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Land Use Change Detection in Baragaon Block, Varanasi District Using Remote Sensing

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ABSTRACT : *Land is a precious resource. Over 21% of the world's population is living on cultivated land constituting only 7% of the total area available on the earth (Wang, Jing et.al, 2012). Accurate and timely information on land use and land use change at a national scale is crucial for long-term economic development planning and for short-term land management (Zhang and Zhang, 2007). Baragaon block, Varanasi district, in recent years, has been witnessing significant land use changes. On the one hand while there is a progressive decline in area under agriculture, built up area has witnessed a prolific growth. Similarly area under wasteland, forests and fallow land too has witnessed a decline. Space technology through Remote Sensing has provided us with viable tool to assess such changes. The present paper highlights the changing trends and pattern of land use in Baragaon Block, Varanasi District using two time frame Satellite data (IRS P-6 LISS III, Standard FCC) of Rabi cropping season. The study is based on standard digital classification techniques and its accuracy assessment.*

KEYWORDS : *Land Use, Change detection, Remote Sensing*

I. INTRODUCTION

Land is a precious resource. Over 21% of the world's population is living on cultivated land constituting only 7% of the total area available on the earth. The state of a country's land resources and environment can significantly affect the sustainable development of the economy (Ma and Cui, 1987; Chen and Peter, 2000; Lin, 2002; Ho and Lin, 2004). When the situation of land use has a negative impact on the sustainable development, the government should enact new or adjust the existing regulations and laws to strengthen effective management of land resources. Many researchers have attempted to analyze the effects of land policies qualitatively (Cai, 2003; Ding, 2003; Ho and Lin, 2004; Lin and Ho, 2005; Lichtenberg and Ding, 2008), but few analysis was based on accurate and reliable data(c.f. Wang, Jing et.al, 2012). Accurate and timely information on land use and land use change at a national scale is crucial for long-term economic development planning and for short-term land management(Zhang and Zhang, 2007). A better understanding of land resources and well-timed regulating and controlling of land use are crucial for sustainable development. We must have a clear picture of the current state of various land-use types and of the changes in land use that have occurred in the past. We need to be able to explain such changes and analyze the driving forces of land policies and predict land-use changes in the future (Wang, Jing et.al, 2012).

Land use mapping has always been a time consuming and expensive process. Space technology in recent years has emerged as a powerful tool for land use /land cover studies, particularly change detection. Contrary to the traditional methods of field survey in which it took several years for the preparation and final mapping of land use/ land cover of an area, remote sensing technology, due to synoptic view, map like format and repetitive coverage, is a viable source of gathering quality land cover information at local, regional and global scales (Csaplovics, 1998; Foody, 2002). Land use is a matter of continuous growth and change in pattern. For economic development of a region, planners need up-to date information which can only be obtained quickly, economically and accurately through remote sensing techniques (Gautam N. C. and Narayan L.R.A. 1983).

II. STUDY AREA:

Baragaon Block(fig. 1) is situated in western and north-western part of Varanasi district. The geographical limit of the study area is $25^0$23' N to $25^0$34'47" and $82^0$39'50" E to $82^0$50'15"E. The total geographical area of the baragaon block is 174.33 km^2 with population 195972(census, 2001) of which 98758 male and 97214 female. The Baragaon Block surrounded by the river Basushi in southern-west and river Varuna in south. It touches the administrative boundary of Jaunpur district in west and north, S.R.N. Bhadohi in south-west, Sewapuri block in south, Harahua in east and Pindra block in north-east.

As this area is located in Indo-Gangatic plain topographically, it is characterized by flat surface with very little regional variation mostly ranging from 60 to 82 m and very little are below 60m above mean sea level(derived from Asterdem). Slope of the study area have noted less variation and mostly comes under the surface inclination of 0 to 7^0. The direction of the slope is varying in multiple directions following the regional trends of slope. Climatically the region has sub tropical monsoonal climate characterized by seasonal extremities. January is the coldest month with mean maximum temperature of 23^oC. Occasionally, though, the minimum temperature may drop down to around 5^o C during mid December and January coupled with occurrence of dense fog. June is the hottest month with mean maximum temperature around 35^oC. However temperatures' soaring above 40^o C is not uncommon with occasional rise in mercury above 45^oC under the

