Geospatial Technology Based Assessment of Dynamics of Land Use and Land Cover Change in and around Neyveli Lignite Mine Area, Cuddalore District, Tamil Nadu, India

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Abstract

An Indian lignite deposit occurs within the Tertiary sediments of the Southern and Western parts of the peninsular region, particularly in Tamil Nadu. Neyveli is known for its Lignite deposits which account for 81 percent of the Tamil Nadu total lignite reserve. NLC India Limited (NLCIL) mining these resources at a rate of 24 million tonnes per annum. This in turn compliments the change in land use pattern in Neyveli and its surrounding region and new developments of Agricultural Land, Afforestation, and Mines area are emerging every day. The present study was therefore undertaken to *analyze the dynamics of land use and land cover changes taken place in and around the Neyveli mine area between 2011and 2019 using Geospatial Techniques. Land use and land cover change detection mapping were conducted by using LANDSAT-4-5-Thematic Mapper, LANDSAT 7 -Enhanced Thematic Mapper Plus(ETM+), LANDSAT 8-Operational Land Imager (OLI), and Sentinel 2 -Multispectral Instrument (MSI) representing six different years from 2011 to 2019 with the help of ERDAS 2014 and Arc GIS 10.1. Supervised classification using a maximum likelihood classifier (MLC) was applied to prepare LULC maps of the Neyveli area. LULC in the study area has undergone a series of complicated changes over the study period. Six major LULC classes viz; Agricultural land, Build up area, Mines area, forest land, water bodies have been identified and Indicates that the major land use in the Neyveli area is Agriculture (73%). The results show that the Agricultural land, build-up area, and mine areas have increased and water bodies, wasteland, and forestland have decreased.*

Keywords: **Land use/Land cover, Change detection, GIS, Remote sensing, Neyveli**

1. Introduction

In common parlance, “land cover (LC)” and “land use (LU)” terms are interchanged, however, they are different. Land use is a more complicated term and is defined as syndromes of human activities such as agriculture, forestry, and building construction that alter land surface processes including biogeochemistry, hydrology, and biodiversity. Land cover refers to the physical and biological coverage over the surface of the land, including water, vegetation, bare soil, and/or artificial structures. While the land cover may be observed directly in the field or by remote sensing, observations of land use and its change generally require the integration of natural and social scientific methods to determine those human activities that are occurring in different parts of the landscape, even when land cover appears to be the same. Neyveli was once predominantly being a wasteland except for the Cashews & Jackfruit trees. In between 1943 - 1947, the Government drilled almost 33 bore wells, and the potential of the Lignite was confirmed, and after 1953, the mine work was started, as a trial attempt. India signed MOU with Germany to dig the first mine of about 14 sq. km, and the discovery and subsequent exploitation of lignite deposits at Neyveli, a small-unknown hamlet six decades ago have transformed into a hub of mining cum-industrial the complex of South India.

Geospatial Technology is a recent tool for advanced land systems, water systems, and ecosystem management. Land use and land cover (LULC) changes have become a central component in current strategies for managing natural resources and for monitoring environmental changes. The LULC information would assist in monitoring the dynamics of land use resulting from the changing demands of the increasing population in and around the Neyveli area. Land use and land cover data will form as basic information for water-resource identification, flood monitoring, water supply planning, and preparing environmental impact statements and help in predicting future impacts on environmental quality.

NLCIL gives importance to reclaiming the mined-out land to maintain ecological balance by making effort to refill the mined-out area and reclaim the land by afforestation and cultivation. In this regard, the present study aims to assess the present land use/land cover pattern and change detection between 2011 to 2019 in and around the Neyveli mine region.

2. Study area

Neyveli falls within the Cuddalore district of Tamil Nadu, India, and it is located 35 km inland from the Bay of Bengal, and 197 km south of Chennai (Figure-1). The town was developed in

1956 after the establishment of Neyveli Lignite Corporation, a public sector enterprise. The study area falls between the co-ordinates of 11°20’00” N to 11°40’00” N latitudes and 79°20’00” E to 79°35’00” E longitudes in the part of SOI Toposheet 58M/7, 58M/6, 58M/11, 58M/10&14, and covers total the geographical area of 1007 sq. km. The Neyveli Township marks the Northern limit while the Vellar River marks the southern limit of the study area. Chennai – Thanjavur highway via Panruti – Vadalur marks the Eastern limit and The western extremity of Mine II marks the Western limit of the Study area. Neyveli region contains two major landscapes, Undulating topography of Lateritic landscape (Majority of the Neyveli region contains this landscapes) of Sedimentary plain and a nearly a plain topography.

3. Methodology

Satellite data used in the present study are LANDSAT 4-5 (TM)-Thematic Mapper, LANDSAT 7 (ETM)-Enhanced Thematic Mapper, LANDSAT 8 (OLI)-Operational Land Imager, and SENTINEL2 (MSI)-Multispectral instrument data in Geo TIFF format for the year 2011,2012,2014,2016,2018, and 2019 with less than 10% cloud cover were acquired for March, April, and May (Table 1). These months correspond to the summer season in the study area. All scenes used in this study were obtained through the open-source from the website of the U.S. Geological

Survey (USGS), Earth Resources Observation and Science (EROS) Centre. The Land Sat 4-5, 7, and 8 is 30m resolution and Sentinel-2A data is 10m resolution. The 1972 survey of India Toposheet (Scale 1:50,000) was used to register and rectify the images. Acquired satellite data was

