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LAND USE AND LAND COVER CHANGE DETECTION FOR THREE DECADES: CASE STUDY FOR COIMBATORE AREA

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ABSTRACT

The spatial dimensions of land use and land cover needs to be known at all times so that policy-makers and scientists will be amply equipped to take decisions. The most important thing is the changing pattern of land use and land cover reflects changing economic and social conditions. In order to consider these factors this research focusing the change detection in land use and land cover for three decades. In this paper analyzed the three decade land use and land cover status of Coimbatore Area. That is 1990 to 2000, 2000 to 2010 and 1990 to 2010 and subsequently, an attempt was made at projecting the observed land use land cover in the next 10 years. For analysis high resolution satellite imagery has used for the analysis. The land use change detections for the period from 1990 to 2000, 2000 to 2010 and over all land use changes from 1990 to 2010 are analyzed under GIS environment. Finally this paper concluded with some remedies for further environmental management.

KEYWORDS

Land use, Land cover, GIS, Satellite imagery

1. INTRODUCTION

The recent availability of high-resolution satellite imagery has led to increased interest in the use of satellite data for large scale mapping applications and detailed land use assessments. This growing interest not only emanates from the fact that satellites provide a synoptic coverage, have a high repetitive cycle, and carry multispectral band sensors that provide information beyond the ordinary ability of the human eye, but also because they offer a cost-effective source of data that enables

timely detection of changes to the land use and land cover, the monitoring and mapping of urban development, assessment of deforestation extents, evaluation of post fire vegetation recovery, the revision of topographic maps among numerous other environmental assessments.

Land use and land cover information are important for several planning and management activities concerned with the surface of the earth because it constitutes key environmental information for many scientific, resource management and policy purposes, as well as for a range of human activities. An accurate knowledge of land use and land cover features represents the foundation for land classification and management. Therefore a wide range of scientists and practitioners, including earth systems scientists, land and water managers as well as urban planners seek information on the location, distribution, type and magnitude of land use and land cover change.

2. STUDY AREA

Coimbatore, district is situated on the banks of river Noyyal between 11° 00' of north latitude and 77° 00' of East longitude. The total area of Coimbatore district is 254 square km. Coimbatore is located at an elevation of about 398 meters. The mean maximum and minimum temperatures during summer and winter varies between 35°C to 18°C. Highest temperature ever recorded is 41 °C and lowest is 12 °C. Coimbatore is situated in the extreme west of Tamil Nadu, near the state of Kerala. It is surrounded by mountains on the west, with reserve forests

and the (Nilgiri Biosphere Reserve) on the northern side. The eastern side of the district, including the city is predominantly dry. The entire western and northern part of the district borders the Western Ghats with the Nilgiri biosphere as well as the Anaimalai and Munnar ranges. It is the third largest district of Tamil Nadu. This district is known as the Manchester of South India and is known for its textile factories, engineering firms, automobile parts manufacturers, health care facilities, educational institutions, and hospitality industries. The hill stations of Ooty, Coonnor and Valparai are close to the city making it a good tourist attraction throughout the year. The district is situated on the banks of the Noyyal River and is close to the Siruvani Waterfalls. This district contains four main reservoir that is Aliar,Thirumurthi ,Amaravathi and Solaiar. Below figure 8.1shown the indexed map of Coimbatore District.

3. DATA AND IMAGERY USED

IRS IA1990, IRS IC 2000 and IRS P9 2010 Level III imageries were collected from Water Research Institution, Tharamani, and Chennai. Topo Sheets 58 A, 58B, 58E and 58 F were collected from Survey of India, Map Sales office, Chennai.

2.4. Preprocessing of Study Area

The three-year imageries were preprocessed using the proposed algorithm discussed in previous chapter. First the imageries were geometrically corrected by using 2D quatric polynomial algorithm then processed by maximum likely resampling algorithm .the georeferenced images were processed by image enhancement algorithm then classified by RGB&L supervised algorithm. Finally changes were predicted by hybrid algorithm.

Figure 1. Coimbatore District Map

2.4.1 Spatial Distribution of Land Use Categories –1990

IRS IA imagery of 28 January 1990 was visually analyzed and classified different kinds of land use in Coimbatore area. The spatial distribution of land use was assessed geographically and their aerial extent quantified and shown in the table 1. The histogram of land use spatial distribution shown in figure.2 and the different categories of land use and land use features classified under level II and I are shown in the figure 3.

