholomew (1955) was the trend-setter in the arrangement of land. In the light of land-cover and land-use, Anderson (1970) orders the land into 4 levels. The highlights in the investigation zone are being distinguished and characterized into 6 types for 1988 and 7 types for 2017 viz. Agricultural land, Built-up land, Fish farm , Forest land, Wasteland, Water and Wetland. The primary motivation behind the examination is to order LULC classes and to play out the change detection. Subsequently, the built-up land enlisted the biggest change in these classes. All things considered, there is little switch in the built - up land regions in the city, yet there is an enormous change in suburbs. The northern and south-eastern parts of the Imphal West district has the biggest expansion of settlement. Above all, agricultural lands (61.11% - 39.68%) and forest areas (15.13% - 8.08%) have been experiencing severe LULC change in this area between 1988 and 2017.

STUDY AREA

Imphal West, the most populated district, lies between latitudes 24°32'20.09" N and 24°68'19.64" N and longitudes 93°43'39.6" E and94°62'42" E is selected for the study. It enjoys the eminent position among many districts of Manipur as half of the Imphal city falls under this district. The study area has been experiencing tremendous socio - spatial and changes. The increased in the number of towns over some time creates a serious change which gives a heavy pressure on the agricultural land. The problem of primacy creates a pull force exerting heavy pressure in the excess attraction in various economic activities result in the epidemic change in the land-use pattern (Deva, 1998).

OBJECTIVE

LULC classification and the change detection via the inter-categorical change are the major objectives.

METHODOLOGY

Data and software used

Remotely sensed georeference Landsat 5 TM and Landsat 8 OLI/TIRS images are being downloaded from USGS with the based years 1988 and 2017. The dates of both the images are chosen to be as nearly as possible in the same vegetation season. Since the images consist of many bands, stacking is done on Erdas 14 in order to get a composite image except the thermal band. The concerned area of both the two images are the subset of the composite images. Prior to the classification, image enhancement techniques such as histogram equalization, radiometric correction are done in order to improve the visibility and interpretability of the images. The available secondary source of data including research articles and books. Some places such as Thangmeiband, Uripok, Waheng leikai, Keisampat, Kwakeithel, Heirangoithong, Langthabal and Mayang Imphal are selected for the study

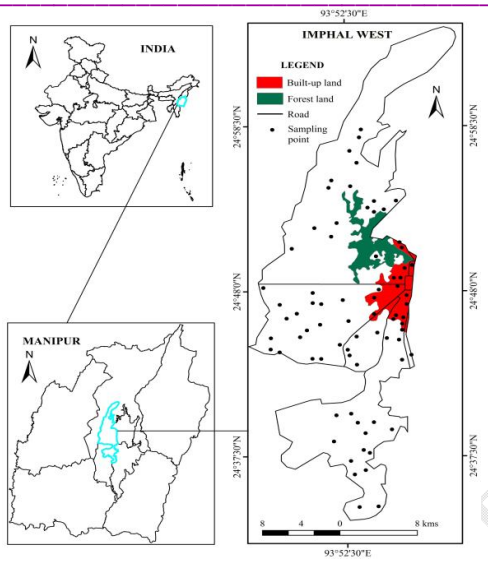


Figure. 1 Study area

Image classification and accuracy assessment.

Each distinctive feature is identified from each band using a spectral response pattern. Out of which, 6 features for the 1988 image and 7 features for 2017 image are identified and classified such as Agricultural land, Fish Farm, Forest land, Wasteland, Water (non stagnant), Wetlands. The two subset images are compared and classified using Maximum likelihood supervised classification on Erdas 14 independently. Accuracy assessment such as the error matrix of both the classified images is used to prove the accuracy. Overall user's and producer's accuracies are also derived from the error matrices. Change detection analysis is performed using the Union Matrix on Erdas 14 and presented in the form of a map.

RESULTS AND DISCUSSIONS

In this survey, 75 points such as random sampling points are taken from both the Landsat 5 TM and Landsat 8 OLI/TIRS to render access to image classification accuracy. Table 1 is the error matrix along with the overall, producer's, user's accuracies and Kappa coefficients. The overall accuracy of the classified image dated 1988 is 89.5% and that of 2017 image is 93%. The Kappa coefficients are 0.89 and 0.92. The 1988 classified image had lower values of producer's and user's accuracies when compared with 2017's. Classification of both the images is difficult as the images used are taken during the lean season i.e. winter season (February). This creates the difficulties in the distinction and differentiation between wasteland, built-up land and agricultural land as they experienced the same spectral response pattern.

Imphal West, during 1988 had the most noteworthy level of agricultural land mirrors the significance of agriculture in their economy, which thus mirrors the circulation of the spatial example of land-use. At the end of the day, this locale reflected the agrarian culture which was in the embryonic phase of advancement.