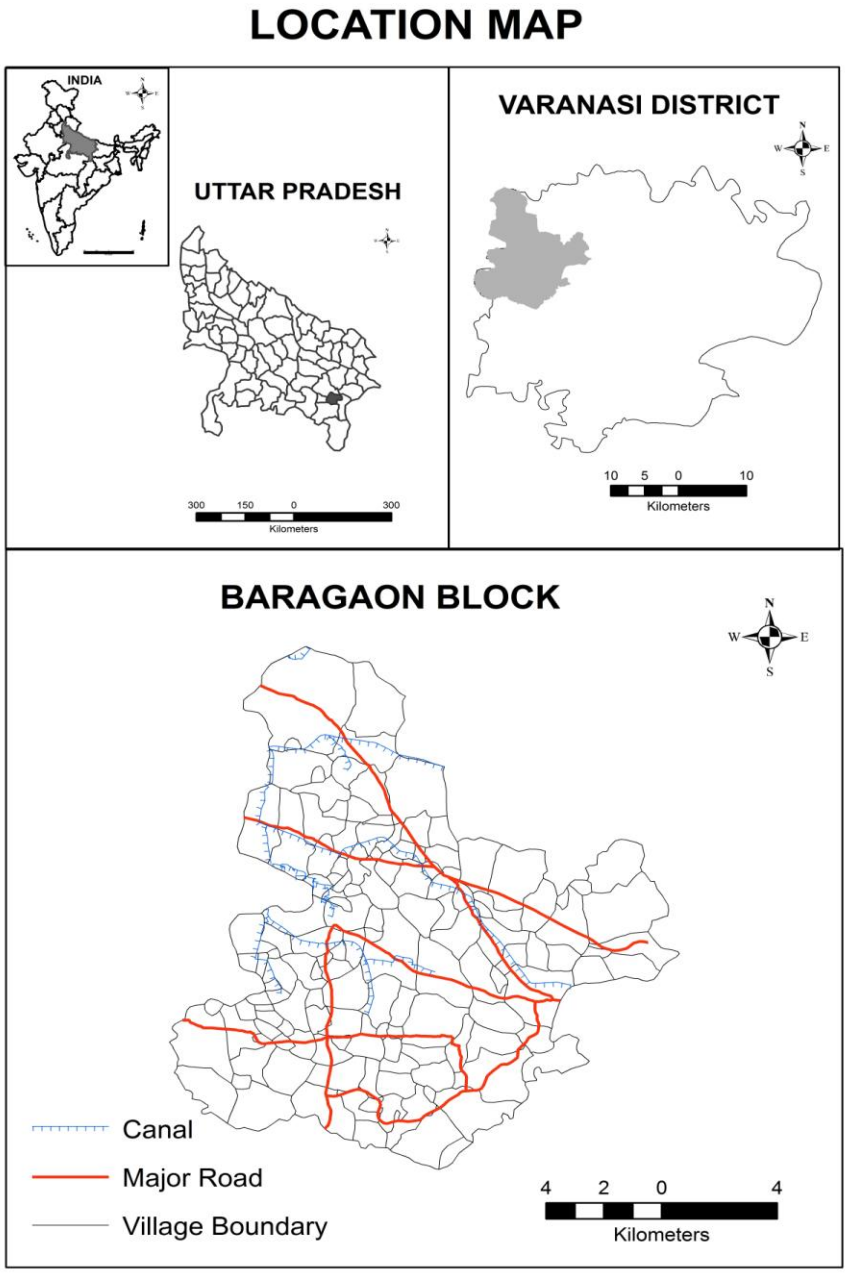

fig. 1

impact of heat wave. The average annual rainfall of the district is around 110cms bulk of which is received from the south west monsoons during June to September, August being the rainiest month.

III. OBJECTIVE OF THE STUDY

The main objective of the present study is to prepare the land use/Land Cover map with land use statistics of the study area and detect changes in the pattern of land use/land cover for two years i.e. 2006 & 2012 using multi temporal satellite data.