Table.1.Spatial Distribution of Land use in 1990

Sl. No	Land use categories Level I		Area in Sq.km	Percentage
1	Water body	River, canal, and tanks	1618.130	18.46
2	Settlement	Towns, Villages, industries	112.161	1.28
3	Forest land	Forest covered by scrub	1370.413	15.63
4	Crop land	Wet crop land		
		Dry crop land	912.531	10.41
5	Barren Land	Barren land		
		Stony waste		
		Barren rocky	4563.534	52.06
6	Fallow Land	Land with / without scrub	163.38	1.86
7	Others	Layout, Quarry	26.334	0.30
		Total area	8766.483	100.00

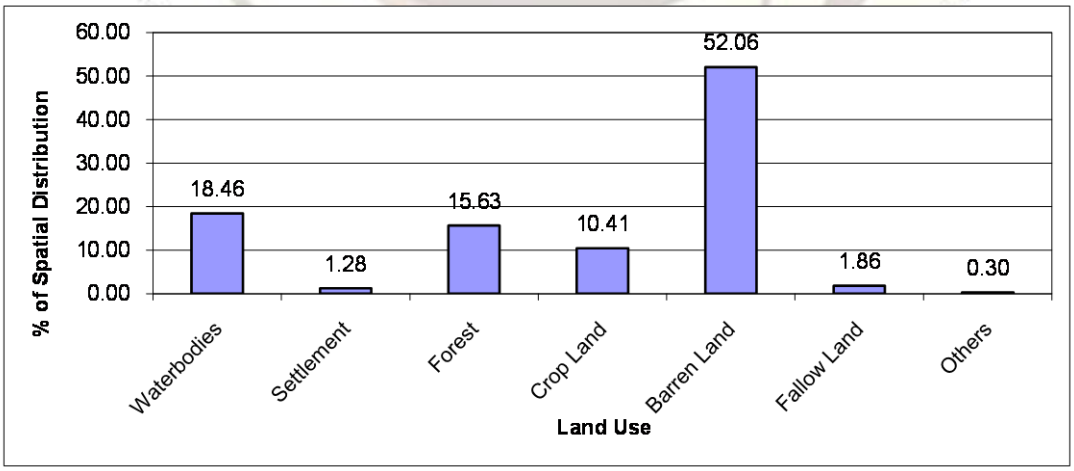

Figure.2 Histogram of land use 1990

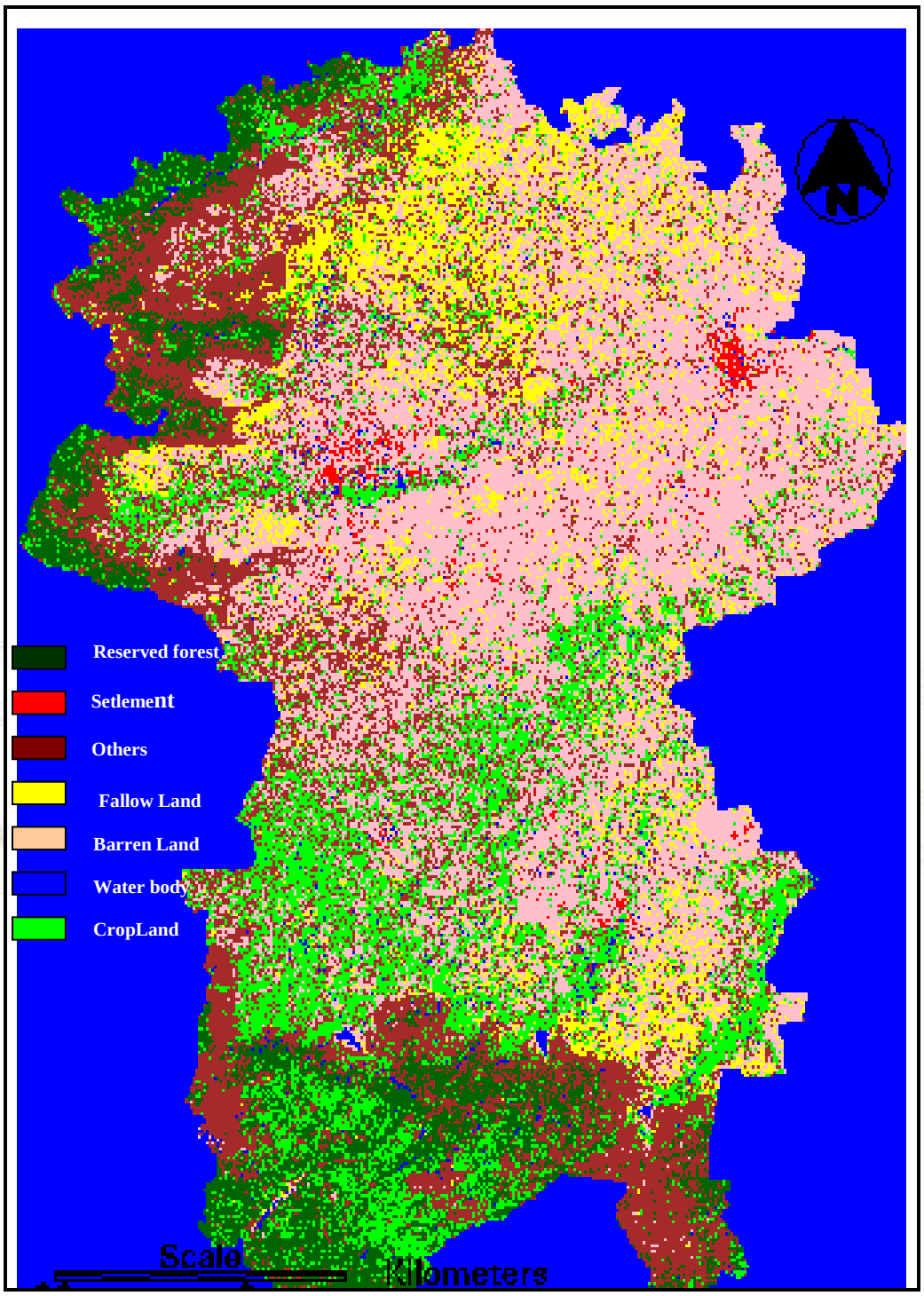

Figure. 3 Land use map of Coimbatore Area -1990

2.4.2 Spatial Distribution of Land Use Categories –2000

IRS I C LISS III satellite imagery of 25 April 2000 was visually analyzed and classified different kinds of land use in Coimbatore area. The spatial distribution of land use analyzed under GIS environment to quantify their aerial extent for April 2000 as shown in table 2. The histogram of land use spatial distribution shown in figure 4 and the different categories of land use and land use features classified under level I and level II are shown in the figure 5

Table .2 Spatial Distribution of land use in 2000

Sl. No	Land use categories Level I		Area in Sq.km	Percentage
1	Water body	River, canal, and tanks	1573.68	17.95
5	Settlement	Towns, Villages, industries	633.02	7.22
3	Forest land	Forest covered by scrub	1522.02	17.36
2	Crop land	Wet crop land		
		Dry crop land	1141.09	13.02
4	Barren Land	Barren land		
		Stony waste		
		Barren rocky	2346.77	26.77
6	Fallow Land	Land with / without scrub	533.75	6.09
7	Others	Layout,Quarry	1016.15	11.59
		Total area	8766.483	100.00

