LAND COVER CHANGE ASSESSMENT USING MULTITEMPORAL DATASETS OF TANINTHARYI REGION, MYANMAR

Khin Mar Yee[1], Thida Win[2], Khin Maung Soe[3], Wah Wah Soe[4], Myint Myint Nyein[5], Naw Kalay Phaw[6], Saw Yu Nadai[7], Nway Nway Latt[8], Phyo Kyaw[9]

[1] Professor, Department of Geography, Myeik University
[2,3] Associate Professor, Department of Geography, Myeik University
[4.5,6] Lecturer, Department of Geography, Myeik University
[7,8] Tutor, Department of Geography, Myeik University
[9] GIS expert, independent researcher

ABSTRACT

Most of the land cover change assessments are usually done on multitemporal datasets of satellite images. This paper is tried to prove to make datasets and mapping of forest cover for change assessments of the Tanintharyi Region. The main data is ten satellite images from the United States of Geological Survey (USGS) with less than 10 percent cloud cover. The maximum likelihood of the supervised classifier is applied in this study to detect land cover changes from Landsat 5 and Landsat 8 images. The forest cover is classified into six major classes viz. closed forest, open forest, other wooden lands, mangrove forest, water, and others. Change matrix, and the net change analysis was performed to compare the changing area of forest cover class conversions for 10 years. The results show the negative hot spot or deforestation area and the positive bright spot of reforestation in the study area.

KEYWORDS: Tanintharyi Region, forest cover change, change assessments, change matrix, the net change

INTRODUCTION

Land Cover (LC) changes play an important role in the planning of regional, local, and global environmental change (Gupta & Munshi, 1985; Mas, 1999). Since the past 100 years, the human population and its influence have increased exponentially on land. Human activities on the Earth's surface result in changes in the land cover. These changes significantly affect key aspects of Earth system functioning (including the balance of energy, water, and soil). Moreover, the pressure on limited natural resources, which is caused by an increase in population, contributes to changes in the land surface cover (Islam et al., 2018). Land cover refers to how the Earth's surface is covered by forests, wetlands, impervious surfaces, agricultural, and other types of land and water (Prakasam, 2010). Land use refers to how humans use the landscape, whether for development, conservation, or mixed uses. Land use includes recreation areas, wildlife habitats, agricultural land, and built-up land (Reis, 2008). Currently, numerous techniques are available for assessing and detecting LULC changes. Among them, remote sensing technology and GIS provide robust tools for acquiring accurate and timely information on land use patterns and their changes (Arveti et al., 2016; Mamun et al., 2013). Remote sensing applications allow land changes to be studied within a limited time and at a low cost. Numerous methods have been developed by many researchers to review changes in the LULC (Singh, 1989) including multi-temporal composite image change detection (Carmelo et al., 2012; Eastman & Fulk, 1993). on-screen digitization of change (Sreedhar et al., 2016), vegetation index differencing, and post-classification change detection (Belal & Moghanm, 2011; Courage et al., 2013; Kafi et al., 2014). The main contribution of this article is to multi-data analyze the LC in Tanintharyi Region without Myeik Island from 2005 to 2015 by using multi-temporal Landsat imagery. The main intention of this study is to determine the human activities' pressure and changes

within the environment. This study specifically focused on interpreting the changes in the land cover through satellite imagery with the ground check survey. Based on the sample, the maximum likelihood of the supervised classification method is applied with the six land cover classes. The resulting LC maps obtained after the classification are then compared spatial and temporal changes. Band combination of spatial analysis defines the changes in LC classes between 2005 and 2015.

STUDY AREA

Tanintharyi Region is an administrative region of Myanmar, covering the long narrow southern part of the country on the Kra Isthmus. It borders the Andaman Sea to the west and the Tenasserim Hills, beyond which lies Thailand, to the east. To the north is the Mon State. The study area covers an area of 369173.9 km² and had a population of 1,406,434 at the 2014 Census.

