Multi-Temporal Remote Sensing of Landuse Dynamics in Zaria, Nigeria

Grace U. M[1] Sawa, B. A.[2]* Jaiyeoba, I. A[3]
1.Department of Geography, Gombe State University
2.Department of Geography, Ahmadu Bello University, Zaria-Nigeria
3.Department of Geography, Federal University, Lokoja- Nigeria

Abstract
This study assesses the impact of growth of Zaria town on the changing pattern of the different landuse/land cover types within and around the town, using Remote Sensing and GIS techniques. Zaria is witnessing rapid rate of urbanization as a consequence of the establishment of the Ahmadu Bello University at Zaria in 1962. It is one of the fastest growing settlements in northern Nigeria. The increasing population from the University community has led to serious competition for land among different landuse types. Multi-temporal satellite imageries for three and half decades (1973, 1990, 1999 and 2006) were used to assess the impact of the growth of Zaria town on the changing pattern of the different landuse/land cover (LULC) types using Remote Sensing GIS techniques. The images were transformed, enhanced, sampled and re-sampled, classified and crossed for change detection. Results of the analysis showed that although there are year to year variations in area under each landuse type, net change detection showed that built up area has been on the increase each year encroaching on scrubland, farmlands and fadama to shrink.
Keywords: change detection, image crossing, multi-temporal, multi-spectral,

1. INTRODUCTION

Early accounts of Northern Nigeria suggest that most of the major settlements in the region were surrounded by vast unaltered mosaic of vegetation landscape with patchy farmstead in the gently undulating terrain of the area. However, there has been high level urbanization and agricultural intensification around such settlements. There is no doubt, therefore, that, these human activities have profoundly changed the landscape of the area cover time. With the establishment of the Ahmadu Bello University at Zaria in 1962, the town has become one of the fastest growing and most populous metropolitan areas in north central Nigeria, exhibiting rapid commercial and agricultural activities, urbanization, and population growth in the past three decades (Bell *et al.* 1999; Bell and Cheung, 2001). The increasing population from the University has led to serious competition for land among different landuse types.

This paper aims at assessing the impact of the growth of Zaria town on the changing pattern of the different landuse/land cover types within and around the town, using Remote Sensing and GIS techniques. The specific objectives are to:

i. map out the land use/ land cover of the area at four points in time (1973, 1990, 1999 and 2009) using multi-temporal satellite imageries and
ii. analyse the land use and land cover changes from the multi-temporal land use and land cover data.

Remotely sensed data has become a spectacularly useful tool for mapping natural resources, and land use/ cover changes over geographical areas by overcoming many limitations of traditional surveying techniques (Ridd and Liu 1998; Ward *et al.* 2003; Rogan and Chen 2004; Gillanders *et al*. 2008; Torres-Vera *et al*. 2009). With the use of remote sensing, it is possible to map and monitor the spatial extent and changes in various land use types, such as changes in vegetation cover, bare surfaces, built up areas and so on. Thus, the research was undertaken to assess the impact of urbanization on the landuse/land cover types within Zaria town and environs with the aid of Remote Sensing and GIS techniques.

2. THE STUDY AREA

Zaria lies in the Northern part of Kaduna state. It is a historical, ancient and traditional centre of the north with its administrative capital situated at *Birnin Zazzau* (Zaria City). It remains a strategic political centre of the north with authority vested solely in hands of the Emir of *Zazzau* (Mortimore, 1970). The study area is some 20km radius around Zaria town. The area is located between latitude 10^0 55′00″N and 11^0 15′30″N and longitude 7^0 28′E and 7^0 55′E. The total area covered is about 2638.20Km^2 at an average altitude of about 613m (Fig 3.1). Zaria metropolitan area comprises two Local Government Areas (LGAs), namely, Zaria and Sabon-Gari LGAs. The study area is bounded in the south by Igabi LGA, to the north by Kudan LGA, to the east Soba LGA and to the west Giwa LGA.

Zaria is situated on part of the vast, gently rolling to undulating Hausa plains of northern Nigeria which extends almost unbroken from Sokoto in the West to the Chad basin and beyond, and from south of Kaduna to the Tigueddi scarp near Agades in Niger Republic (Thorp, 1970).

The region experiences a tropical continental climate with distinct wet and dry seasons (Kowal & Knabe, 1972). The rainfall regime is single maximum with a long-term average of about 1100 mm per year ninety percent of which fall between April and October (Adejuwon *et al*; 1989). Temperature is generally high throughout the year with the mean daily maximum temperature of about 37ºC and shows a major peak in April then drops rapidly to its lowest value between December/January.

The Zaria area is a dissected portion of the Zaria-Kano plains, an extensive peneplain developed on crystalline metamorphic rocks of the Nigerian Basement complex (Wright and McCurry, 1970). The vegetation is that of the northern guinea savanna formed on leached tropical ferruginous sandy soils (Tomlinson, 1963). Some occupy valley bottom positions are hydromorphic (Hausa Fadama) (FAO: Gleysols) soils.

3. MATERIALS AND METHODS

3.1 Data Required and Sources

The data required for the study are multitemporal satellite imageries of Zaria for 1973, 1990, 1999 and 2009 for processing of land use and land cover change. These satellite imageries were sourced from the National Centre for Remote Sensing (NCRS Consult), Jos.

Table 1 summarizes the characteristics of imageries acquired, because the imagery of 1973 (MSS) and that of 2009 (NigeriaSat-1) were of different spatial resolutions, they had to be re-sampled to that of 1999 (ETM) before further analysis were carried out on them. Another major difference of the imagery used relate to the fact that they differ in their acquisition dates.

Figure 3.2 summarizes the procedure that was followed in the satellite imagery processing and analysis.

3.2 Pre-processing Stage

The pre-processing stage usually involves image rectification and image sub-setting. This is to correct whatever distortion that might have occurred during acquisition from satellite (Paul, 1992; Ogunleye, 2010). The images that were used for this work, however, did not have to go through the process of image transformation and enhancement by the researcher as the agency that provided the images (that is NCRS, Jos) had already done that.

3.3 Image Sampling and Re-sampling

This process aids in sampling and identifying each land use stated using the spectral signature of each of the land use/ land cover. In this regard, it aided the sub-division of the image into separated regions represented by image objects which contain information about their spectral characteristic, shape and position, thereby enabling the pixels of the images in identification of their spectral properties. For the re-sampling, as indicated earlier, the images are in different spatial resolution (Table 1). There was therefore, the need to resample for easy classification and crossing to obtain the change detection.

3.4 Image Classification

Before any useful thematic information can be extracted from remote sensing data, a land use land cover (LULC) classification scheme has to be developed to obtain the class of interest to the analyst (Congalton, 1991). Mather (1999) considered classification to be the process of recognition of the pattern associated with each pixel position in an image in terms of the characteristics of the objects. Classification involves three main issues: creating samples, image sampling and generalizing the sampled features (Jeb, 2008b).

For the purpose of this study, supervised classification, based on seven classes (Table 2), was employed. The supervised classification technique entails “training” of the image data into various themes or classes, based on their land use/land cover scheme drawn out. With this technique, samples of the different features on the image are given sample pixels depicting a given land use/land cover type. The Maximum Likelihood Classifier assumes that a pixel has certain probability of belonging to a particular class. These probabilities are equal for all classes and the input data in each band follows the Gaussian (normal) distribution function (Lillesand *et al,* 2004).

3.5 Image Crossing/Change Detection

Image crossing is a process of overlaying two classified imageries. It detects changes that have occurred over time in an area. Change detection on the other hand is the process of determining and/or describing changes in the land-cover and land use properties. There are many techniques available to detect and record differences (e.g., image differencing, ratios or correlation) and these might be attributable to change (XiaoMei and RongQing 1999). However, the simple detection of change is rarely sufficient in itself, information is generally required about the initial and final land cover or types or land uses. After the maps were classified, they were overlaid/crossed in order to detect any change that has taken place over the examined period

4. Ground Truthing

The main purpose of ground truthing is to verify the classified images done prior to ground truth with the actual observable situation on ground.

5. RESULTS AND DISCUSSION

The original land use/land cover satellite imageries of the study area for the four different years as obtained from National Centre of Remote Sensing Jos are presented in figures 5.1, 5.2, 5.3, and 5.4.

5.1 Spatial and Temporal Variation in Land use/Land cover

Results of the supervised classification of land use/land cover for the four years are individually presented in Figures 5.5, 5.6, 5.7 and 5.8 while Table 3 presents the statistics of area covered by each land use type for each period.

The summary of area occupied by each land use in each year as depicted by Table 3 clearly indicates that there is considerable change in the land use/land cover of Zaria over the three and half decade under study. There is however no consistent change in the area coverage of the different land uses over time. The only exception is the built-up area that showed a consistent increase over time.

Bare surfaces covered about 146km^2 (5.5%) in 1973 but decreased to about 33km^2 (1.2%) in 1999 and increased again to 85km^2 (3.2%) in 2009. This corroborates Abbas and Arigbede (2011) and may be attributed possibly to the time the image was obtained during the dry season when a lot of crops have been harvested and the land left bare and also to the increasing construction works in terms of buildings in Zaria.