Built-up land canvassed about 13.90 % in 1988 to 24.47 % in 2017 (Table. 2). This involves the extra 110788.7 hectares of land has come up inside 29 years. The agrarian land diminished from 61.11 % in 1988 to 39.68 % in 2017. The wetlands, water, and forest land show comparable changes. Just the wasteland increments as much as 256.73 hectares to 2546.25 hectares. Most importantly, another component viz. Fish Farm has come up as another land-use in the examination territory. The infringement of forest land for development just as for the ascent of new built – up land is prominent . Above all, the expansion of built - ups towards agricultural land has been expanding step by step because of increment in population.

LULC change somewhere in between 1988 and 2017 reveals the unpredictable and dynamic interchange that exists between changing financial and spatial process. It is the built-up land that shows the greatest change among the highlights. In the urban areas concerned there is a bit change in connection with the constructions , yet in that area there is an enormous expansion at the periphery . It is seen that the northern and southern sides of Imphal West experience the biggest expansion of built-up land . There is an expansion and strengthening of land-use on the northern and south-eastern part of the study area. The linear built-up land found in the northern side of the region signifies the value of streets in pulling out the settlement from the Imphal city. It is on the grounds that there is an improved openness of National Highway no. 2 which outcomes in the expanded impression of more jobs opportunities . A similar marvel in likewise manner is experienced in the Uripok and Kwakeithel areas.

` The vast majority of the wetlands and forest land that were once are currently changed over to agrarian grounds and built-up land for other purposes. There is an unmistakable difference in wetlands to built - up in the Langol Game village region (north-west), particularly the Langol lake which was once is currently changed over to thick built-up land to suit the National Games which was raised in 1997 and other Government and Private buildings. Another example of the same case for the conversion of farming area and wetland to built – up land is obviously found in and around the International Tulihal Airport region which infringed the agricultural land for the extension of airplane terminal. Additionally, with regularly expanding populace, the agricultural land are being encroached so as to accommodate the recently emerge works step by step.

The land-use design in the city center is especially not the same as those at the edge. At the city center, the occupants used their properties in the foundation of new built-up land which incorporates wandered usefulness, for example, rents, shops, and so on. The majority at the edge of the downtown area are basically portrayed in cultivating on the agrarian land.

It is found that the advancement of urban land-utilization in provincial urban fringe convey with it the relating change not simply only in the morphological piece of the state, yet moreover addresses the economic related conditions. Thus, people is particularly expected to find out the change occurring around them (Manglem et al, 2016).

Table 1. Accuracy assessment of Landsat 5 TM, 1988 and Landsat 8 OLI/TIRS,2017 images

Accuracy assessment of the Landsat 5 TM, 1988									
Features	W	WL	AL	WAS	BUL	FL	RT	PA(%)	UA(%)
AL	2	2	69	1	1	0	75	89	92
BUL	0	5	3	0	67	0	75	91	89
FL	2	1	3	6	0	63	75	92	84
W	70	0	0	3	1	1	75	94	93
WAS	0	0	2	70	2	1	75	86	93
WL	4	65	0	1	2	3	75	89	86
CT	78	73	77	81	73	68	450		
Overall accuracy=89.8%, Kappa co-efficient=0.87									
Accuracy assessment of the Landsat 8 OLI/TIRS, 1988									
Features	W	WL	AL	WAS	BUL	FF	FL	RT	PA(%)	UA(%)
AL	0	1	68	2	1	2	1	75	97	90
BUL	0	1	1	1	70	1	1	75	93	93
FF	0	1	0	0	1	70	3	75	88	93
FL	0	0	0	2	2	1	70	75	90	93
W	70	0	0	2	0	1	2	75	98	93
WAS	0	0	0	72	0	3	0	75	91	96
WL	1	71	1	0	1	1	0	75	95	94

CT	71	74	70	79	75	79	77	525		
Overall accuracy=93%, Kappa co-efficient=0.92										

*W= Water, WL= Wetland, AL= Agricultural land, WAS= Wasteland, BUL= Built-up land, FF= Fish Farm, FL= Forest land, RT= Row total, CT= Column total, PA= Producer's Accuracy, UA= User's Accuracy.

The modification in the land-use is because of the adjustment in an instructive plan that gains money all the more effectively other than agribusiness among the majority. A large portion of the general population residing in the city area are migrants from the periphery of Imphal West. The opening for work is the main consideration of expanding populace and change in land-use structure that wins in the investigation area. It is also discovered that because of increment in populace, there is an unmistakable move towards nearby the surrounding suburbs towards the edge of the city centre.