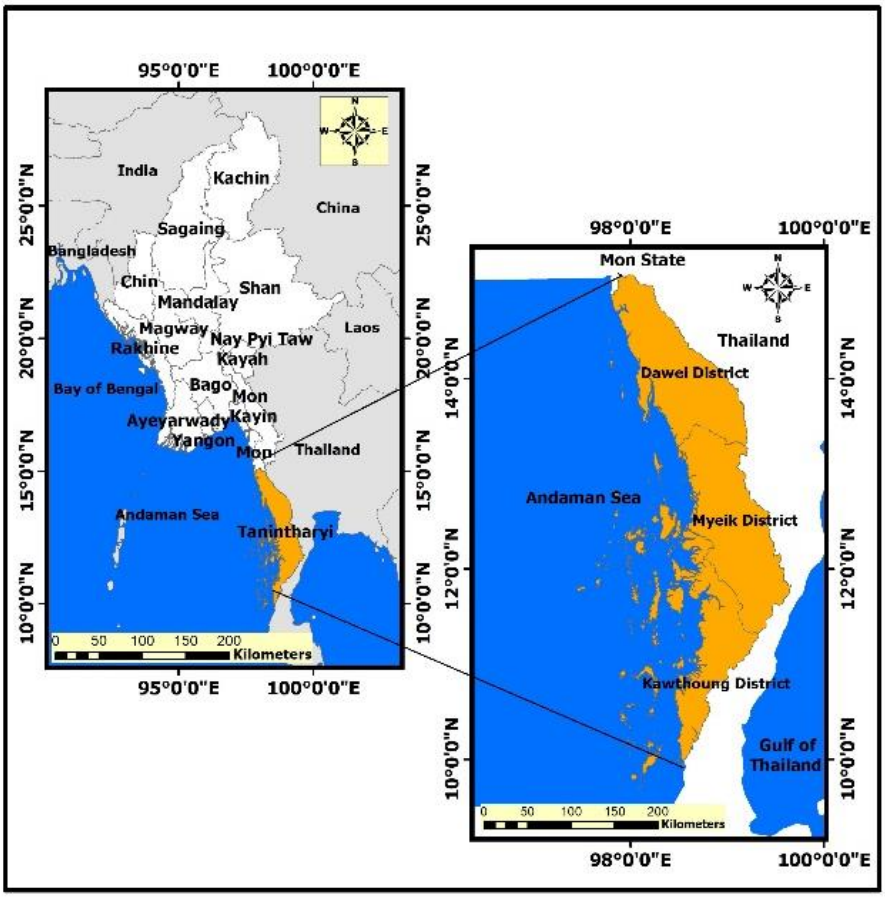


Figure 1. The Location of Tanintharyi Region

OBJECTIVES

-To present the spatial and temporal changes of land cover classification
-To study the image combination and data arrangement
-To analysis on the dataset of the spatial and multitemporal changes

DATA AND METHODOLOGY

The main data based on the satellite image and the sample survey data according to the national land cover classification. Figure 2 shows the selected image of the study area in 2005 and 2015 with the least cloud cover. Table 1 is the definition of National land cover classification. The study area has six land cover classes. They are closed forest, open forest, other wooded land, others, water, and mangrove forest.

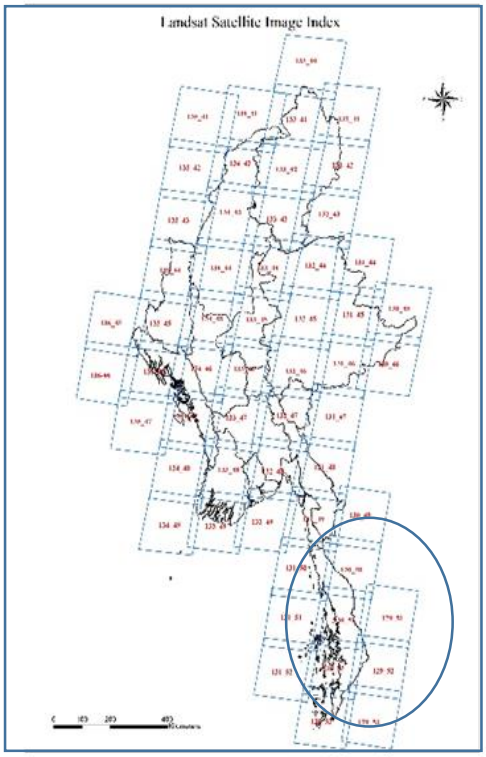


Figure 2. selection satellite image for the study area

Table 1. National Land Cover Classification

No.	National LULC Categories	Definition
1	Closed Forest	Under forestry or no land use, spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of more than 40 percent, or trees able to reach the threshold in situ.
2	Open Forest	Under forestry or no land use, spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover between 10 and 40 percent, or trees able to reach these thresholds in situ.
3	Other wooded land	Areas mostly covered by grassland and stunted trees, shrub forests, lower than 10% crown density.
4	Cropland	Permanent agriculture areas, mostly from plains and valleys. In some cases, it is mixed with shifting cultivation
5	Other lands	Other areas (rock, bare land, sandbanks)

No.	National LULC Categories	Definition
6	Settlement	This category includes all developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories.
7	Wetlands	This category includes areas of peat extraction and land that is covered or saturated by water for all or part of the year.
8	Mangroves	Area covered by Mangrove tree species as interpreted from satellite imagery and aerial photographs
9	Snow	Lands cover by snow, especially snowcap mountain areas.
10	Water	Inland water bodies, lakes, reservoirs, large streams, and rivers.
11	Grasslands	Lands cover by herbaceous vegetation with< 10% of tree cover and <10% of shrubs cover.