By contrast, the Fadama area increased from 146km^2 (5.5%) in 1973 to 634km^2 (24%) in 1999 and subsequently decreased to 571km^2 (21.7%) in 2009. The increase in area of fadama to 634km^2 in 1999 presumably is because by the time the imagery was taken, the rainy season had stopped. Secondly, before 1999, only few Hausa farmers were into fadama farming but when irrigation farming was introduced and farmers discovered that they made more profit from it than the rain-fed agriculture, they moved into irrigation farming along the flood plains thereby decreasing the area of the fadama in recent years.

The area covered by plantation/forest decreased from 89km^2 (3.4%) in 1973 down to 50km^2 (1.9%) in 1999 and increased again to 63km^2 (2.4%) in 2009. This agrees with Ifatimehin and Ufuah (2006) and Ishaya, Ifatimehin *et al* (2009). The decrease in forest area between 1973 and 1999 no doubt reflects the high deforestation rate in the area. Although even as far back as 1962, much of the natural forest has disappeared in Zaria, there were still a number of man-made forests in the region. For example, there used to be some known forests, such as Maje reserve located along Zaria-Funtua main road, Fatika reserve located west of Zaria town and the Guga plantation located west of Samaru. All existed until early 1980s. By the 1990s, the only visible forest left was the Kabama forest located north of Zaria which today has disappeared as well. The main factor responsible for this decline is clearing for city expansion and logging. There was a slight increase in the area of plantation in 2009. It rose from 1.88% in 1999 to 2.40% in 2009 and this was as a result of the tree planting that took place within the Ahmadu Bello University environment and some other institutions in the 90s'. The increase in recent years is as a result of the conscious attempt to green the environment to reduce the impact of climate change.

The scrubland also decreased from 1,766km^2 (66.9%) in 1973 down to 1,283km^2 (48.6%) in 1999, and increased slightly again to 1,350km^2 (51.2%) in 2009. This is in concordance with Ishaya, Ifatimehin *et al* (2009). The decrease in scrubland between 1973 and 1999 is as a result of so many people even civil servants going into farming prior to salary increment by the Federal Government of Nigeria in 2000. Immediately salaries were increased the standard of living of many civil servants changed so they abandoned their farms creating an increase in area of scrubland as from 2000.

The cultivated land increased from 409km^2 (15.5%) in 1973 to about 529km^2 (20%) both in 1990 and 1999, and decreased slightly to 433km^2 (16.4%) in 2009. This again agrees with Ishaya, Ifatimehin *et al* (2009). Salaries have started improving so not many civil servants were going to the farm.

The area of water body decreased from 38km^2 (1.5%) in 1973 to 18km^2 (0.68%) in 1990, and increased again to 28km^2 (1.1%) in 1999 before decreasing sharply to 4.2km^2 (0.16%) in 2009. The sharp decrease in area of water bodies coincides with the mass movement of farmers into fadama farming causing the constriction of water channels.

Unlike the other land use categories, the built-up area revealed an increase value from 44km^2 (1.7%) in 1973, through 69km^2 (2.6%) in 1990 and 81km^2 (3.1%) in 1999 to 130km^2 (4.9%) in 2009. This corroborates Abbas and Arigbede (2011) and depicts the high rate of urbanization in Zaria. Urban growth has led to even marginal lands now giving way for residential buildings. The upward trend in built-up area over the region no doubt reflects the increased population and consequent conversion of other land uses into residential areas. Today, most of the then isolated villages in the 60s' around Zaria metropolitan areas have actually coalesced into the town. Prominent among such settlements are Wusasa, Dan-magaji, Hanwa, Zango, Dogarawa, Samaru New

Extention, Emanto and Graceland.

5.2 Change Detection

The net change in Land use/land cover in Zaria exhibited by the crossed imageries from 1973 to 2006 is presented in Figures 5.9, 5.10 and 5.11 while Table 4 shows the statistics of the land use/ land cover analysis.

While the bare surfaces, plantation/forest and scrublands show respectively net negative values between 1973/1990 and 1990/1999 and net positive in the 1999/2009, the fadama and scattered cultivation showed net positive in the first two periods interval and net negative in the third period while the percentage changed showed somewhat constantly increasing values for the bare surfaces however, those for the plantation/forest and scrublands show rather concave and convex pattern respectively. In the same fashion, the percentage net change for the fadama and cultivated land showed convex and concave pattern respectively. The net change in built up area is positive throughout the examined period, while that of the water body first showed a net negative and then net positive and finally net negative change. While the magnitude of change for the former land use category first showed a decrease and then an increase that of the latter land use category showed somewhat upward trend throughout.

6. Conclusion

The results of this research has clearly shown that Zaria is experiencing rapid expansion leading to a large chunk of the scrubland, farmlands and even part of the flood plains giving way to residential buildings.

7. Acknowledgement:

We wish to acknowledge the authority of the Ahmadu Bello University, Zaria for providing the fund for this research. We are also indebted to our GIS expert Pastor Emmanuel Oluleye of the Department of Geography, Ahmadu Bello University, Zaria for the map digitization and analysis.

REFERENCES

Abbas I.I and Arigbede, Y.A. 2011. Sustainable land management in Zaria using Remote Sensing and GIS techniques. *Journal of Ecology and the Natural Environment* Vol. 3(4), pp. 131-138.

Adejuwon, S.A., Adejuwon, J.O. and Balogun, E.E. 1989. The annual and seasonal patterns of rainfall fluctuations in sub- Saharan West Africa. *International journal of climatology*, vol. 10, Pp 839-843.

Bell, D.V.J., Tilman, A. & Cheung, A. 1999. Advancing sustainability in the great lakes basin, York Centre for Applied Sustainability York University. Prepared for Environment Canada.

Bell, D.V.J. 2001. Sustainable urban communities in Canada: From Rio to Johannesburg. York Centre for Applied Sustainability York University. Prepared under contract for Stratos as background documentation for the report of the Government of Canada to the World Summit.

Congalton, R. 1991. A review of assessing the accuracy of classifications of remotely sensed data' *in Remote Sensing of the Environment* vol 37, Pp 35-46.

Gillanders, S.N., Coops, N. C., Wulder, M.A., Gergel, S.E. and Nelson, T. 2008. Multitemporal remote sensing of landscape dynamics and pattern change: describing natural and anthropogenic trends. Progress in Physical Geography, 32 (5), 503–528.

Ifatimehin, O. O. and Ufuah, M.E. 2006. An Analysis of Urban Expansion and Loss of Vegetation Cover in Lokoja, Using GIS Techniques *The Zaria Geographer (2006), Vol. 17, No.1, pp.28-36* Department of Geography, Ahmadu Bello University, Zaria.

Ishaya S., Ifatimehin, O.O. and Okafor, C. 2008. Remote Sensing and GIS Applications in Urban Expansion and Loss of Vegetation Cover in Kaduna Town, Northern Nigeria, *Am.-Eurasian Journal of Sustainable Agriculture, 2(2): 117-124.*

Ifatimehin, O.O, Musa,S.D and Adeyemi, J.O 2009. An Analysis of the Changing Land Use and its Impact on the Environment of Anyigba Town, Nigeria. *Journal of Sustainable Development in Africa* (Volume 10, No.4.

Jeb, N.D. 2008b. *Introduction to Remote sensing and Geospatial Information System* Techniques. Journal article of National Centre for Remote Sensing, Jos, Nigeria., pp 1-7.

Kowal, J.M and Knabe, O.T. 1972. An Agro-Climatological Atlas of Northern states of Nigeria. A.B.U press, Zaria. Pp 111.

Lillesand T., Kiefer R. and Chipman J.W. 2004. *Remote Sensing and Image Interpretation*. Fifth edition, John Willey and Sons, Inc., New York.

Mather, P.M. 1999. Computer Processing of remotely sensed images – An Introduction; John Wiley and sons, Toronto.

Mortimore, M.J. 1970. Zaria and its Region, Occasional paper No. 4 Department of Geography, A.B.U. Zaria, published for the 14th *Annual conference of Nigerian Geographical Association, Zaria*. Pp 15.

Ogunleye, E.K. 2010. A study of urban growth dynamics using geoinformatics techniques in Zaria, Kaduna state. Unpublished M.Sc thesis, submitted to the Department of Geography and Regional Planning, Ambrose Alli University, Ekpoma.

Paul, J.C. 1992. Principles of Remote sensing, 1st ed. New York: John Wiley and sons Inc.

Ridd, M. K. and Liu, J. 1998. A comparison of four algorithms for change detection in an urban environment. *Remote Sensing of Environment,* 63(2), 95–100

Rogan, J. and Chen, D. 2004. Remote sensing technology for land cover and land use mapping and monitoring. Progress in Planning, 61(4), 301–325

Thorp, M.P. 1970. “Landforms” cited in Zaria and its region, Mortimore M.J. (ed.) *Occasional paper No. 4 Department of Geography, A.B.U., Zaria*. Pp 13-18

Tomlinson, P.R. (1963). Soils of Northern Nigeria, Samaru. Institute for Agricultural. Research, ABU, Samaru.Zaria

Torres-Vera, M.A., Prol-Ledesma, R.M. and Garcia-Lopez, D. 2009. Three decades of land use variations in Mexico City. *International Journal of Remote Sensing,* 30(1), 117–138.