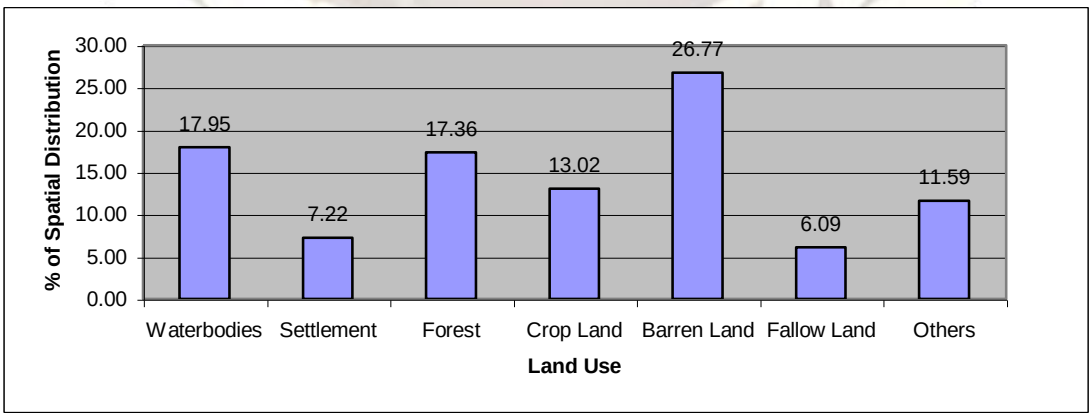

Figure.4 Histogram of land use 2000

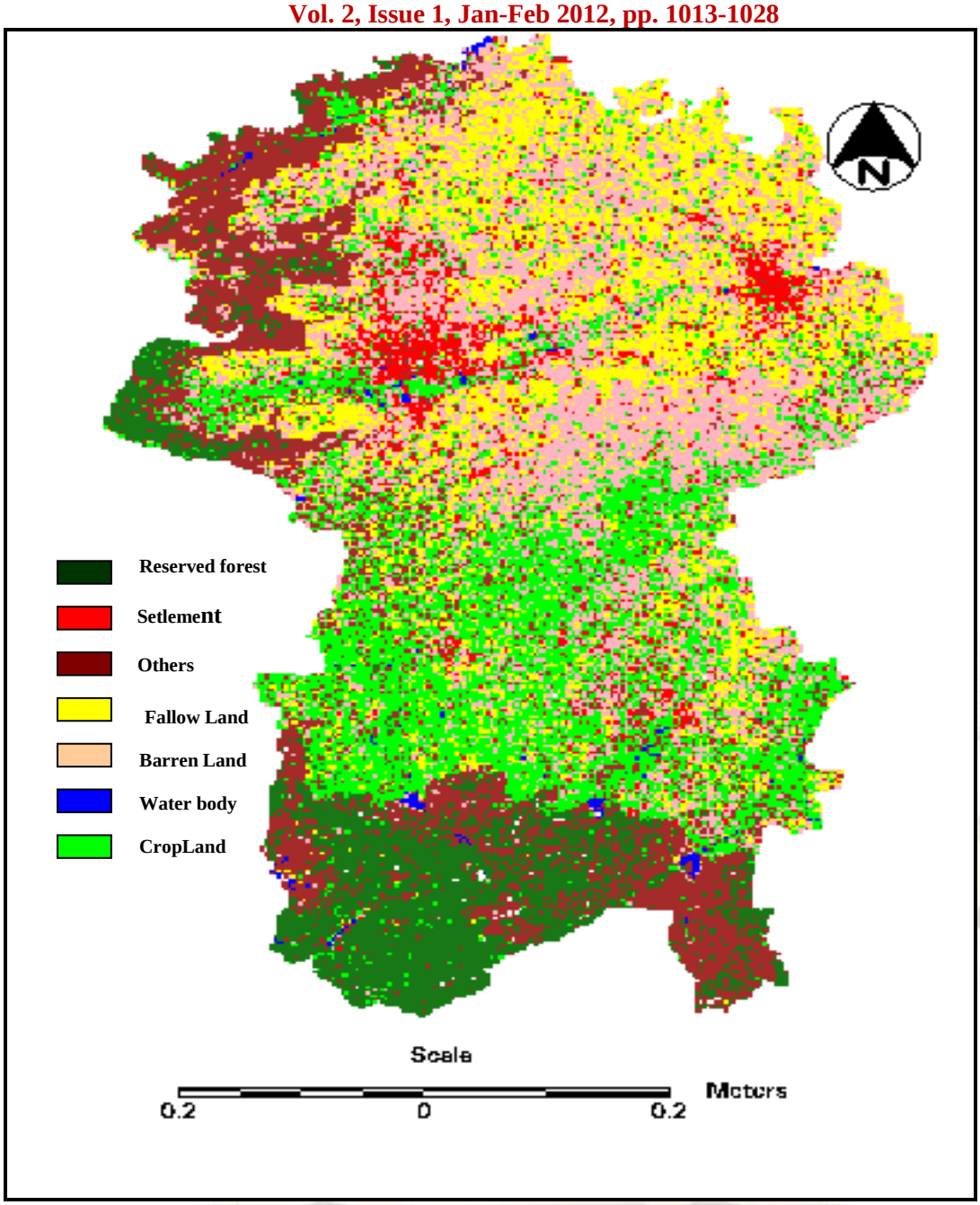

Figure. 5 Land use map of Coimbatore Area -2000

2.4.3 Spatial Distribution of Land Use Categories –2010

IRS P6 LISS III satellite imagery of 16 February 2010 was visually analyzed to know the present status of land use in Coimbatore area. The spatial distribution of land use quantified under GIS environment as furnished in the table 3. The histogram of land use spatial distribution shown in figure 6 and the different categories of land use and land use features classified under level I and level II are shown in the figure 7.

Table.3 Spatial Distribution of Land use in 2010

Sl. No	Land use categories Level I		Area in Sq.km	Percentage
1	Water body	River, canal, and tanks	1463.52	16.69
2	Settlement	Towns, Villages, industries	811.37	9.26
3	Forest land	Forest covered by scrub	1466.41	16.73
4	Crop land	Wet crop land		
		Dry crop land	1259.54	14.37
5	Barren Land	Barren land		
		Stony waste		
		Barren rocky	1624.91	18.54
6	Fallow Land	Land with / without scrub	759.919	8.67
7	Others	Layout, Quarry	1380.81	15.75
		Total area	8766.483	100.00