Source: Definition of National Land Cover Classification

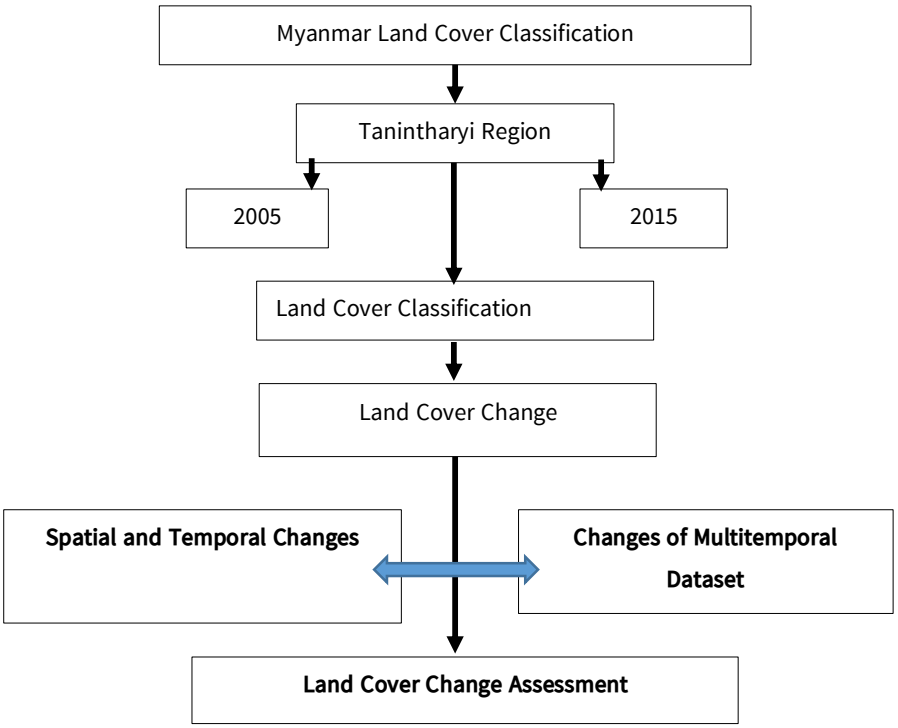


Figure 3 Workflow

The figure is the workflow of this research work. There are three main processes to approach the destination. First, the extract by mask gets from the study area from the LC of Myanmar for 2005 and 2015. The second step is the combination of the two raster images. Third step is the change assessment of spatial and temporal multi-data of the Tanintharyi Region.

RESULTS AND DISCUSSION

Forest cover change assessments are usually done on multitemporal datasets of satellite images. Normal rules are 1) The interpreter must be the same person, 2) Satellite data specification, etc. must be the same. However, this paper tried to pave a new way how to use already interpreted datasets of Forest Cover for change assessments of the Tanintharyi region. The two datasets are the

main core data of the Global Forest Resources Assessment (2005) and (2015). The forest cover is classified into six major classes viz. closed forest, open forest, other wooden lands, mangrove forest, water, and others. Change matrix, and the net change analysis was performed to compare the changing area of forest cover class conversions for 10 years. The results show the negative hot spot or deforestation area and the positive bright spot of reforestation from 2005 to 2015.