Ward D., Phinn, S. and Murray, A. 2003. Monitoring growth in rapidly urbanizing areas using remotely sensed data. *The Professional Geographer*, 52(3), 371–386.

Wright, S.B. and McCurry, P. (1970). Geology, In Mortimore M.J. (ed) Zaria and its Region, *Occasional Paper* department of Geography, A.B.U., Zaria No. 4 pp 5-12.

XiaoMei, Y. and Rong,Q. 1999. *Change Detection Based on Remote Sensing Information model and its Application on Coastal Line of yellow River Delta*. Earth Observation Center, NASDA, China.

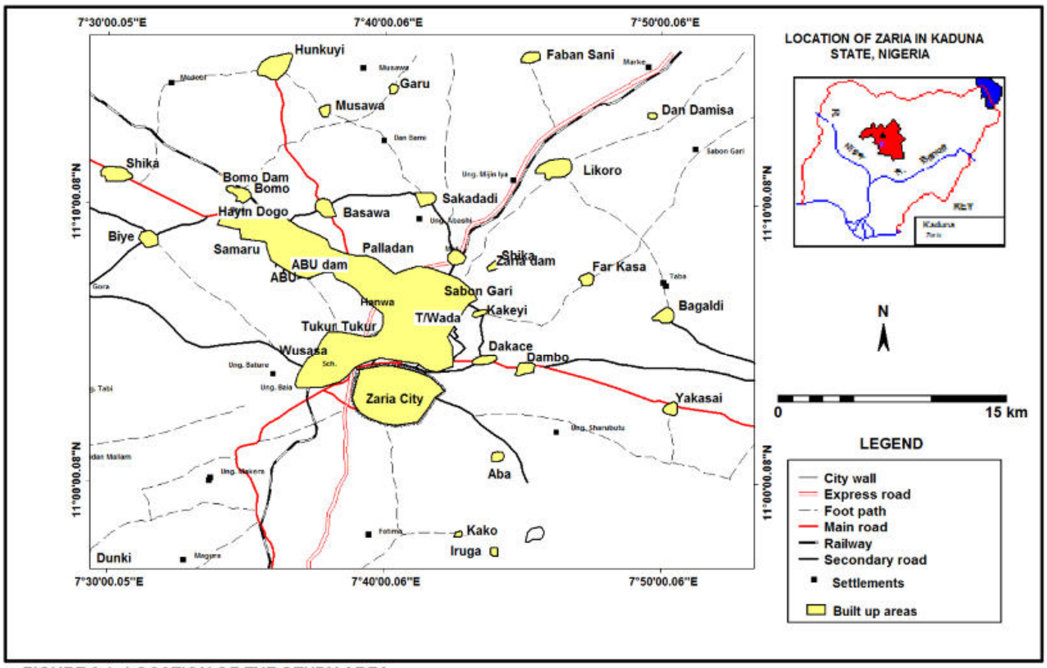

FIGURE 3.1: LOCATION OF THE STUDY AREA

Source : Modified from Zaria Topographic Map, Sheet 102, and Igabi 124, 1: 100,000

Table: 1 Satellite Data Used for Digital Image Processing

Date of acquisition	Type of satellite image	Spatial resolution (m)
7th December 1973	Landsat Multi Spectral Scanner (MSS)	28
27th November 1990	Landsat Thematic mapper (TM)	30
19th October 1999	Landsat Enhanced Thematic Mapper (ETM)	30
10th September 2009	NIGERIASAT-1	32

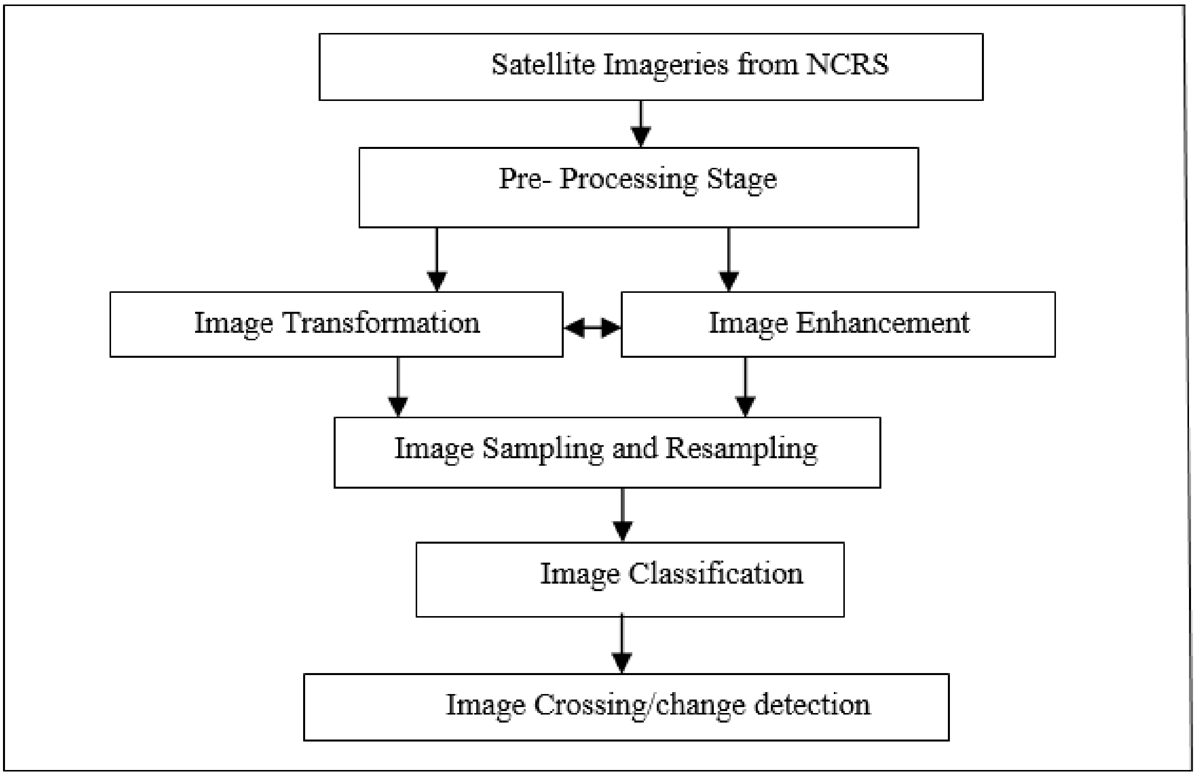

Figure 3.2: Flow Chart of method of Analysis of Satellite Image

Table 2 Classification Schemes Adopted in the Study

S/N	**Land use/ land cover type**	**Interpretation**
1.	Built-up areas	This includes all developed lands such as: Residential, Administrative, Educational, Industrial and commercial land uses.
2.	Bare surfaces	All bare surfaces such as: sites of building under construction, rock outcrops, dilapidated buildings, and farm sites left to fallow.
3.	Water bodies	All water surfaces such as: Rivers, Streams, Ponds and Dams.
4.	Scattered cultivation	All agricultural land uses such as farming
5.	Forest/Plantation	All lands protected by law from exploitation, it could be natural or man-made, that is, land used mainly for wood production, other forest products, recreation, protection, including natural forest, plantation, afforestation, woodlots, other.
6.	Scrub lands	All land areas covered with small and scattered trees and cannot be classified as forest usually the height are less than 2 meters tall.
7.	Fadama	All marsh land covers.