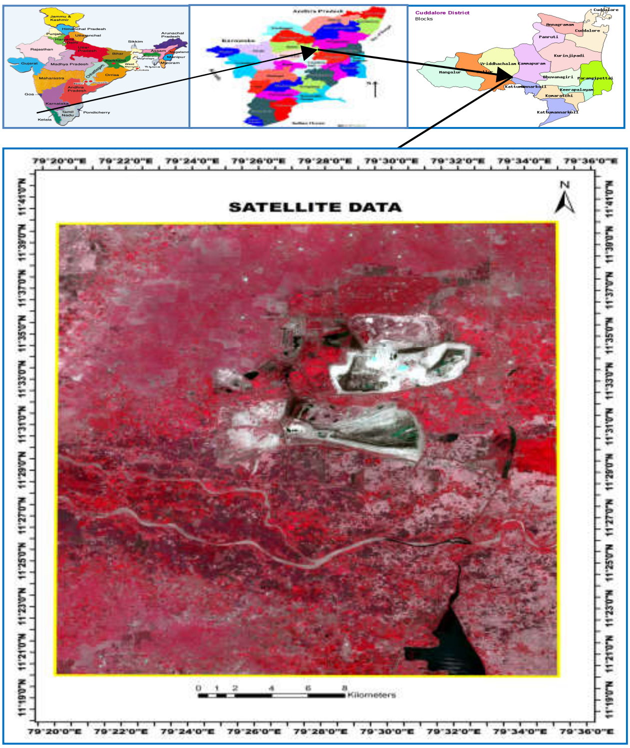

Figure 1. Location of the Study Area

reregistered using the image to map registration technique, and then each image was cropped concerning the study area using the Area of Interest (AOI) cropping technique. These AOI images were re-projected to a common projection; Universal Transverse Mercator (UTM) with (World Geocoded System 84) WGS 84 datum and Zone 44 North.

Change detection analysis encompasses a broad range of methods used to identify, describe and quantify the differences between images of the same scene at different times or under different conditions. The land use/land cover map of the study area was prepared for the years 2011, 2012, 2014, 2016, has been correlated with the land use land cover map of the year 2018 and 2019. The change detection statistics for the classification of the land use/land cover were established, to enable us to infer the changes that occurred from 2011 to 2019.

Table.1 Satellite Data Specification				
S.NO	**Sensor**	**Path /Row**	**Year**	**Resolution**
1	LANDSAT 4,5 (TM)	142/052	2011	30m
2	LANDSAT 7 (TM)	142/052	2012	30m
3	LANDSAT 8 (OLI)	142/052	2014	30m
4	LANDSAT 8 (OLI)	142/52	2016	30m
5	LANDSAT 8 (OLI)	142/52	2018	30m
6	SENTINEL2 (MSI)	10980	2019	10m

4. Result and Discussion

Based on field survey, ground truth verification as well as a visual interpretation of satellite imagery and available collateral data, six major land use/land cover categories have been identified for the study area. These LULC categories along with their subcategories are shown in Fig. 2A to 2F for the year 2011 to 2019 respectively. The details of the areal extent and its corresponding percentage for the total study area are given in Table 2 for the year from 2011, 2012,2014,2016,2018, to 2019. The description of major levels of land use/land cover categories together with their corresponding image characters, as observed in the imagery is as follows.

4.1 Land Use/Land Cover

In the study area, the highest of the six classes is agricultural land, which covers an area of 73% (Fig.3). Forestland occupies the least amount of areal extent with 4% among the classes. The remaining categories like Mines area, Built-up land, Water bodies, and Wasteland are cover an area of 8%, 9%, 5%, and 1% respectively.

4.2. Comparative Analysis of Study Area

Dynamic land use/land cover maps serve as a basic inventory of land resources throughout the world. Whether regional (or) local in scope, geospatial technology serves as the best tool in acquiring and presenting land cover data on time. The comparative analysis of land use categories like Agriculture land, forest land, Mines Area, built-up land, Water bodies, and Wasteland from the years 2011, 2012, 2014, 2016,2018, and 2019 are established and its relative changes for each land use category of the study area were determined. The amount of area covered under each category of the study region, for the period of study along with its changes has been given in Table 3 and Fig. 4.

4.2.1. Agriculture Land

Agriculture areas are sub-classified into Single crop, Double crop, Fallow, Plantation / Horticulture, Plantation, Plantation (NLC), and Cashew plantation. The land use/land cover comparison of agriculture area between the year 2011 and 2019 are shown in figure 5. The study reveals that the agriculture single crop is increased from 104.04 sq. km in 2011 to 134.13 sq. km in 2016 and decreased from 124.04 sq. km in 2018 to 114.1 sq. km in 2019, while the agriculture double-crop area decreased from 241.3 sq. km to 219.3 sq. km in the study period. Fallow land has been gained from 219.95 sq. km in 2011 to 213.6 sq. km in 2019. Change in the cashew plantation area expresses that 167.32 sq. km in 2011 and 154.7 sq. km in 2019. The plantation is also exposed gain from 14.72 sq. km to 18.13 sq. km between 2011 and 2016. The Plantation/ Horticulture is increased from 1.54 sq.km in 2011 to 3.98 sq.km in 2019.