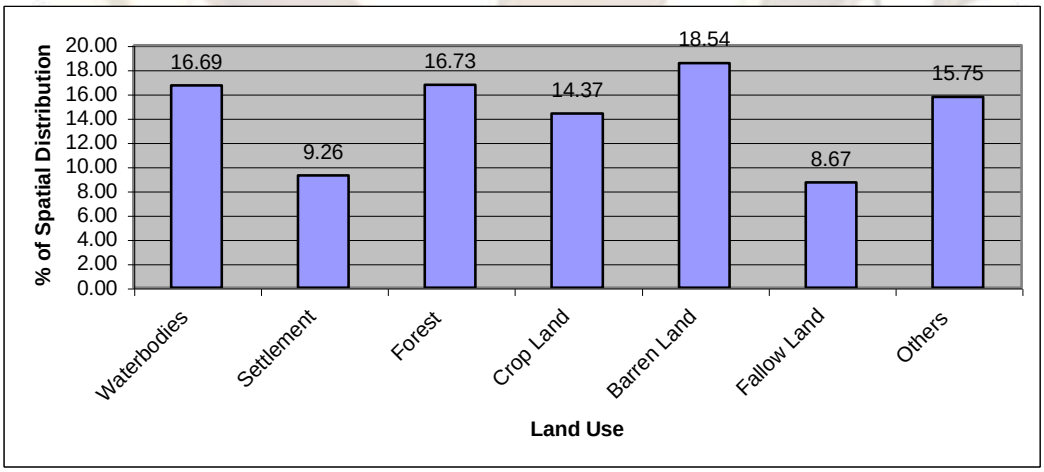

Figure. 6 Histogram of Land use 2010

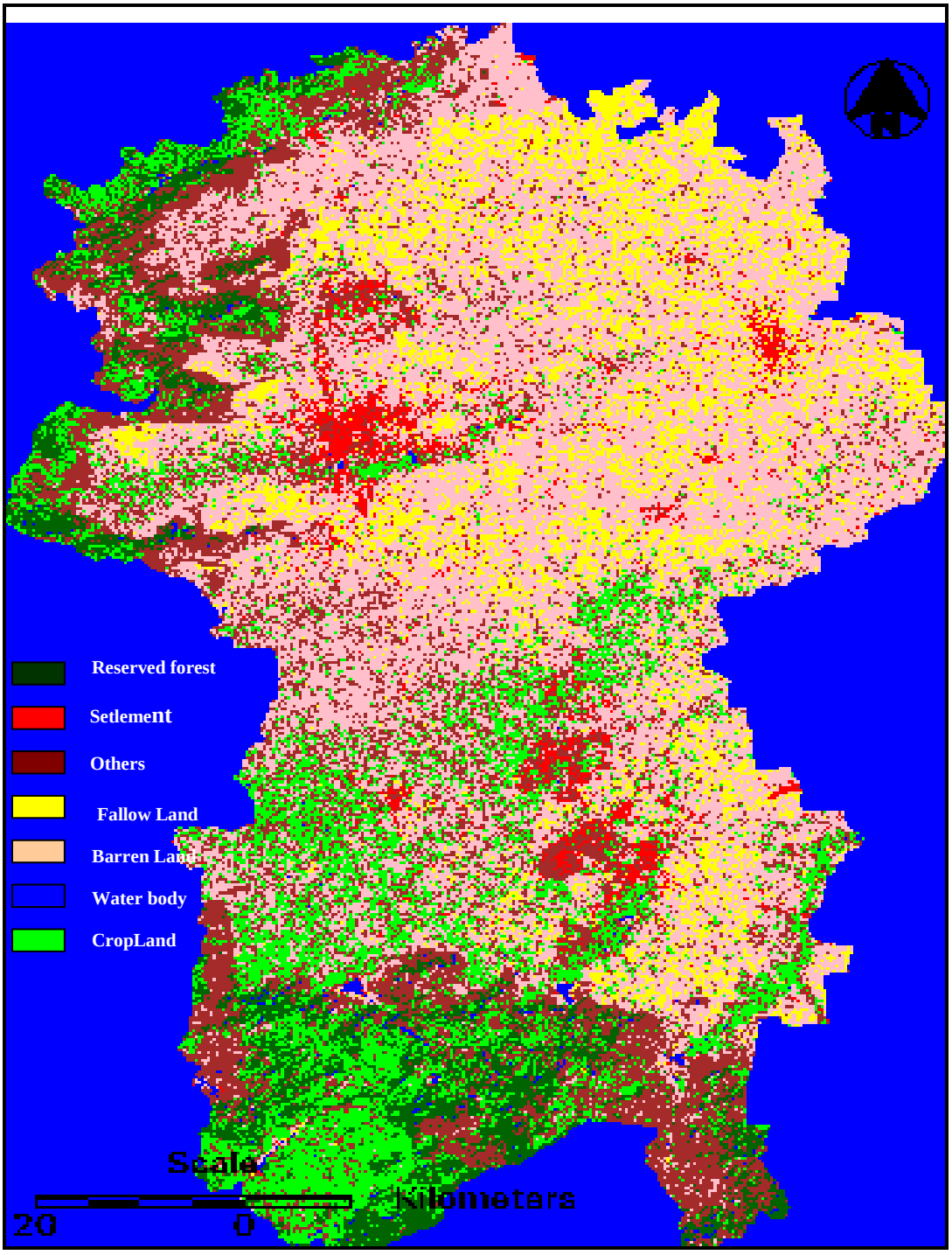

Figure. 7 Land use map of Coimbatore Area- 2010

3. LAND USE CHANGE DETECTION- GIS ANALYSIS

The land use change detections for the period from 1990 to 2000, 2000 to 2010 and over all land use changes from 1990 to 2010 are analyzed under GIS environment. All land use features such as crop land (wet/dry crop); forest land (dense forest and scrub forest), fallow land included the land with / without scrub, barren land included stony waste, barren rocky, alkalinity, water bodies (tanks, river and canal), and others (layout, commercial land and quarry) are individually assessed to know the changes in spatial distribution in this area. The changes in the land use over the period deflect either development activity or vagaries of natural phenomenon.