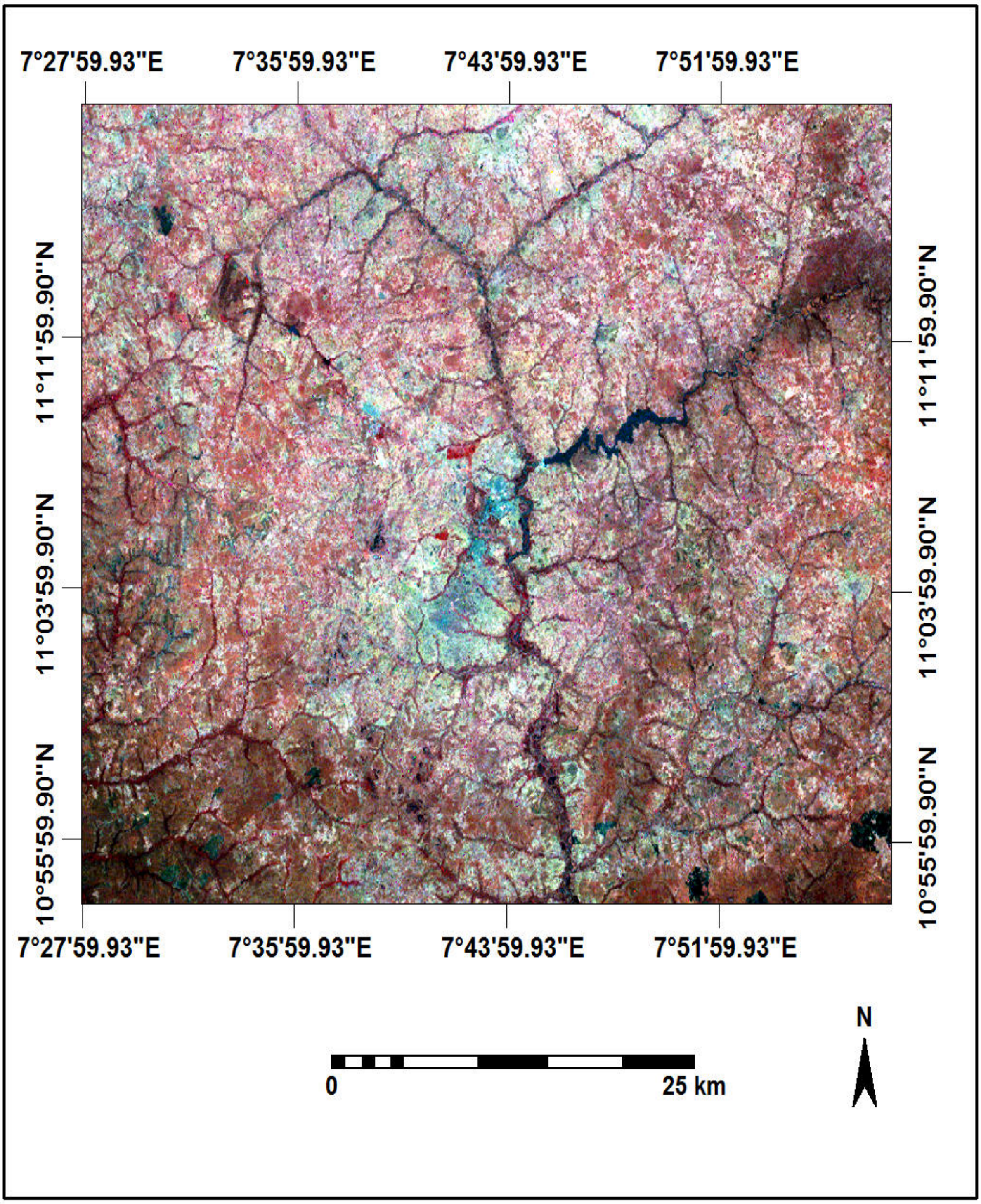

FIG.5.1 LAND USE LAND COVER IMAGERY OF THE STUDY AREA, MSS 1973

Source: National Centre for Remote Sensing (NCRS), Jos. 2011

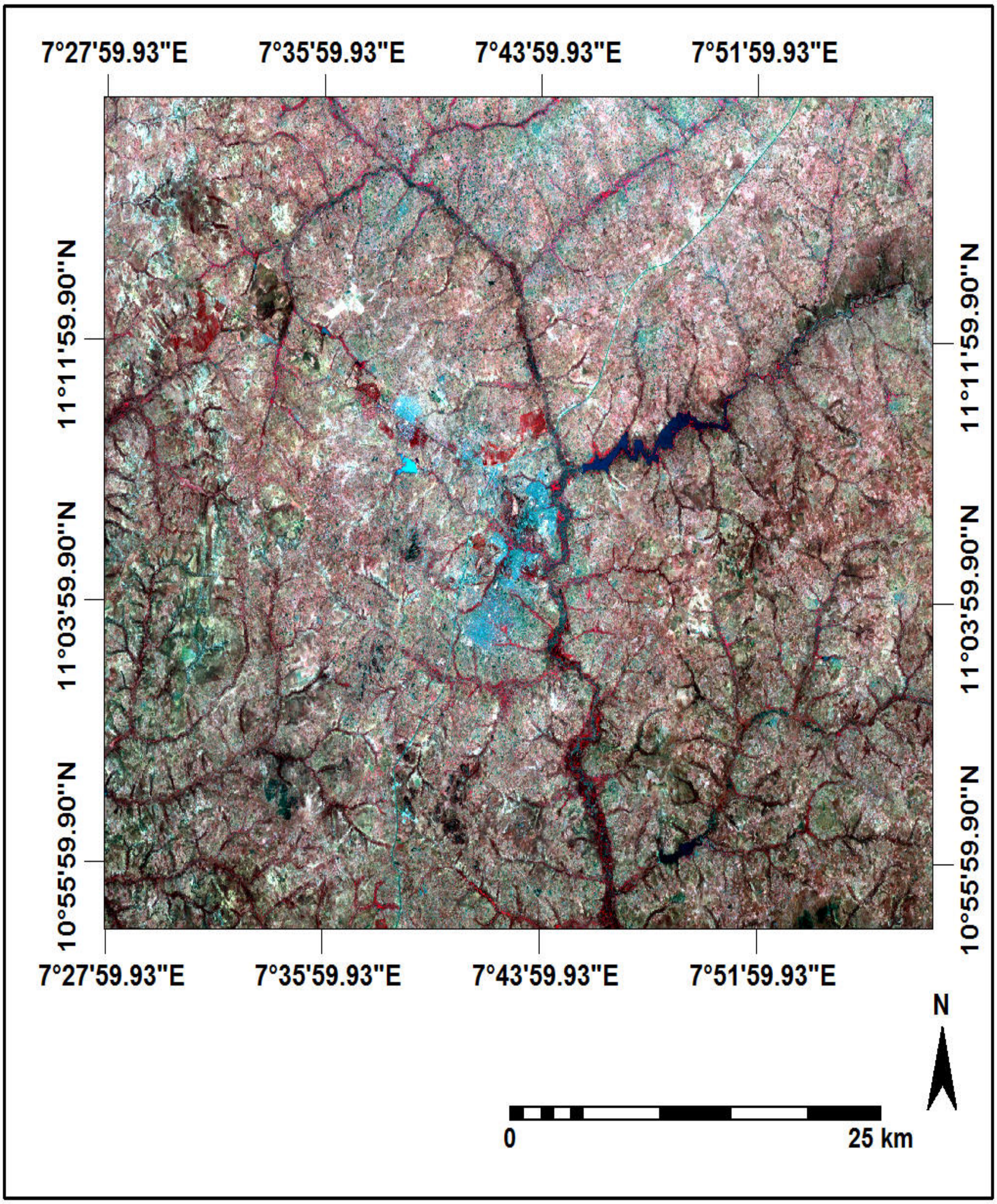

FIG.:5.2 LAND USE/LAND COVER IMAGERY OF THE STUDY AREA, TM 1990

Source: National Centre for Remote Sensing (NCRS), Jos. 2011

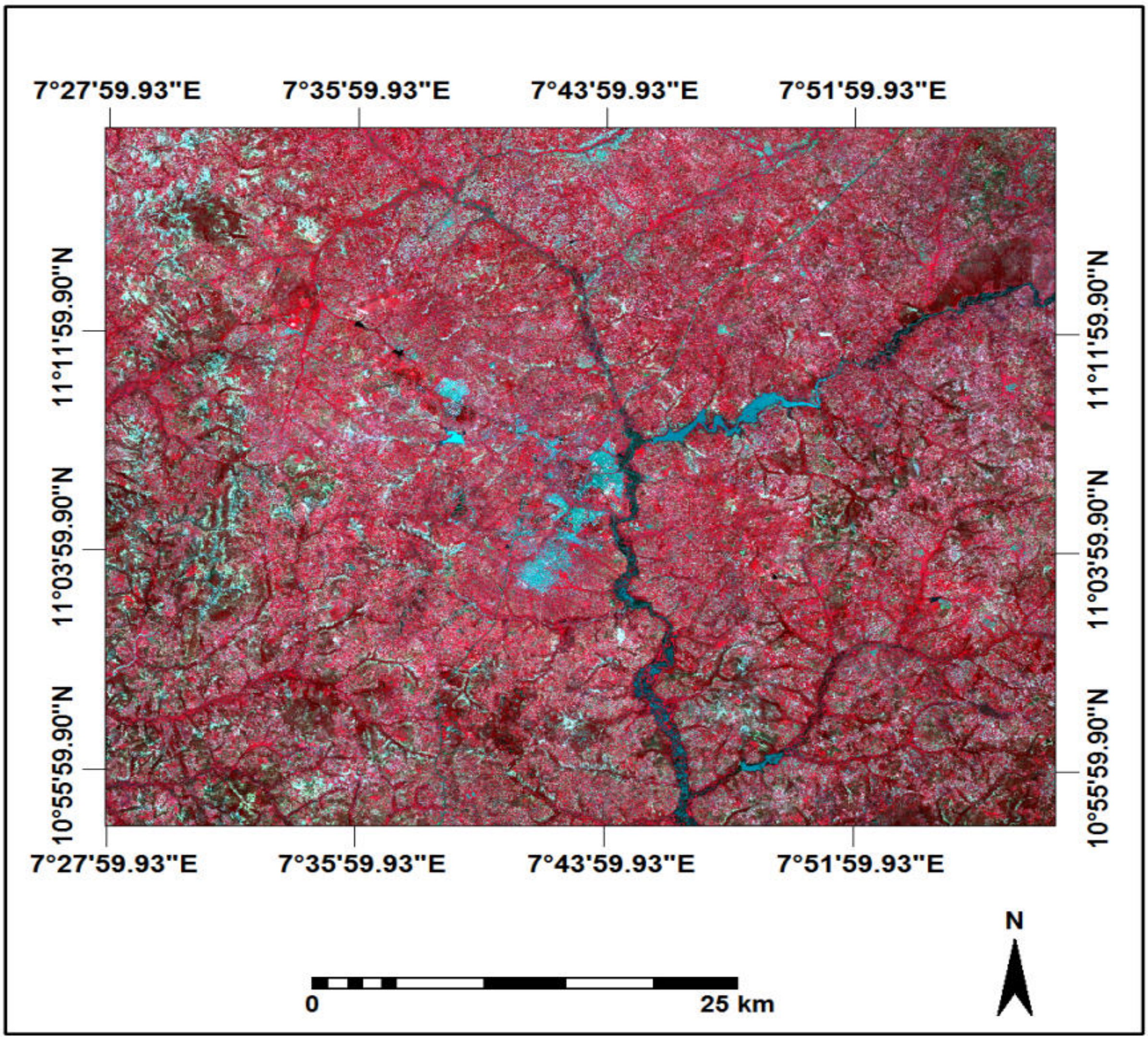