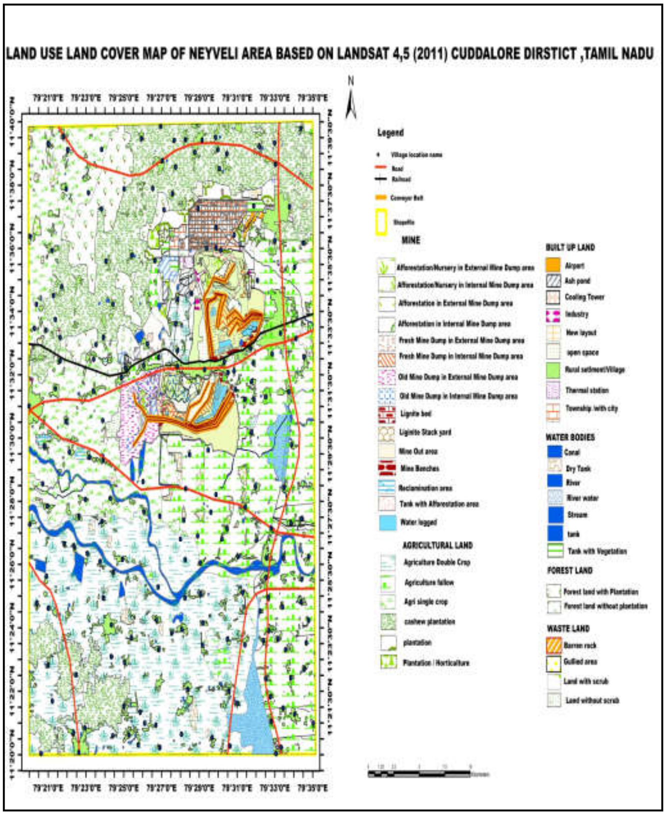

Figure 2A. Land use / Land cover map of Neyveli area of 2011

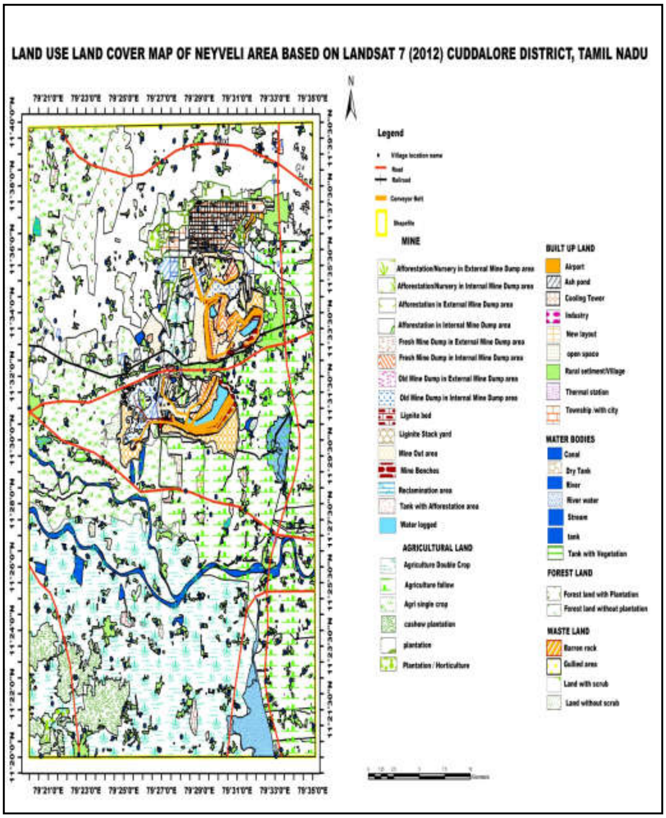

Figure 2B. Land use / Land cover map of Neyveli area of 2012

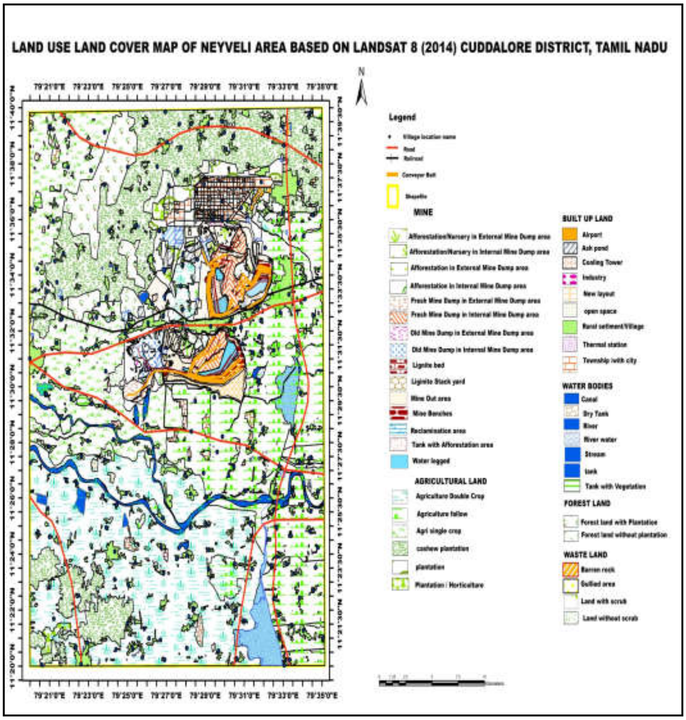

Figure 2C. Land use / Land cover map of Neyveli area of 2014

Figure 2D. Land use / Land cover map of Neyveli area of 2016

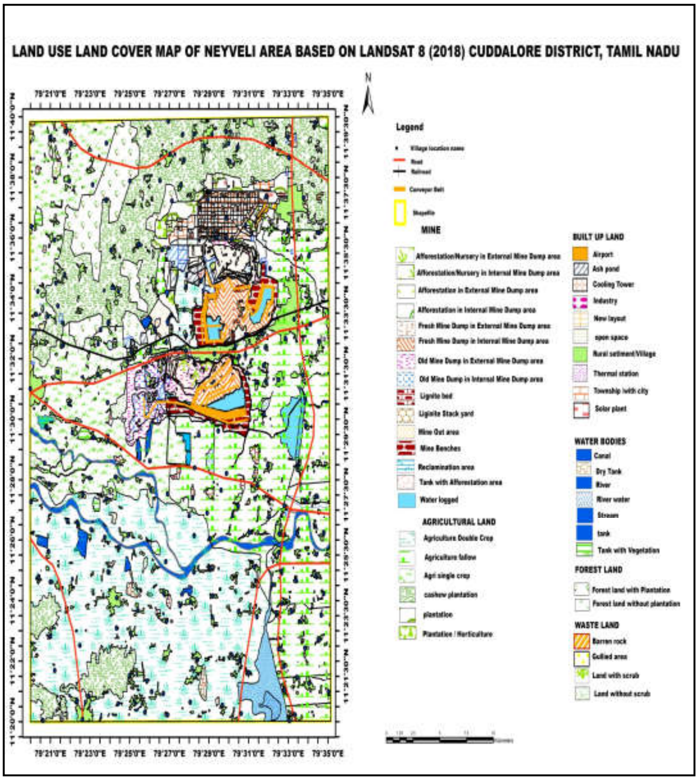

Figure 2E. Land use / Land cover map of Neyveli area of 2018

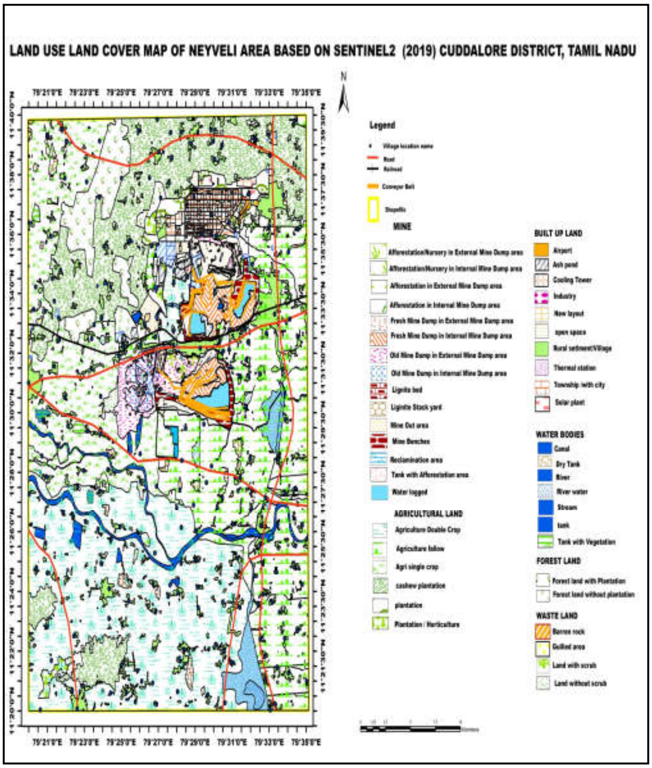

Figure 2F. Land use / Land cover map of Neyveli area of 2019

Table 2 Comparative Analysis of LULC in the Study Area representing the period between 2011 and 2019

S.NO	Land use / Land cover classes			Area in sq.km (2011)	percentage	Area in sq.km (2012)	percentage	Area in sq.km (2014)	percentage	Area in sq.km (2016)	Percentage	Area in sq.km (2018)	Percentage	Area in sq.km (2019)	Percentage
1	Mine	External Mining	Afforestation	2.94	0.29	3.86	0.37	5.65	0.55	10.87	1.1	1.86	0.18	2.68	0.27
			Afforestation / Nursery	1.49	0.14	1.87	0.19	0.62	0.06	0.29	0	0.39	0.04	4.01	0.39