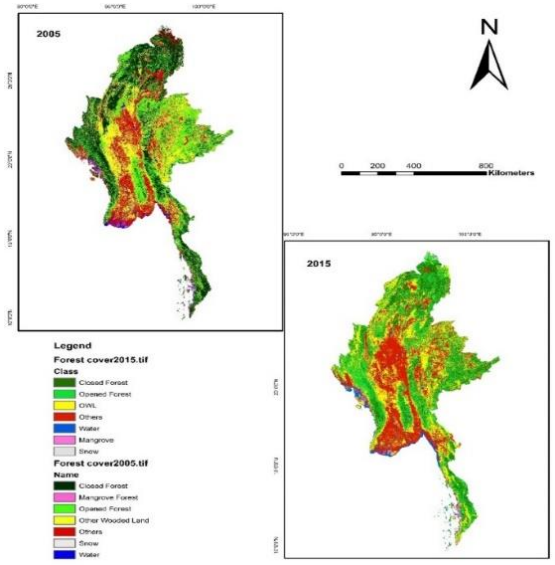


Figure 4. Land Cover of 2005 and 2015 in Myanmar

Figure 4 shows the classes of LC for 2005 and 2015 in Myanmar. There are seven types of LC classes; closed forest, opened forest, other wooded land, others, water, snow, and mangrove forest. The study area is extracted by a mask from the LC classes of Myanmar. The output maps are the LU class of the Tanintharyi Region for two periods. Figure 5 is the spatial and temporal conditions of LU classes in the study area. The visualization of LU classes closed forest is changed to open forest and other wooded lands. These changes are made the multi-data with the combination process.

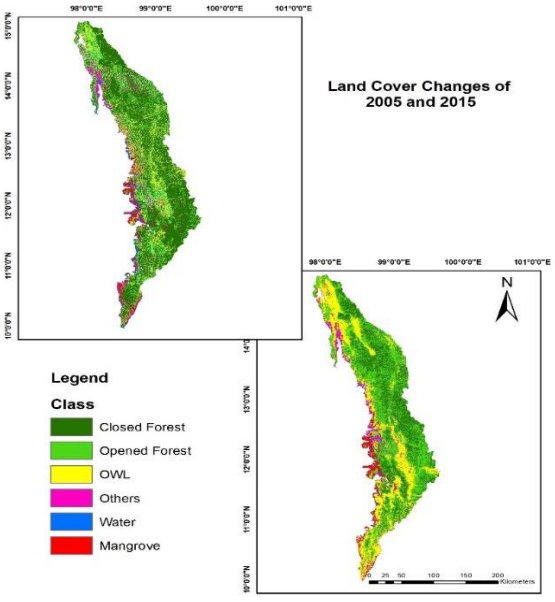
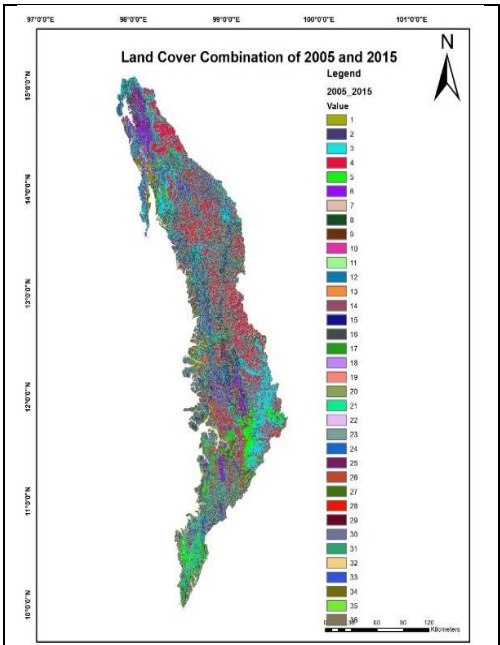


Figure 5. Land Cover Classification (2005 and 2015)



OBJECTID	Value	Count	2005	2015	Area(Sq_km)
1	1	1896160	2	1	1706.54
2	2	4342990	2	2	3908.69
3	3	9468804	1	2	8521.92
4	4	8244581	1	1	7420.12
5	5	4258838	1	3	3832.95
6	6	3659991	2	3	3293.99
7	7	605161	4	1	544.64
8	8	1193961	4	2	1074.56
9	9	1087714	4	3	978.94
10	10	565028	5	2	508.53
11	11	730849	5	3	657.76
12	12	243705	5	1	219.33
13	13	399067	2	4	359.16
14	14	253378	4	4	228.04
15	15	351518	1	4	316.37
16	16	79381	7	2	71.44
17	17	138789	3	3	124.91
18	18	133919	3	2	120.53
19	19	109215	1	5	98.29
20	20	243765	1	6	219.39
21	21	145345	2	6	130.81
22	22	93010	4	6	83.71
23	23	97062	3	4	87.36
24	24	51451	7	4	46.31
25	25	33717	3	1	30.35
26	26	189774	7	3	170.80
27	27	329244	3	6	296.32
28	28	13675	7	1	12.31
29	29	84106	2	5	75.70
30	30	880290	7	6	792.26
31	31	110173	7	5	99.16
32	32	327174	3	5	294.46
33	33	63967	4	5	57.57
34	34	441838	5	4	397.65
35	35	92796	5	6	83.52
36	36	58883	5	5	52.99

Figure 6. The Output of Band Combination (2005 and 2015)

Figure 6 shows the output of band combination and attribute table of changes of band combination. The attribute table shows the changes in the combination of LC during the periods of 2005 and 2015. The attribute saves with the dbf file to transfer for the change matrix and net change table by using of creation of a pivot table. The data replacement of row and column, the result receives the LC statistic changes of 2005 and 2015. The outcome table can be seen in Table 3.