FIG.:5.3 LAND USE/LAND COVER IMAGERY OF THE STUDY AREA, ETM 1999

Source: National Center for Remote Sensing (NCRS), Jos, 2011

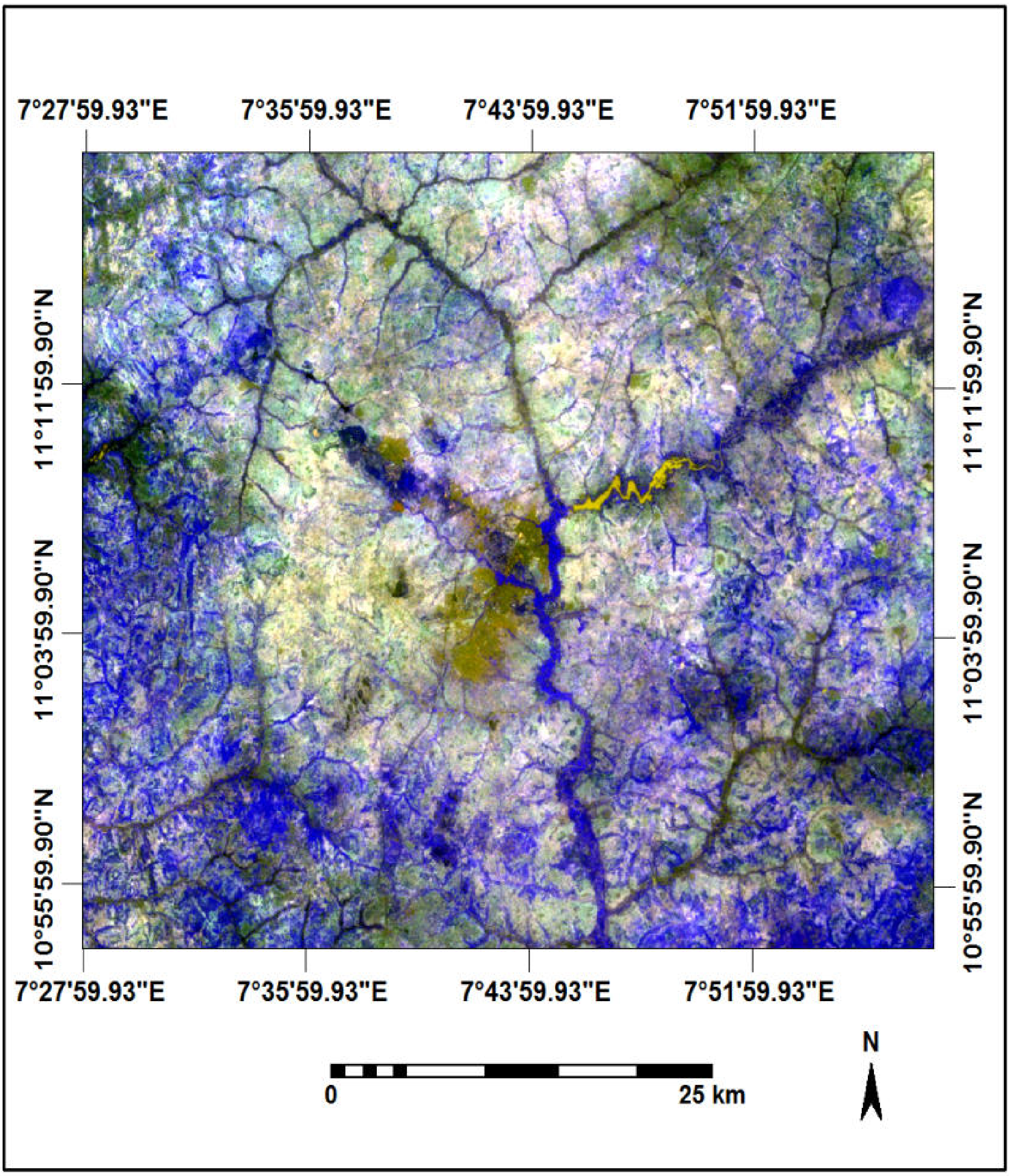

FIG.:5.4 LAND USE/ LAND COVER IMAGERY OF THE STUDY AREA, NIG. SAT-1, 2009

Source: National Centre for Remote Sensing (NCRS), Jos. 2011

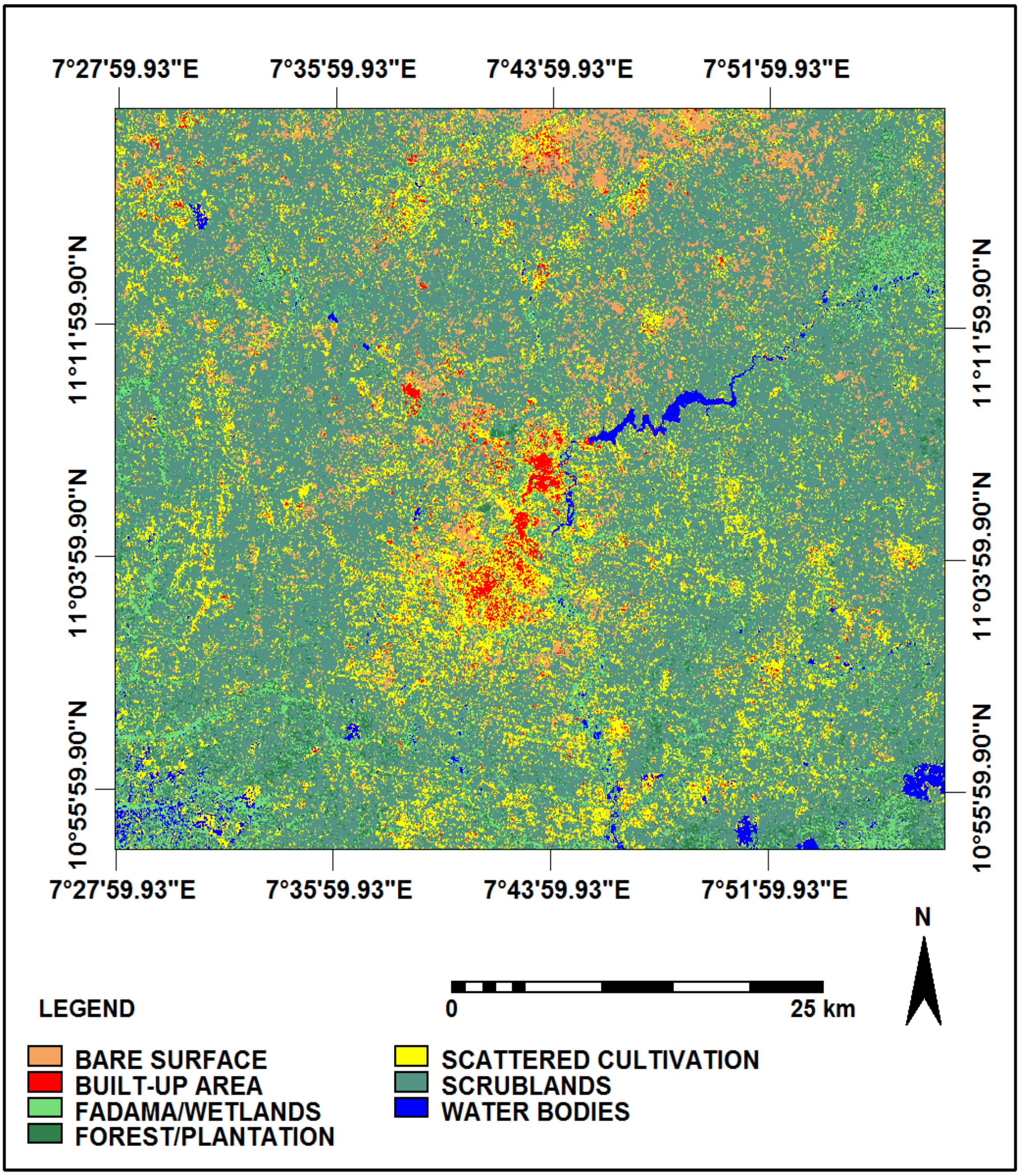

FIG.:5.5 MSS 1973 CLASSIFIED MAP OF THE SYUDY AREA