IV. MATERIALS AND METHOD

In the present study geocoded ortho-rectified IRS P6 LISS-III(Resourcesat-II) satellite image (fig. 2) Row 54 and path 102 having a resolution of 23.5 meters acquired from NRSC, Hyderabad of Rabi season dated 25th January 2006 and 30th January 2012 and Survey of India Toposheets Nos.63K/10, 63K/11, 63K/14 and 63K15 on 1: 50,000 scale have been used. A number of steps viz. image registration, generation of ancillary data layers, unsupervised classification by considering 30 spectral classes followed by recoding the spectral classes in land use/land cover thematic classes, accuracy assessment generation of change detection map, tables etc. All the processing has been done on ERDAS Imagine and Arc GIS software. Field checks have been performed for ascertaining the ground truth. Error Matrix for accuracy assessment has been generated and finally the land use map and reports have been prepared.

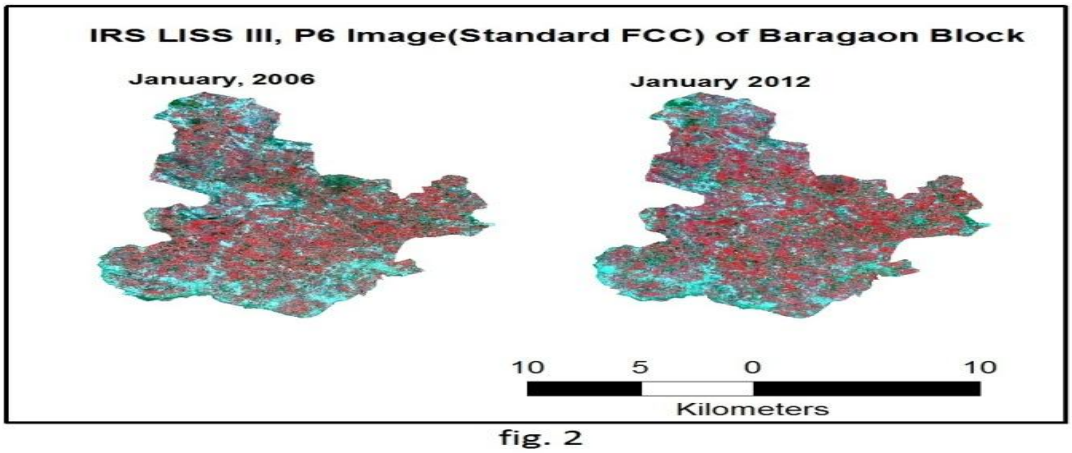

fig. 2

V. RESULT AND DISCUSSION

Table-1 and Figure 3 shows the pattern of land utilization and the changes under each category of land use in Baragaon Block, Varanasi district during 2006 and 2012 taking 2006 as base year. Following the Land Use/Land cover classification scheme as developed by NRSC six land use/land cover classes' viz. water bodies, built up area, fallow land, area under agriculture, waste land and area under Plantation/Orchards have been delineated for the study area. Agriculture constitutes the major economic activity in the study area. Owing to fertile soil, availability of water and plain surface it is an intensely cultivated region. In 2006 around 34 percent of the total area was under agriculture and the corresponding figure in 2012 was around 44 percent, this shows the change of 1807 hectare which shows the around 30 percent increase in 2012 over 2006.