		Dump Area	Fresh Mine Dump	4.74	0.47	2.79	0.28	7.01	0.69	5.51	0.5	0	0	0	0
			Old Mine Dump	19.98	1.98	0.63	0.06	0.57	0.06	8.31	0.8	24.5	2.43	24.72	2.45
		Internal Mining	Afforestation	6.21	0.62	1.62	0.16	5.61	0.56	6.26	0.6	5.57	0.55	4.76	0.47
			Afforestation / Nursery	1.78	0.17	2.48	0.25	2.41	0.24	0.16	0	1.22	0.12	0.44	0.04
		Dump Area	Fresh Mine Dump	7.14	0.71	10.21	1.01	14	1.4	11.02	1.1	21.1	2.09	16.87	1.67
			Old Mine Dump	16.96	1.69	11.64	1.16	5.71	0.57	2.73	0.3	10.1	1	9.46	0.93
		Reclamation Area		0.27	0.03	0.52	0.05	0.99	0.09	0.77	0.1	0.62	0.06	1.03	0.1
		Mining Area	Lignite bed	0.36	0.04	0.47	0.05	0.74	0.07	1.17	0.1	1.61	0.16	1.01	0.1
			Lignite stock yard	0.79	0.08	0.79	0.08	0.78	0.08	1.11	0.1	0.82	0.08	1.33	0.13
			Mine benches	7.23	0.71	7.93	0.79	7.8	0.77	11.39	1.1	11.5	1.14	10.5	1.04
			Mined out area	11.24	1.12	10.34	1.03	3.99	0.39	5.39	0.5	2.38	0.24	0	0
			Tank with in Afforestation area	1.29	0.13	1.6	0.16	1.47	0.15	0.83	0.1	0.12	0.01	1.53	0.15
			Water Logged Area/Sump	3.29	0.33	4.03	0.4	5.47	0.54	6.06	0.6	6.61	0.66	7.29	0.72
			Total Mine Area	**86**	**8.5**	**61**	**6**	**63**	**6**	**72**	**7**	**88**	**9**	**86**	**8.5**