Source: Laboratory Analysis, 2012

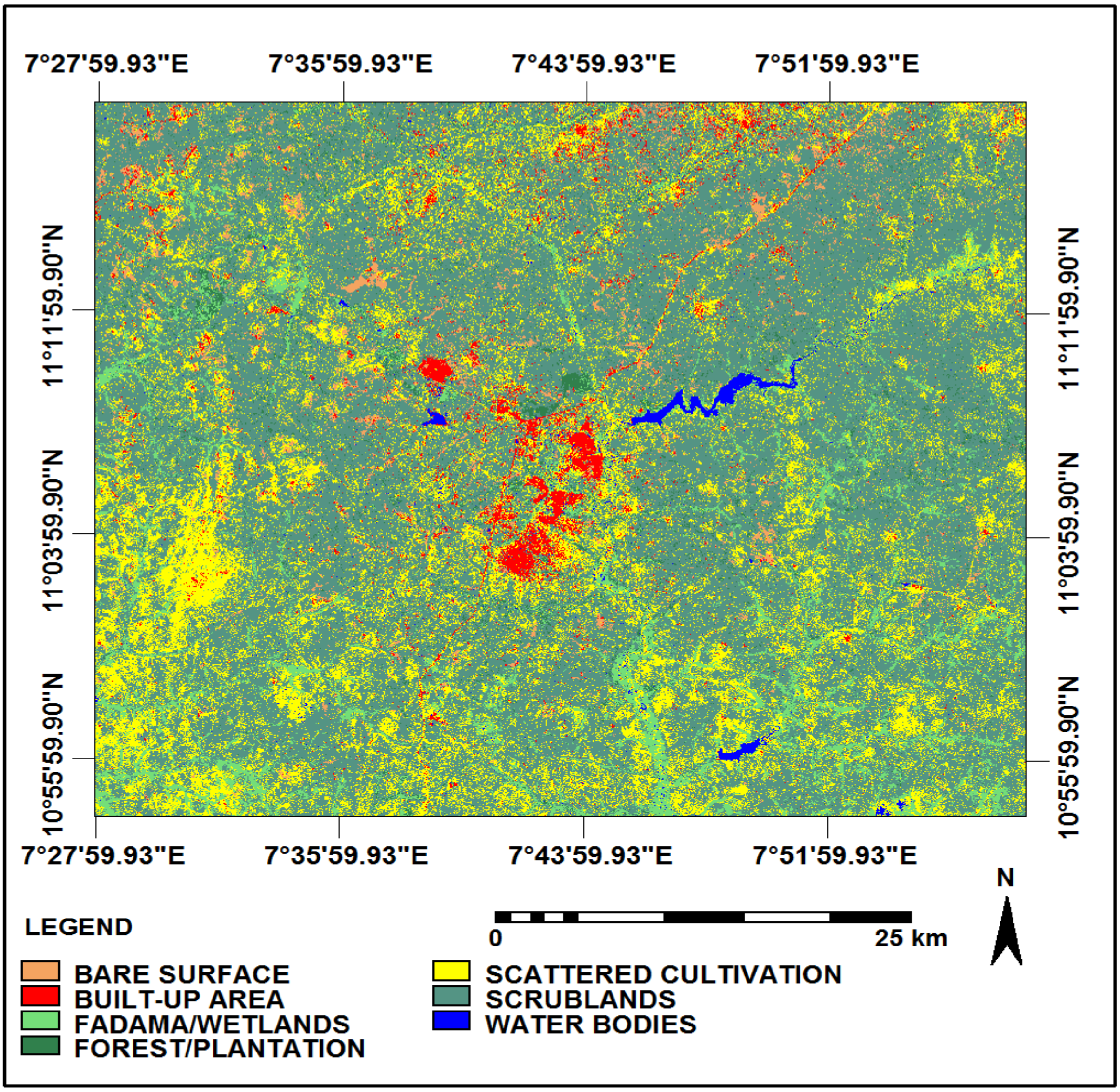

FIG:5.6 TM 1990 CLASSIFIED MAP OF THE STUDY AREA

Source: Laboratory Analysis, 2012

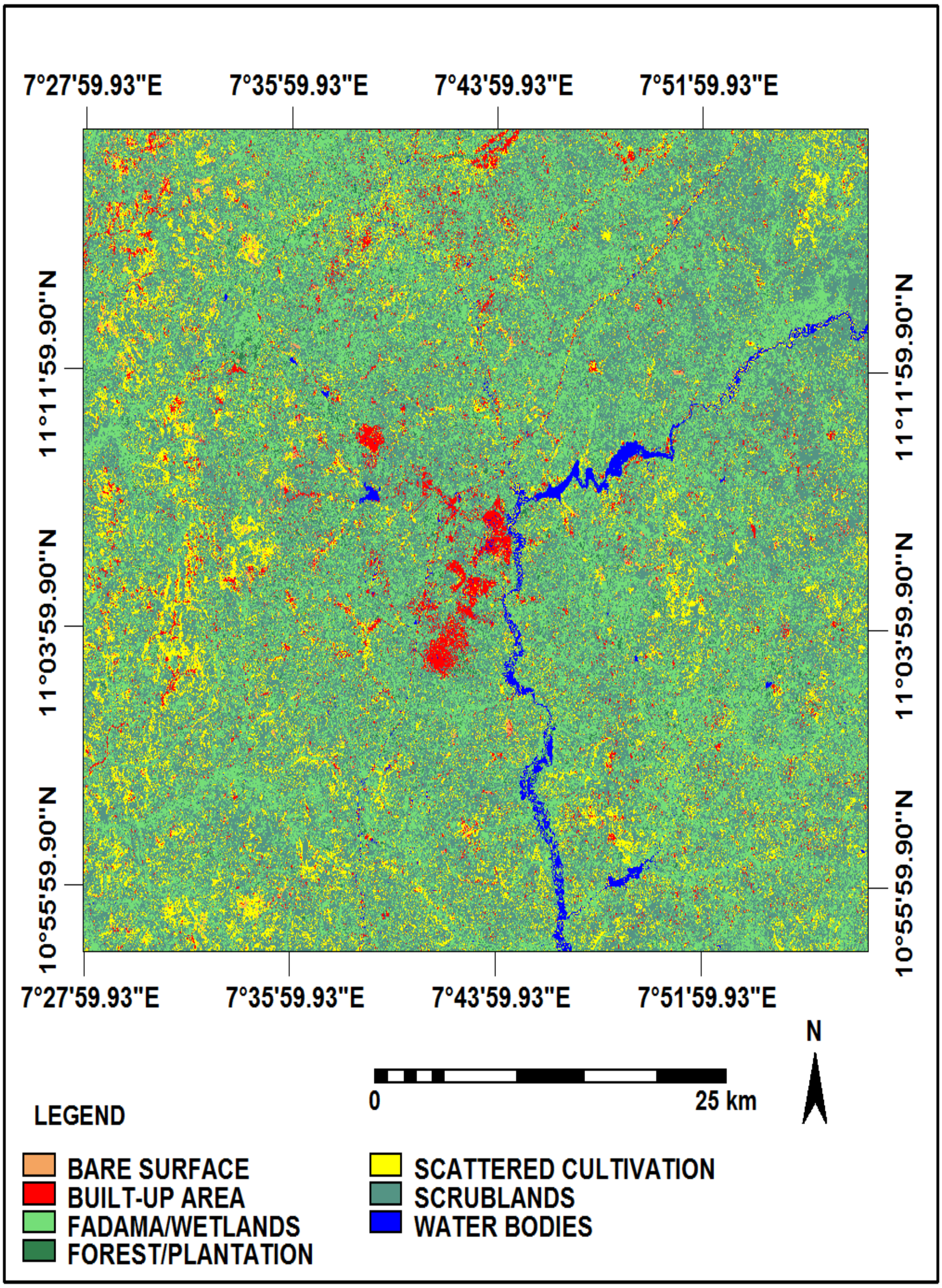

FIG:5.7 ETM 1999 CLASSIFIED MAP OF THE STUDY AREA

Source: Laboratory Analysis, 2012

Journal of Environment and Earth Science www.iiste.org
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.5, No.9, 2015