Table. 2 LULC features over two points of time(1988 and 2017)

	1988		2017	
Features	Area in hectares	Percentage	Area in hectares	Percentage
Agricultural land	29419.07	61.11	19104.43	39.68
Built-up land	6691.30	13.90	11780.43	24.47
Fish Farm	-	-	6393.26	13.28
Forest land	7286.19	15.13	3891.49	8.08
Wasteland	256.73	0.53	2546.25	5.29
Water	334.10	0.69	1354.15	2.81
Wetland	4154.17	8.63	3071.01	6.38
Total	48141.56	100	48141.56	100

The change recognition procedure is to perceive LULC on computerized picture that change qualities of enthusiasm between at least two dimensions of time. Change identification includes the utilization of multi-information or multi-fleeting informational indexes to isolate territories of land spread change between the dates of symbolism (Erason, 2017). Among the highlights, built-up land demonstrates the most astounding per cent of change. The expansion in areal degree of the wasteland is seen unmistakably in the southern side of the examination territory for example close to the Loktak Lake. The cause behind the expansion in the wasteland and fish farm is the consequence of the construction of the Ithai Barrage in 1983 which had changed the normal out flow of the Loktak Lake into Khrodrak river. This expanded the sedimentation in the Loktak Lake which is to be removed by the Manipur River. This helps in the superficiality of the Loktak Lake which cause submergence of the adjacent fields and makes a zone of wasteland (unusable inundated area) and wetland during the lean season.

The wetlands are straightforwardly changed into many fish farms which act as a good income source as the Loktak lake and the Manipur river gives the plentiful water. Also the transformation of rural land to fish farm for commercialization is found in these zones .

Grouping of land-use isn't solely bound to the downtown area or its outside breaking point. The increase in the change of forest land to recreational land is a procedure with action. Awunching Park near Pheidinga is a critical point of reference. The change of 36 Acres of forest land to recreational land is an issue of land-use change. The conversion of Agricultural land to recreational land is also clearly seen in the Shangri-La and Millennium parks in Lamsang areas. The intensity of agriculture land that were once is by and by becoming the real phony spot of enthusiasm of the state. This results in the expansion of newly built up areas by constructing other relevant infrastructural development.

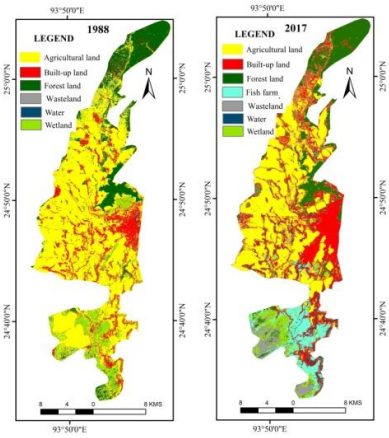


Figure 4. LULC of Imphal West in 1988 and 2017

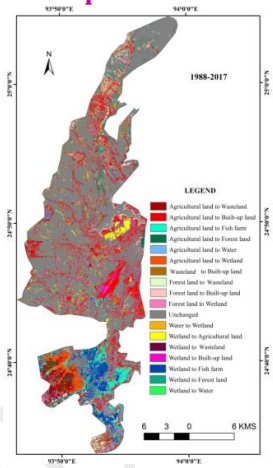


Figure 5. Inter-categorical LULC change in Imphal West district from 1988 to 2017.

Table. 2 Areal extent of inter-categorical change over two points of time (1988 and 2017)

Features	Area in hectares	percentage
Agricultural land to Built-up land	6074.20	12.61
Agricultural land to Fish farm	1744.62	3.62
Agricultural land to Forest land	1170.28	2.43
Agricultural land to Wasteland	1494.51	3.10
Agricultural land to Water	764.85	1.58
Agricultural land to Wetland	1811.82	3.76
Forest land to Built-up land	969.77	2.01
Forest land to Wasteland	566.14	1.17
Forest land to Wetland	270.27	0.56
Unchanged	27189.49	56.47
Wasteland to Built-up land	646.32	1.34
Water to Wetland	28.22	0.05
Wetland to Agricultural land	1304.58	2.70
Wetland to Built-up land	1275.07	2.64
Wetland to Fish farm	1954.94	4.06
Wetland to Forest land	294.14	0.61
Wetland to Wasteland	316.66	0.65
Wetland to Water	265.68	0.55
Total	48141.56	100

CONCLUSION

It is showed from the study that the quick increment of populace in Imphal West district intrudes the prolific grounds at the edge of the urban centre. The usage of land for different purposes prompts land use differentiation. Besides, the expansion in the quantity of towns triggered the enhancement of land-use change . The improved communication and transportation draws in more settlements along the streets and highways . A few zones are likewise encountering the extreme loss of wetlands. In the event that the present pace of urbanization is continuing, sooner or later, the study area will lose the region of eco-accommodating environment. And it very well may be contemplated that this strategy for classification should be applicable for every single other region.

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