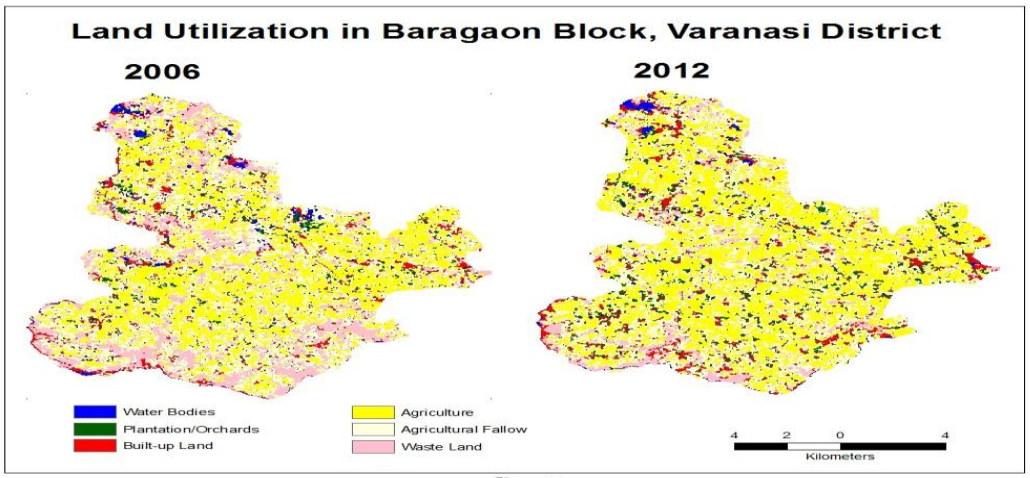

fig. 3

Table 1: Land Utilization in Baragaon Block in 2006 and 2012

Land Use Category	Classified Pixels		Area in 2006		Area in 2012		change	
	2006	2012	in ha	in %	in ha	in %	in ha	in %
Water Bodies	4652	3494	268	1.524	201	1.14	-67	-24,89
Plantation/Orchards	9075	16677	522.7	2.972	961	5.46	438	83.76
Built-up Land	17880	19755	1030	5.856	1138	6.47	108	10.87
Agricultural Fallow	123849	111433	7134	40.56	6419	36.5	-715	-10.03
Agriculture	102869	134238	5925	33.69	7732	44	1806.85	30.49
Waste Land	46985	19773	2706	15.39	1139	6.48	-1567.4	-57.92
Total	**305310**	**305310**	**17586**	**100**	**17856**	**100**	---	---

Source: Computed by the authors from IRS P6 LISS III Satellite Image

Fallow land, described as agricultural area devoid of cropping at the time of the recording of the data covered 7133.70 hectares area in 2006 which was 28.97percent of the total area. In 2012 it declined to 6418.54 hectares thereby declining by around 10 percent in 2012 over 2006. In relative terms it constituted 36.49 percent of the total area in 2012 (Table-1).

Plantatioan/orchards includes the area under the tree canopy and social forestry etc. Unfortunately the study area is devoid of significant forest cover. In 2006, 522.72 hectares constituting only 2.97 percent of the total area was under forest cover. It further increased to around 960 hectares thereby showing an increase of around 83 percent in 2012 over 2006. This is mainly due to social afforestation etc.

Built-up Land, defined as an area of human habitation developed due to non agricultural land use and that has a cover of buildings, transport and communication, utilities in association with water vegetation and vacant lands(NRSA 2006) constituted 5.85 percent of the total area in 2006. It increased to 6.47 percent in 2012. It has recorded a 10.48 percent growth in 2012 over 2006 signifying a construction spree owing to expansion of settlements and urbanization. Major concentration of the built up land can be observed in and around Baragon Bolck Headqurter, the principal urban centre of the study area, new construction and around existing rural settlements and service centres..Waste land is described as degraded land which can be brought under vegetative cover with reasonable effort and which is currently under utilized and land which is deteriorating for lack of appropriate water and soil management or on account of natural causes. It includes gullied land, scrub land, sandy area, salt affected area barren rocky waste etc (NRSA 2006). Area under wasteland has declined by around 57 percent in 2012 over 2006 which suggests that it has been reclaimed for varied utilization.

Water bodies includes the surface water bodies i.e. ponds, rivers, streams, canals etc. It accounted roughly 1.5 percent of the total area both in 2006 and around 1.14 in 2012. In terms of change it has recorded almost 24 percent decrease in 2012 over 2006.

VI. ACCURACY ASSESSMENT

No image classification is said to be complete unless its accuracy has been assessed. To determine the accuracy of classification, a sample of testing pixels is selected on the classified image and their class identity is compared with the reference data (ground truth). The choice of a suitable sampling scheme and the determination of an appropriate sample size for testing data plays a key role in the assessment of classification accuracy (Arora and Agarwal, 2002). The pixels of agreement and disagreement are generally compiled in the form of an error matrix. It is a *c* x *c* matrix (*c* is the number of classes), the elements of which indicate the number of pixels in the testing data. The columns of the matrix depict the number of pixels per class for the reference data, and the rows show the number of pixels per class for the classified image. From this error matrix, a number of accuracy measures such as *overall accuracy, user's* and *producer's accuracy*, may be determined (Congalton, 1991). The overall accuracy is used to indicate the accuracy of whole classification (i.e. number of correctly classified pixels divided by the total number of pixels in the error matrix), whereas the other two measures indicate the accuracy of individual classes. User's accuracy is regarded as the probability that a pixel classified on the map actually represents that class on the ground or reference data, whereas producer's accuracy represents the probability that a pixel on reference data has been correctly classified.