2	**Built up land**	Industrial area		**4.6**	**0.45**	**4.22**	**0.42**	**4.17**	**0.14**	**4.99**	**0.5**	**4.55**	**0.45**	**4.55**	**0.45**
		Rural settlement/Village		**56.94**	**5.65**	**63.19**	**6.27**	**64.6**	**6.41**	**55.84**	**5.5**	**57.2**	**5.67**	**60.36**	**5.99**
		Township/city		**15.07**	**1.49**	**15.94**	**1.58**	**16**	**1.58**	**16.51**	**1.6**	**16.2**	**1.6**	**15.65**	**1.55**
			Air strip	**0.04**	**0**	**0.04**	**0.003**	**0.04**	**0**	**0.04**	**0**	**0.04**	**0**	**0.04**	**0.003**
			Ash pond	**2.86**	**0.28**	**2.86**	**0.28**	**2.85**	**0.28**	**2.86**	**0.3**	**2.85**	**0.28**	**2.85**	**0.28**
			Cooling Tower	**0.4**	**0.03**	**0.41**	**0.04**	**0.37**	**0.03**	**0.92**	**0.1**	**0.43**	**0.04**	**0.44**	**0.04**
			New layout	**1.84**	**0.18**	**1.68**	**0.17**	**2.21**	**0.22**	**2.35**	**0.2**	**2.2**	**0.22**	**2.22**	**0.22**
			Open/vacant land	**1.59**	**0.16**	**1.44**	**0.14**	**1.7**	**0.17**	**5.18**	**0.5**	**1.57**	**0.16**	**1.54**	**0.15**
			Public & Semi public	**0**	**0**	**0**	**0**	**0**	**0**	**0.23**	**0**	**0**	**0**	**0**	**0**
			Thermal Station	**4.31**	**0.42**	**4.06**	**0.4**	**4.05**	**0.4**	**3.26**	**0.3**	**4.3**	**0.43**	**4.3**	**0.43**
			Solar Plant	**0**	**0**	**0**	**0**	**0**	**0**	**0.23**	**0**	**3.09**	**0.3**	**2.85**	**0.28**
			Total Built Up land Area	**88**	**8.7**	**94**	**9.3**	**96**	**9**	**92**	**9**	**92**	**9**	**95**	**9.4**

3	**Agricultural land**	Cropland	Agriculture Double crop	**241.3**	**23.96**	**241.33**	**23.96**	**215**	**21.4**	**216.7**	**22**	**219**	**21.8**	**219.3**	**21.78**
			Fallow	**219.95**	**21.84**	**217.08**	**21.55**	**221**	**21.9**	**211.9**	**21**	**213**	**21.2**	**214**	**21.21**
			Agriculture Single crop	**104.04**	**10.33**	**116**	**11.52**	**124**	**12.3**	**134.1**	**13**	**124**	**12.3**	**114.1**	**11.33**
		Plantation	Cashew Plantation	**167.32**	**16.62**	**166.07**	**16.49**	**167**	**16.5**	**153.1**	**15**	**158**	**15.7**	**154.7**	**15.36**
			Plantation	**14.71**	**1.46**	**14.43**	**1.43**	**14**	**1.39**	**18.13**	**1.6**	**14.6**	**1.44**	**14.57**	**1.45**
			Plantation/Horticulture	**1.54**	**0.15**	**3.42**	**0.33**	**3.72**	**0.36**	**1.5**	**0.1**	**1.5**	**0.15**	**3.98**	**0.39**
			Total Agricultural Land Area	**749**	**74**	**758**	**75**	**744.7**	**74**	**736**	**73**	**730**	**73**	**720**	**72**

4	**Forest Land**		Forest land with Plantation	**33.92**	**3.37**	**37.41**	**3.71**	**34.7**	**3.45**	**36.56**	**3.6**	**36.6**	**3.64**	**37.72**	**3.75**
			Forest land without Plantation	**5.4**	**0.54**	**2.7**	**0.27**	**5.4**	**0.54**	**2.44**	**0.2**	**2.7**	**0.27**	**2.7**	**0.27**
			Total Forest land area	**39**	**3.9**	**40.1**	**4**	**40**	**4**	**39**	**4**	**39**	**3.9**	**40**	**4**
5	**Wasteland**		Barren rock	**0.87**	**0.08**	**1.08**	**0.1**	**0.97**	**0.09**	**0.83**	**0.1**	**0.87**	**0.08**	**0.87**	**0.08**
			Gullied/Ravenous land	**0.21**	**0.02**	**0.27**	**0.02**	**0.24**	**0.02**	**0.21**	**0**	**0.21**	**0.02**	**0.23**	**0.02**
			Land with scrub	**2.92**	**0.29**	**4.29**	**0.42**	**4.31**	**0.43**	**9.72**	**1**	**2.92**	**0.28**	**2.92**	**0.29**
			Land without scrub	**2.05**	**0.2**	**5.64**	**0.56**	**2.05**	**0.2**	**2.26**	**0.2**	**2.05**	**0.2**	**2.05**	**0.2**
			Total Wasteland area	**6.1**	**0.6**	**11**	**1.1**	**8**	**1**	**13**	**1**	**6**	**1**	**6.1**	**0.6**
6	**Water bodies**		River	**12.04**	**1.19**	**12.04**	**1.19**	**12**	**1.19**	**11.99**	**1.2**	**12**	**1.19**	**12.04**	**1.19**
			River with water	**2.06**	**0.2**	**0.09**	**0.01**	**0.32**	**0.03**	**0.06**	**0**	**0.09**	**0.01**	**1.27**	**0.13**
		Canal		**2.41**	**0.24**	**2.47**	**0.25**	**2.52**	**0.25**	**2.41**	**0.2**	**2.38**	**0.24**	**2.38**	**0.24**
		Stream		**0.15**	**0.01**	**0.15**	**0.01**	**0.15**	**0.01**	**0.15**	**0**	**0.15**	**0.15**	**0.15**	**0.01**
		Tank		**6.96**	**0.69**	**7.72**	**0.77**	**7.72**	**0.77**	**24.84**	**1.5**	**7.97**	**0.79**	**7.96**	**0.79**
			Dry tank	**11.08**	**1.1**	**11.21**	**1.11**	**11.2**	**1.12**	**13.48**	**1.5**	**12**	**1.19**	**9.87**	**0.98**
			Tank with Water	**2.12**	**0.21**	**5.38**	**0.53**	**18**	**1.79**	**0.89**	**1.1**	**11.2**	**1.12**	**23.77**	**2.36**
			Tank with vegetation	**3.5**	**0.35**	**4.27**	**0.42**	**4.29**	**0.4**	**1.48**	**0.2**	**3.8**	**0.3**	**2.47**	**0.25**
			Total w.b area	**40**	**4**	**43**	**4.3**	**56**	**6**	**55**	**6**	**50**	**5**	**60**	**6**
			Total	**1007**	**100**	**1007**	**99**	**1007**	**100**	**1007**	**100**	**1007**	**100**	**1007**	**100**