3.1 Land Use Change Detection (1990-2000)

The land use change detections from 1990 to 2000 reflect that changes especially in the wet and dry crops gained 20.03%. Cultivation practices has increased mainly due to human population growth who exerted in agriculture actives for their survival, increasing number of irrigation wells and free electricity for agriculturalist announced by the Government of Tamil Nadu, in July 1989. Built-up land has increased 8.43% due to high growth rate of human population. Decreasing trend of land use is also found to occur as barren land 45.58% and fallow land 69.39% in its extent caused by the development of land use practices. It was observed that the 9.96 % of forest increased in east and south reserved forest. Alkalinity land is found to occur in and around But most of the land was affected by layout, quarry and commercial land. It was observed that the 97.40% affected the useful land. Spatial distribution of land use and land use change detection between 1990 and 2000 was furnished in Table 4.

Table. 4 Spatial Distribution of Land use and change detection between 1990-2000

S I N o	Land use category		Extent of land use in Sq.km		Loss in sq.km	Gain in Sq.km	Variation	
	Level I		1990	2000			In sq.km	%
1	Water body	River, canal, and tanks	1618.13	1573.68	44.45	-	44.45	2.74
2	Settlement	Towns, Villages, industries	112.161	633.02	-	520.859	520.859	8.43
3	Forest Land	Dense Forest, Scrub Forest	1370.413	1522.02	-	151.601	151.601	9.96
4	Crop land	Wet crop land and Dry Crop Land	912.531	1141.09	-	228.559	228.559	20.03
5	Barren land	Barren land Stony waste Barren rocky	4563.534	2346.77	2216.764	-	2216.764	45.58
6	Fallow Land	Land with / without scrub	163.38	533.75	370.37	-	370.37	69.39
7	Others	Layout, Quarry,	26.334	1016.15	-	989.816	989.816	97.40
		Total area	**8766.483**	**8766.483**				

3. 2 Land Use Change Detection 2000-2010

Analyzed the land use change detections from 2000 to 2010 reflect that changes especially in the wet and dry crops gained 9.40% respectively. Cultivation practices has continuously increased in the past two decade this was mainly due to human population growth who exerted in agriculture actives for their survival, increasing number of irrigation wells. Built-up land has increased 22% due to high growth rate of human population. There was a tremendous change in built-up land. Nearly 10% of water body was decreased. Decreasing trend of land use was also found to occur in barren land in its extent caused by the development of land use practices. 3.69% degraded of forestland was observed in the Annaimali reserved forest where located in the Southern part of Coimbatore area due to intrusion of farming communities for agriculture use. Fallow land and others were increased. The spatial distribution of land use and land use change detection between 2000 and 2010 shown in table 5

Table. 5 Spatial Distribution of Land use and Change detection 2000-2010

Sl No	Land use category		Extent of land use in Sq.km		Loss in sq.km	Gain in Sq.km	Variation	
	Level I		2000	2010			In sq.km	%
1	Water body	River, canal, and tanks	1573.68	1463.52	110	-	110	6.98
2	Settlement	Towns, Villages, industries	633.02	811.37	-	178.35	178.35	22
3	Forest Land	Dense Forest, Scrub Forest	1522.02	1466.41	55.61	-	55.61	3.65
4	Crop land	Wet crop land and Dry Crop Land	1141.09	1259.54	-	118.45	118.45	9.40
5	Barren land	Barren land	2346.77	1624.91	721.86	-	721.86	30.76
		Stony waste						
		Barren rocky						
6	Fallow Land	Land with / without scrub	533.75	759.919	-	226.169	226.169	29.76
7	Others	Layout, Quarry,	1016.15	1380.81	-	364.66	364.66	26.40
		Total area	**8766.483**	**8766.483**				

3.3 Land Use Change Detection Over the Period of 1990-2010

Over all changes in the spatial distribution of land use is assessed from 1990 to 2010 and shown in the table 6. From the analysis it observed that built up land and cropland have increased a considerable extent ie built up land 86.17% and cropland 27.55% due to developmental activities in Coimbatore area.In the 2010 Title Park was constructed in that period. Barren land has decreased up to 64.39%. Land affected by quarry has highly increased. But 6.54% of forest increased. Nearly 7% of water body decreased. Due to improper management of groundwater for agriculture use leads to the lowering of groundwater level in many parts now facing the Coimbatore area.

Table. 6 Spatial distribution of Land use and change detection between 1990-2010

Sl No	Land use category		Extent of land use in Sq.km		Loss in sq.km	Gain in Sq.km	Variation	
	Level I		1990	2010			In sq.km	%
1	Water body	River, canal, and tanks	1618.130	1463.52	154.61	-	154.61	6.98
2	Settlement	Towns, Villages, industries	112.161	811.37	-	699.209	699.209	86.17
3	Forest Land	Dense Forest, Scrub Forest	1370.413	1466.41	-	95.99	95.99	6.54
4	Crop land	Wet crop land and Dry Crop Land	912.531	1259.54	-	347.009	347.009	27.55
5	Barren land	Barren land Stony waste Barren rocky	4563.534	1624.91	2938.624	-	2938.624	64.39
6	Fallow Land	Land with / without scrub	163.38	759.919	-	596.539	596.539	78.5
7	Others	Layout, Quarry,	26.334	1380.81	-	1354.476	1354.476	98.09
		Total area	**8766.483**	**8766.483**				