Table-2: Accuracy Assessment of Classified Map

Class Name	Reference Totals	Reference Totals	Classified Totals	Classified Totals	Number Correct	Number Correct	Producers Accuracy	Producers Accuracy	Users Accuracy	Users Accuracy
	2006	2012	2006	2012	2006	2012	2006	2012	2006	2012
Water Bodies	1	2	1	1	1	1	100.00 %	50.00%	100.00 %	100.00 %
Plantation/ Orch	1	2	1	3	1	2	100.00 %	100.00 %	100.00 %	66.67%
Built-up Land	5	3	3	3	2	2	40.00%	66.67%	66.67%	66.67%
Agriculture	15	22	17	22	15	22	100.00 %	100.00 %	88.24%	100.00 %
Agricultural Fallow	18	15	20	18	15	15	83.33%	100.00 %	75.00%	83.33%
Waste Land	10	6	8	3	8	3	80.00%	50.00%	100.00 %	100.00 %
Totals	50	50	50	50	42	45				
Overall Classification Accuracy (2006)= 84.00%(2006), 90.00%(2012) **Overall Kappa Statistics = 0.7763 (2006), 0.8539 (2012)**										

Source: Computed by authors in ERDAS Imagine

In the present study, in order to assess the classification accuracy of classified images, 50 sample points for both years 2006 and 2012 was selected using stratified random sampling in ERDAS. Sample points assigned to each class of classified images were verified with reference image(ground truth) to derive producer & user accuracy for each class and overall classification accuracy as depicted in Table-2. The overall classification accuracy stands at 84% and 90% for the year 2006 and 2012 respectively.

VII. SUMMARY AND CONCLUSION

The present study aptly brings to light the changing trend in the pattern of land utilization in the study area. Among different categories of land use, area under agriculture is predominant accounting for more than 40 percent area in both 2005-06 and 2011-12 followed by fallow land and built up area. Area under forests is abysmally low accounting for not more than 2 percent of the total area. Change analysis shows a considerable increase in the built up area which has grown by 10.87 percent signifying a spree in construction activity mainly on account of rising demand for residential accommodation This however has had a negative impact on area under agriculture. Area under plantation/orchards has increased around 440 hectare in 2012 over 2006. Under waste land, there is a decline of 57 percent in 2012 over 2006. Thus, while reduction in the area under wasteland is encouraging reduction in the agricultural area is a cause of concern. This is because reduction in agricultural area means loss of fertile land and additional pressure on the existing agricultural area to meet the additional food demand of the growing population in future.

VIII. ACKNOWLEDGEMENT

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REFERENCES

[1] Anderson, J.R., Hardy, E.T., Roach, J.T. and Witmer, R.E. (1976). A land use and land cover classification system for use with remote sensing data. Professional Paper 964, U.S. Geological Survey, Washington, D.C.

[2] Congalton, R G., A review of assessing the accuracy of classifications of remotely sensed data. *Remote Sensing of Environment*, 3(7), 1991, 35-47

[3] Csaplovics, E., High Resolution space imagery for regional environmental monitoring — status quo and future trends. *International Archives of Photogrammetry and Remote Sensing*, *32(7), 1998*, 211-216.

[4] Foody, G. M. (2002). Status of Land Cover Classification Accuracy Assessment, *Remote Sensing of Environment*, *80*, 2002, 185-201.

[5] Gautam N. C. and Narayan L.R.A., Landsat MSS Data for Land Use and Land Cover Inventory and Mapping: A Case Study of Andhra Pradesh, *Photonirvachak Journal of the Indian Society of Photo Interpretation and Remote Sensing*, Springer, India. *1(3)*, 1983, 15-27.

[6] Manual of National Land Use Land Cover Mapping using Multi-temporal Satellite Data (May, 2006), National Remote Sensing Centre, Dept. of Space, govt. of India, Hyderabad.

[7] Wang Jing; Chen, Yongqi; Shao, Xiaomei; Zhang, Yanyu; and Cao, Yingui. Land-use changes and policy dimension driving forces in China:Present, trend and future. Land Use Policy 29, 2012, 737– 749.

[8] Zhang, Jixian and Zhang, Yonghong. Remote sensing research issues of the National Land UseChange Program of China. ISPRS Journal of Photogrammetry & Remote Sensing 62, 2007, 461–472.