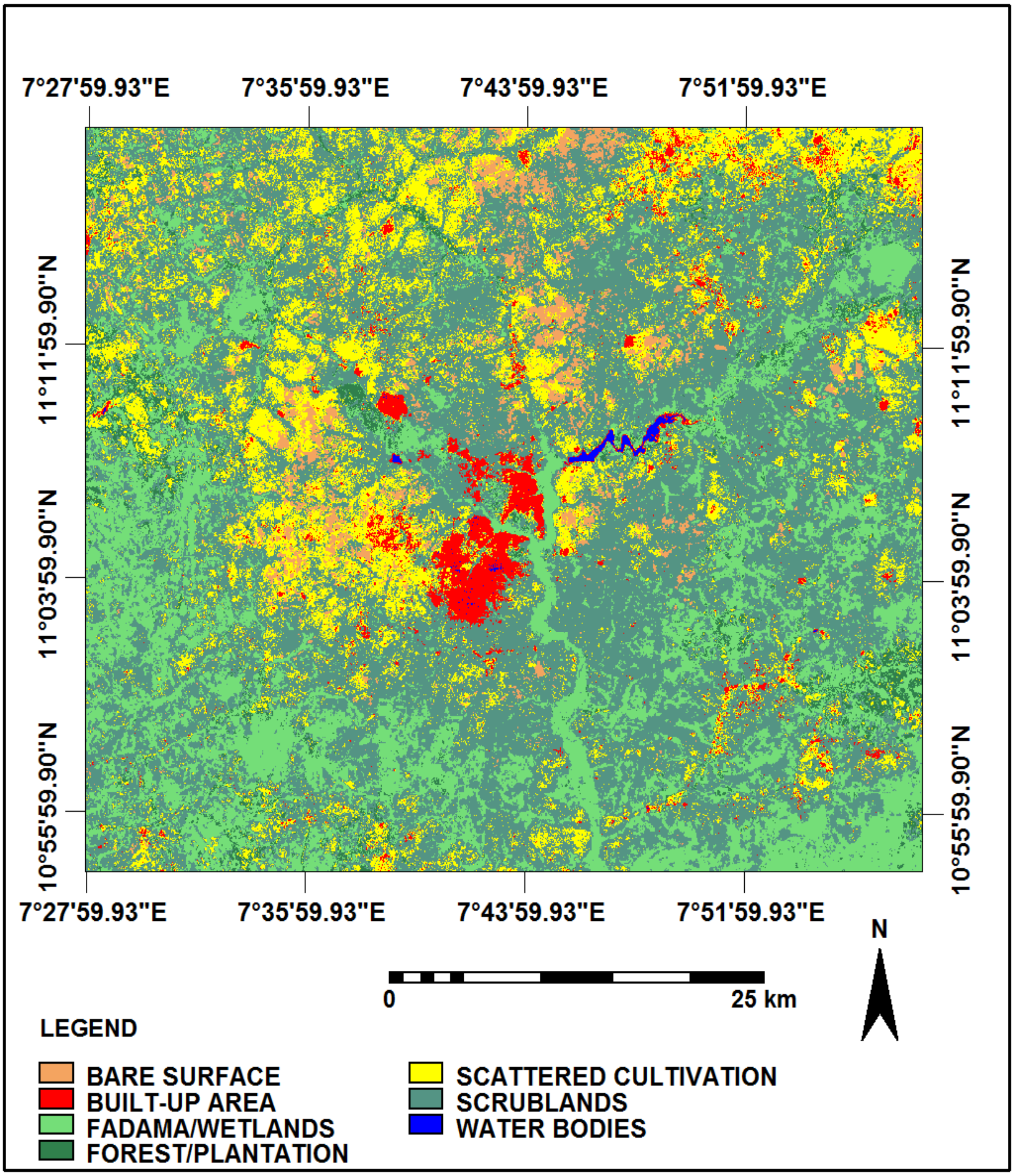

FIG.:5.8 NIG. SAT 1 CLASSIFIED MAP OF THE STUDY AREA

Source: Laboratory Analysis, 2012

Table 3: Land use Land cover Change Summary in Km^2 With Time

LULC	1973	1990	1999	2009
Bare surfaces	145.77 (5.5%)	77.10 (2.9%)	32.81 (1.2%)	85.47 (3.2%)
Built-up area	44.27 (1.7%)	68.89 (2.6%)	80.93 (3.1%)	130.25 (4.9%)
Fadama	146.35 (5.5%)	171.55 (6.5%)	634.38 (24.0%)	571.29 (21.7%)
Plantation/forest	89.24 (3.4%)	58.39 (2.2%)	49.60 (1.9%)	63.36 (2.4%)
Scattered cultivation	408.69 (15.5%)	528.10 (20.0%)	529.09 (20.1%)	433.24 (16.4%)
Scrubland	1,765.72 (66.9%)	1,716.36 (65.1%)	1,283.02 (48.6%)	1,350.39 (51.2%)
Water bodies	38.16 (1.5%)	17.81 (0.68%)	28.37 (1.1%)	4.20 (0.16%)
TOTAL	**2638.20**	**2638.20**	**2638.20**	**2638.20**

Note: % cover in bracket

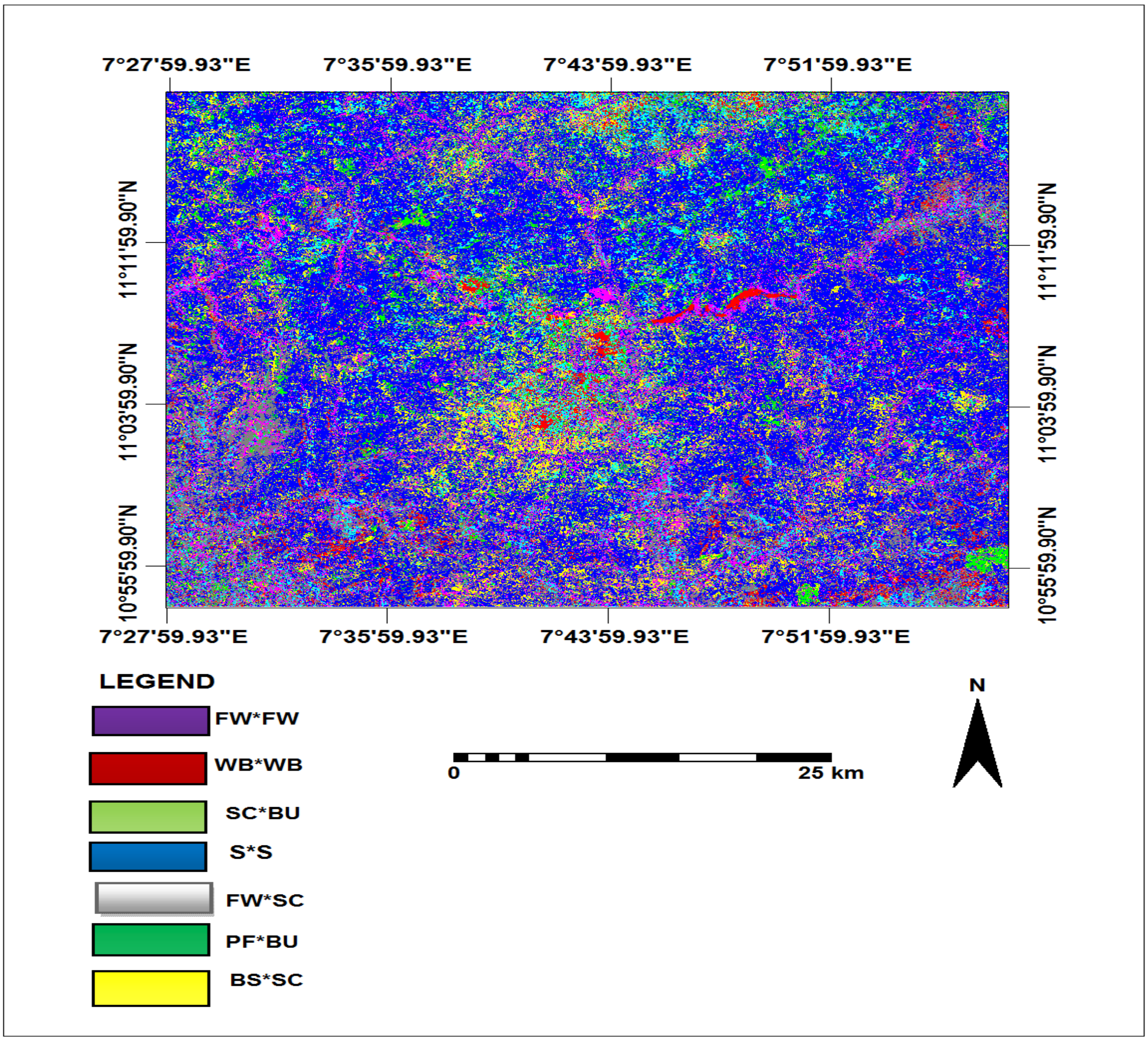

FIG.:5.9 MSS AND TM CROSSED MAP OF THE STUDY AREA

Source: Laboratory Analysis,

***FW: Fadama, WB: Water bodies, BU: Built-up, SC: Scattered cultivation, S: Scrublands, BS: Bare surfaces, PF: Plantation/forest**

Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.5, No.9, 2015

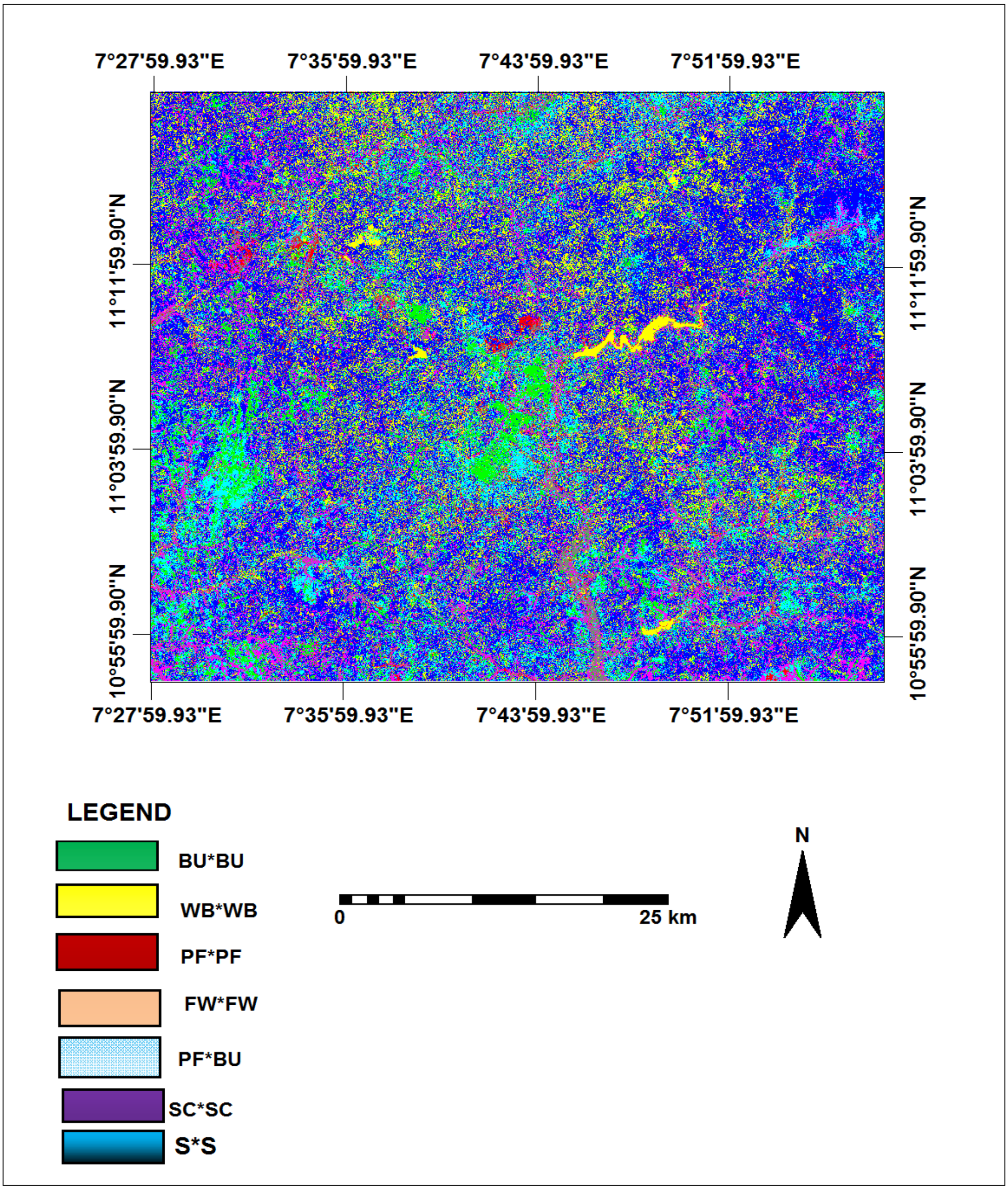

FIG.:5.10 TM AND ETM CROSSED MAP OF THE STUDY AREA

Source: Laboratory Analysis,

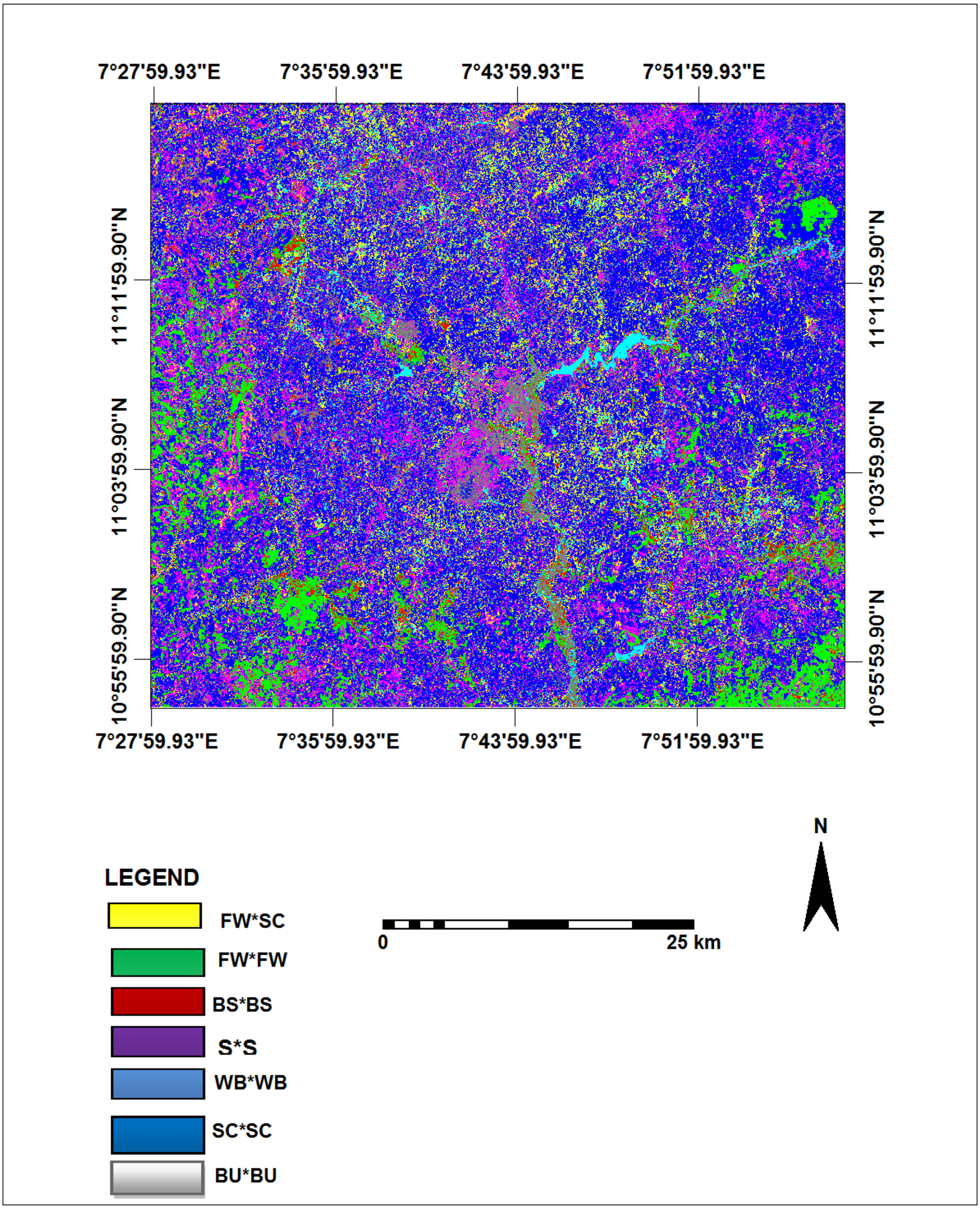

FIG.:5.11 ETM AND NIG. SAT-1 CROSSED MAP OF THE STUDY AREA

Source: Laboratory Analysis, 2012

***FW: Fadama, WB: Water bodies, BU: Built-up, SC: Scattered cultivation, S: Scrublands, BS: Bare surfaces, PF: Plantation/forest**

TABLE: 4 LULC CHANGE DETECTION

LULC	1973 and 1990		1990 and 1999		1999 and 2009	
	Area/ km^2	%	Area/ km^2	%	Area/ km^2	%
BARE SURFACES	-68.67	47.12	-44.29	57.44	+52.66	160.50
BUILT-UP AREA	+24.62	51.61	+12.04	17.48	+49.32	60.94
FADAMA	+25.20	17.22	+462.83	269.79	-63.09	9.95
PLANTATION/FOREST	-30.85	34.57	-8.79	15.05	+13.76	27.74
SCATTERED CULTIVATION	+119.41	29.22	+0.99	0.19	-95.85	18.12
SCRUBLANDS	-49.36	2.80	-433.34	25.25	+67.37	5.25
WATER BODIES	-20.35	53.33	+10.56	59.29	-24.17	85.20

Positive (+) indicates an increase in area coverage
Negative (-) indicates a decrease in area coverage