It was observed that the increasing trend in the built up land. We can see in the below figure 8.8.In this figure 8.8 two images were used IRS IA 1990 and IRS P6 2010

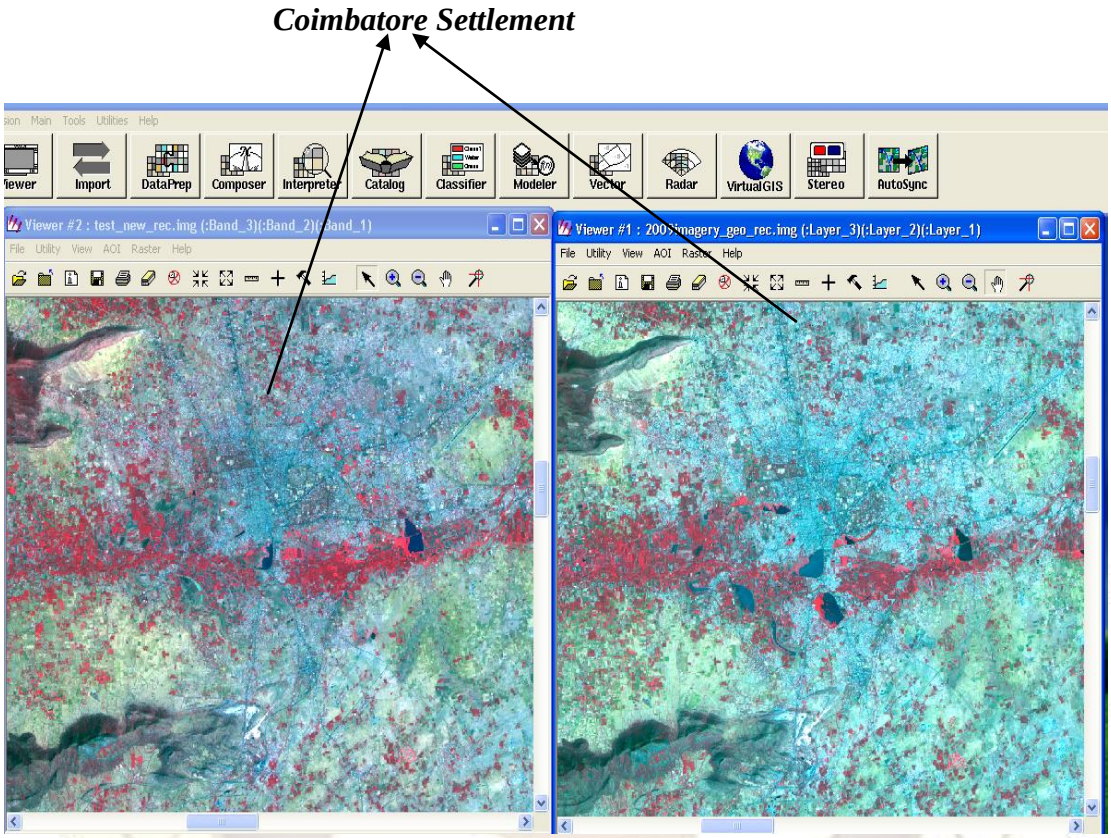

Figure .8 Increasing Settlement in the 1990 to 2010 imagery

3.4 Land Use Change Detection over the period of 2020(in next 10 year)

It was observed that the trend of crop land and built –up land increased in the past 2 decade. So it will be the trend in the next 10 year. Figure 9 shows the land use and land cover in next 10 year. The red color in the denoted the built up land. It can be observed visually. The map was processed by ERDAS Imagine 9.2.