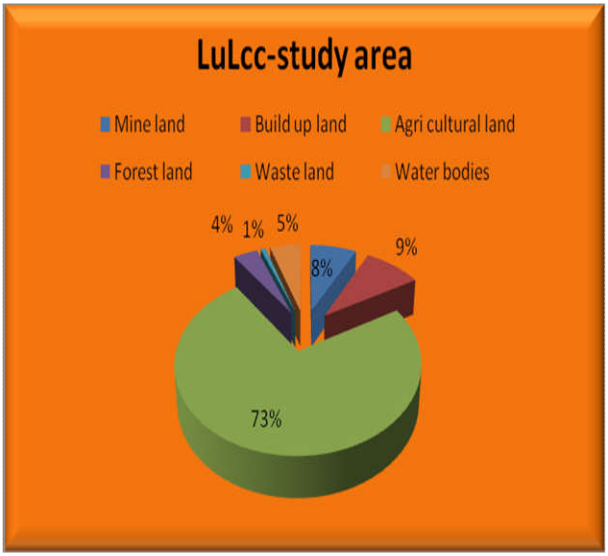

Figure 3. Percentage of Land use Land cover Classes of study area

Table 3 Study Area for Classification							
S. No	Land use /Landcover Classes	Area in Sq.km					
		2011	2012	2014	2016	2018	2019
1	Agri cultural land	748.87	758.33	744.65	735.51	731.41	720.28
2	Forest land	39.32	40.11	40.11	38.99	39.32	40.44
3	Mine land	85.74	60.6	62.86	71.86	88.4	85.63
4	Build up land	87.66	93.84	95.95	92.41	92.44	94.84
5	Water bodies	40.33	43.33	56.27	55.3	49.68	59.96
6	Waste land	6.05	11.28	7.57	13.03	6.06	6.08
	TOTAL	1007					

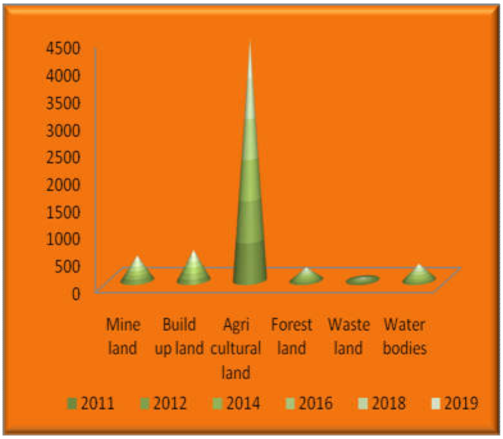

Figure 4. Land use /Land cover classes for study area

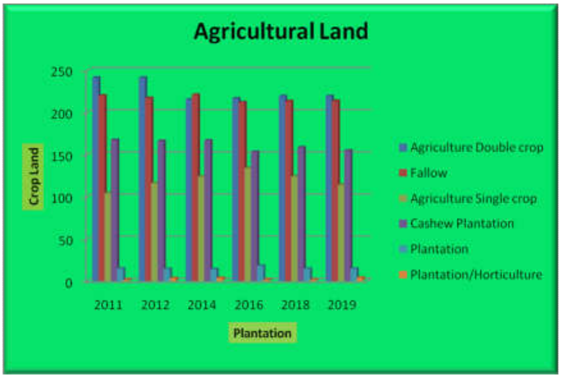

Figure 5. Land use Land Cover comparison of Agricultural Land

4.2.2. Forest Land

Forest areas are sub-classified into forestland with Plantation and forestland without Plantation. The land use/land cover comparison of forest area between the year 2011 and 2019 are shown in figure 6. The forestland without plantation is decreased from 5.4 sq. km in 2011 to 2.7 sq. km in 2019. The forestland with plantation exposes gain from 33.92 sq. km in 2011 to 37.72 sq. km in 2019.