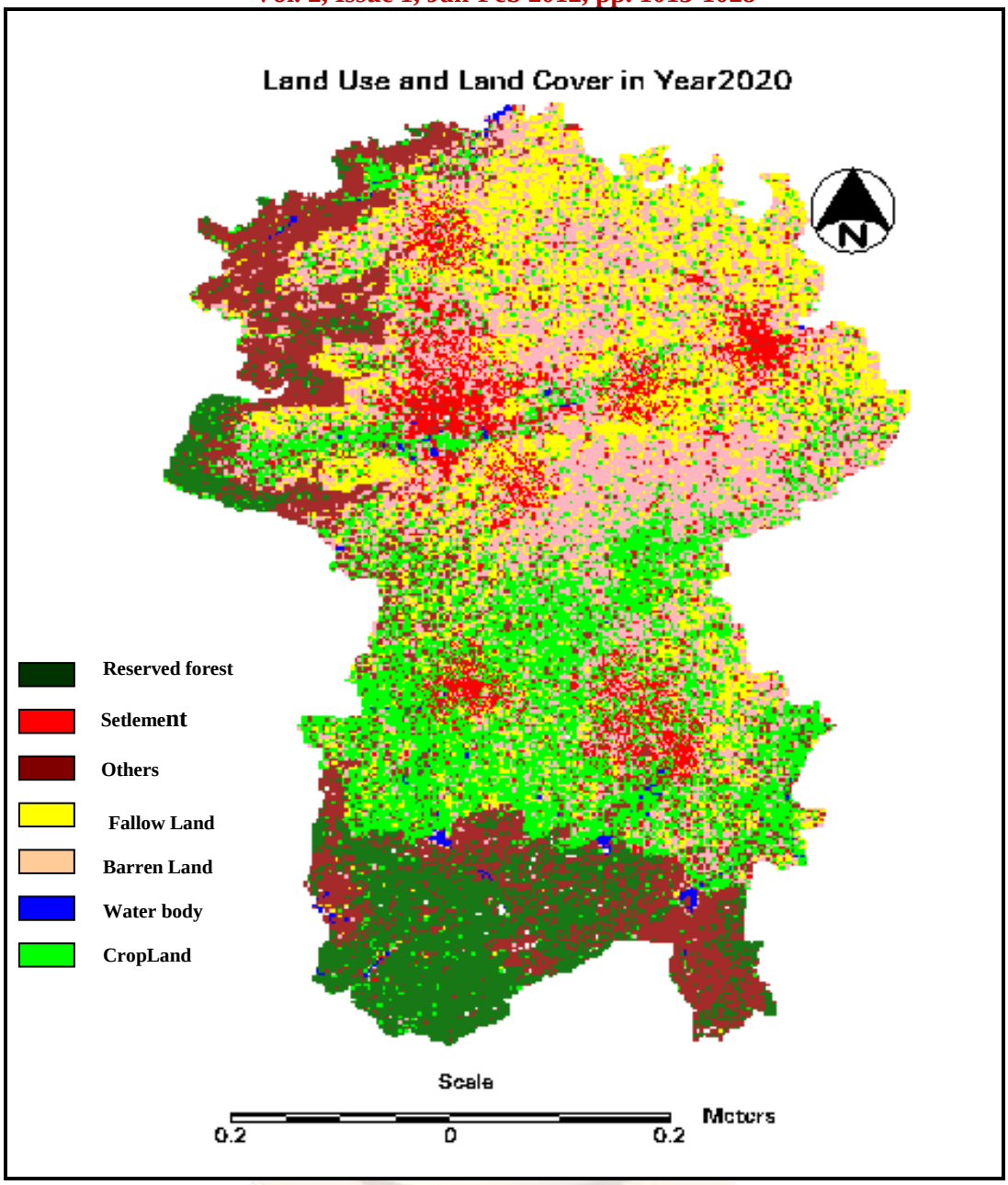

Figure 9. Land Use and Land Cover in the year 2020

4. CONCLUSION AND RECOMMENDATIONS

The past and present land use patterns assessed and compared the changes by overlay analysis under GIS environment for the period 1990 to 2000, 2000 to2010 and 1990 to 2010 in Coimbatore area. During the year 1990and 2000, it was observed that the following land use categories have increased in its extent i.e. built-up land 8.43%, cropland 20.03% and forest 9.96% at the same time there was decreasing trend in the Fallow land 69.39%, barren land45.58%, and water bodies 2.74%. Increasing trend on intensive cultivation practice during 1990 to 2000 was mainly due to provision of free current for agriculturalist announced by the Government of Tamil Nadu in July 1989.

The land use change detection study also analyzed for the period of 2000 to2010. The study reflects that the following category have increased in its extent i.e built-up land 22%, crop land 9.40%, land with/without scrub and shrub 29% waste. Decreasing trend observed especially in the forest area 6.98% is mainly due to depletion of water level found to occur in many parts of Coimbatore area. Decreasing trend is also observed in barren land 30.76%. Land affected by quarry has increased to 26% in and around Northeastern part of this area. Deforestation has increased to 3.65% in Annaimali reserved forest in the southern and valayar reserved forest in the eastern part of this area.

Over all land use detection is assessed for the period 1990 to 2010. From the analysis it observed that built-up land and cropland have increased a considerable extent (built up land: 86.17% and cropland 27.55%)due to developmental activities in Coimbatore area. From the 3 decay observation the future trend of Coimbatore in builup land will be followed the same trend in the 1990 to 2010. The next 10-year will follow the trend in 1990 to 2010.

Improper management of surface and groundwater for agriculture activities leads the depletion of groundwater level in many parts of the Coimbatore area now facing the critical water scarcity. Thus land use plan at micro level have to be prepared through full participation of the agriculture communities. The government agencies can provide the needed technical advice on selection of crops grown based on the availability of groundwater resources of the area and popularizing micro irrigation system for sustainable land use practices in this area. Agricultural department can also make a study in this regard and suggest suitable cropping patterns, which are consuming less water in this area.

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