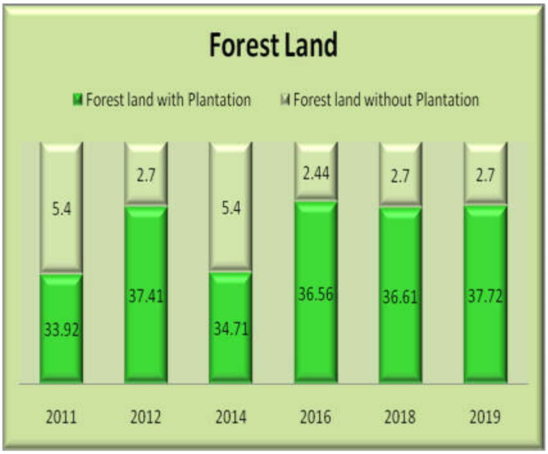

Figure 6. Land use Land Cover comparison of Forest Land

4.2.3. Mine Area

Analysis of the contributions to the land use/land cover changes in the mines area is very important to this study. The mining area is further sub-classified into External Mining Dump, Internal Mining Dump, and Mining Area.

i) External Mining Dump

The external mine dump is further classified into fresh mine dump, afforestation, afforestation/nursery plantation, and old mine dump. Shows the land use/land cover variation of external mining dump. The fresh mine dump area is decreased from 7.01 sq. km in 2014 to 5.51 sq. km in 2016. The old mine dump area is increased from 19.98 sq. km in 2011 to 24.72 sq. km in 2019. Within these ten years, the afforestation class is decreased drastically from 10.87 sq. km in 2016 to 2.68 sq. km in 2019. Afforestation / nursery plantation is declined from 1.49 sq.km to 4.01sq.km (Fig 7).

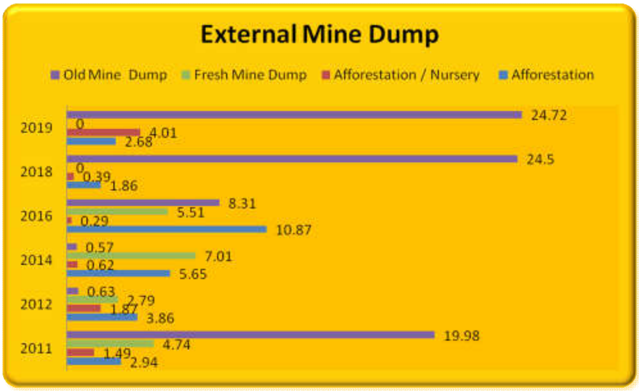

Figure 7. Land use Land cover comparison of External Mine Dump

ii) Internal Mining Dump

The internal mine dump is further classified into fresh mine dump, afforestation, afforestation/nursery plantation, and old mine dump. It can be observed that the internal mine dump area has been experienced losses at the expense of 8.79 sq. km (Fig 8), between the years 2011 and 2019. The fresh mine dump area increased drastically from 7.14 sq. km in 2011 to 21.14 sq. km in 2018, and it decreased from 14.04 sq. km in 2014 to 11.02 sq. km in 2016. The old mine dump is declined from 16.96 sq. km in 2011 to 16.87 sq. km in 2019. Within these ten years, the afforestation region gradually decreases from 6.21 sq. km in 2011 to 4.76 sq. km in 2019. Afforestation/nursery plantation is also declined from 1.78 sq. km in 2011 to 0.44 sq. km in 2019. Reclamation area was increased from 0.27 sq.km in 2014 to 1.03sq.km in 2019.

iii) Mining Area

The spatial variation between 2011 and 2019 exhibits, gain of 3.98 sq. km in the mining area. Mines are categorized into lignite beds, lignite stockyards, mine benches, tanks within afforestation area, mined-out area, reclamation area, and waterlogged area. The land use/land cover variation of mining area between the year 2011and 2019 are shown in figure 9. The results of the comparison study show that the Mined out area has been contracted from 11.24sq.km and 3.99 sq. km in 2011, and 2014 to 5.39 sq. km and 2.38 sq. km in 2016 and 2018. Consequently, mines benches are also increased from 11.39 sq. km in 2016 to 11.47 sq. km in 2018.

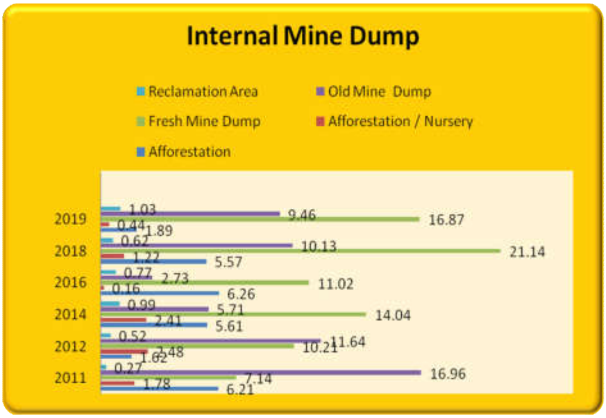

Figure 8. Land use Land cover comparison Internal Mine Dump

On the other hand, the lignite stockyard is occupying 0.79 sq. km in 2011, which increased to 1.33 sq. km in 2019. Lignite bed expresses a gain of 0.65 sq. km from 2011 to 2019 and a loss of 0.60 from 2018 to 2019. Tanks within afforestation have been developed in the mines for irrigation purposes, showing 1.29 sq. km in 2011, while in 2019 it increased to 1.53 sq. km.

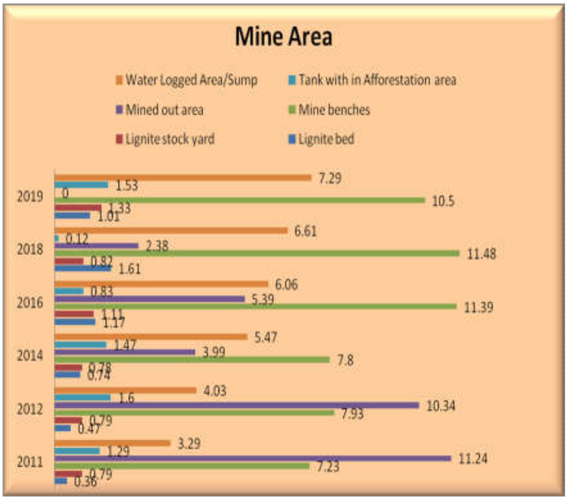

Figure 9. Land use Land covers comparison of Mine Area

4.2.4. Built upland

Built-up area is sub-classified into Township, Rural settlement, Industrial area, Rehabilitation settlement, Vacant land, Thermal station, and Ash Pond. The built-up land category of the study area expresses no major variation from 2011 to 2019. It occupies 15.07 sq. km in 2012 and is 16.51 sq. km in

2016. In general, this category contributes 17.86 % of the spatial extent of the land use/land cover of 2016. The land use/land cover distribution of built-up area from the year 2011 to 2019 is shown in figure 10. The result of the study shows that the township area is spread for 16.51 sq. km and contributed 17.91 % during 2016 within the built upland category. Rural settlement increases from 56.94 sq. km in 2011 to 64.55 sq. km in 2014 with a gain of 7.61 sq. km and increased from 55.84-sq.km in2016 to 60.36 sq. km in 2019. While the Industrial areas are increased from 4.6 sq. km in 2011 to 4.99 sq. km in 2016 and the same 4.55 sq. km was prevailed in 2018 and 2019. It is observed that there is again in cooling tower and solar plant and loss in Airstrip, Ash pond, new layout, open space / vacant land, and public / semi-public utility from 2011 to 2019.

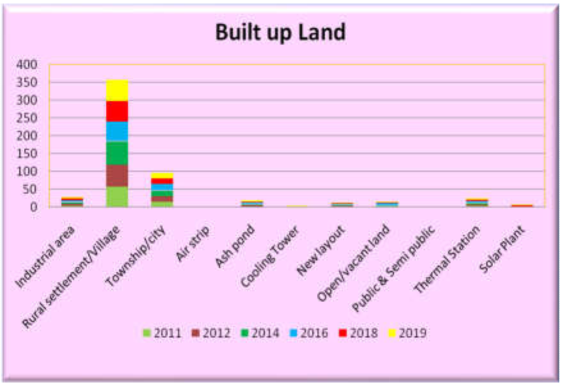

Figure 10. Land use /Land cover comparison of Built up Land

4.2.5. Water Bodies

The category of water bodies covers a total of 59.9 sq. km (2019). This occupies 5.94 % of the study area. It is increased from 40.3 sq. km (2011) to 59.9 sq. km and expresses the gain of 19.6 sq. km during 2019. The comparison of this category is shown in Figure 11. As increased status found in riverbed vegetation due to seasonal effects, tank with vegetation decreased its areal spread to 1.03 sq. km in 2019. The water body category covers a total of 59.9 sq. km.

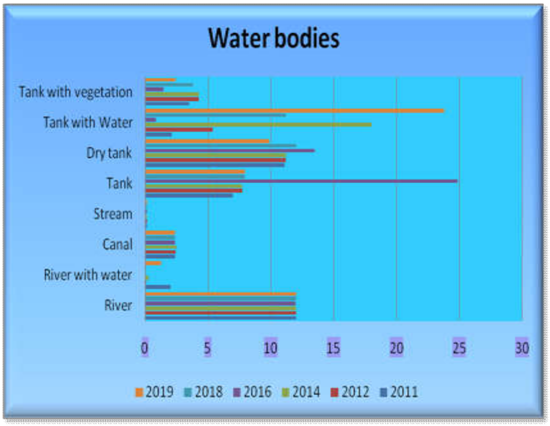

Figure 11. Land use Land Cover Comparison of Water bodies

4.2.6. Waste Land

The wasteland categories are sub-classified into land with scrub, a land without scrub, barren land, and Gullied / Ravenous land. The land use/land cover comparison of the wasteland category of the year from 2011 to 2019 is shown in figure 12. It occupies 2.92 sq. km during 2011 and it is increased to 9.72 sq. km with a loss of 6.8 sq. km in 2016. The study reveals that the land with the scrub area is increasing from 2.92 sq. km to 9.72 sq. km for the period of 2011 to 2016. The land without scrub has also expressed a significant difference and loss of 3.59 sq. km when compared with 2011 data. There are not many changes were noticed in the other categories.

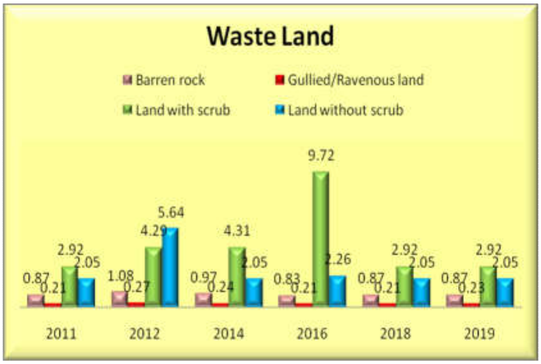

Figure 12. Land use Land Cover Comparison of Waste Land

5. Conclusion

Dynamic Land use and land cover change detection Map of the study was carried out for the total area of 1007.sq.km of Neyveli region using Geospatial Techniques and Geographical Information System techniques were used to was very much useful in identifying the fine details. The Land uses of the study area were compared from 2011, 2012, 2014, 2016, 2018 to 2019 and the comparative study indicates that various dynamic land-use changes and their positive impact on the total study area and mining area. The highest of the six classes is agricultural land, which covers an area of 73% (Fig.3). Forestland occupies the least amount of areal extent with 4% among the classes. The remaining categories like Mines area, Built-up land, Water bodies, and Wasteland is covering an area of 8%, 9%, 5%, and 1% respectively. The outcome of the study would be more useful for future planning and maintaining the sustainability of land in and around the Neyveli Lignite mine area.

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