Table 3. Change Matrix of Land Cover Classification (2005-2015)

		2015 (sq km)						
2005 (sq km)		**Closed Forest**	**Opened Forest**	**OWL**	**Others**	**Water**	**Mangrove Forest**	**Grand Total**
	Closed Forest	**74201.2**	85219.2	3163.7	982.9	38329.5	**2193.9**	**204090.5**
	Open Forest	17065.4	**39086.9**	3591.6	757.0	32939.9	1308.1	**94748.9**
	OWL	303.5	1205.3	**873.6**	2944.6	1249.1	2963.2	**9539.1**
	Others	5446.4	10745.6	2280.4	**575.7**	**9789.4**	837.1	**29674.7**
	Water	2193.3	5085.3	3976.5	**529.9**	**6577.6**	835.2	**19197.9**
	Mangrove Forest	123.1	714.4	463.1	991.6	1708.0	**7922.6**	**11922.7**
	Grand Total	**99333.0**	**142056.7**	**14348.8**	**6781.7**	**90593.6**	**16060.1**	**369173.9**

Source: Based on image combination

Table 3 is the change matrix statistic of LC classification for 2005 and 2015. The table shows three colors. The black colour is no change area. The yellow color is no changing area. The red color is a negative change and the green color is a positive change. The data is explained that the closed forest is very large changes to open forest and other wooded lands.

Table 4. Land Cover Net Change (2005-2015)

Land Cover	2005 (sq-km)	2015 (sq-km)	Net Change (sq-km)	Change Assessment
Closed Forest	204090.5	99332.99	-104757	Negative Change
Open Forest	94748.93	142056.7	47307.82	Positive Change
Water	9539.145	90593.6	81054.45	Positive Change
Other Wooded Land	29674.72	14348.83	-15325.9	Negative Change
Others	19197.89	6781.662	-12416.2	Negative Change
Mangrove Forest	11922.7	16060.05	4137.354	Positive Change
Grand Total	369173.9	369173.9		

Source: Based on Change Matrix

Figure 7 and Table 4 represents the net change condition of the LC classification. In 2005, the closed forest area was 204090.5 sq km and 99332.99 sq km in 2015. The open forest increased from 94748.93 sq km in 2005 to 142056.7 sq km in 2015. Other wooded land and other areas decreased 28742.1 sq km between 10 years. Mangrove forest conserved from 11922.7 sq km in 2005 to 16060.05 sq km in 2015.

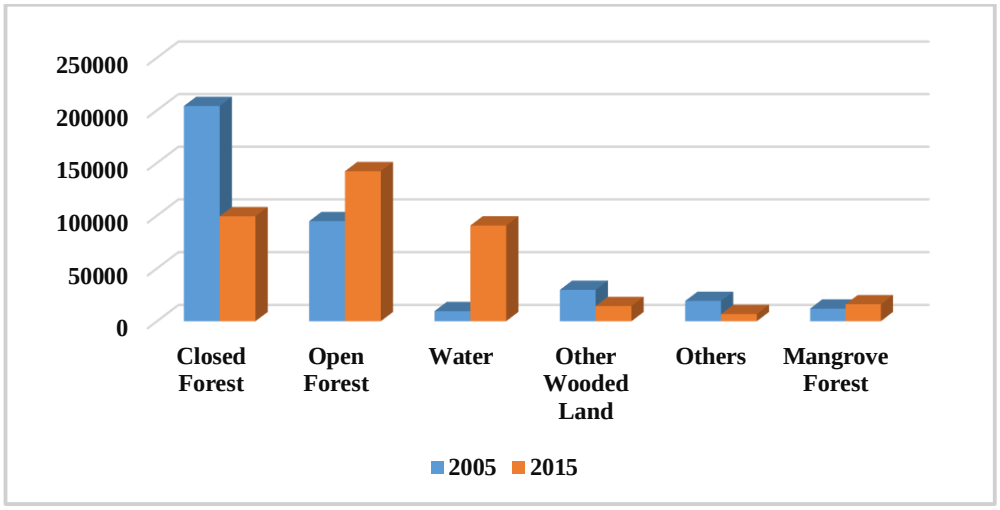


Figure 7. The Changes of LC (2005-2015)

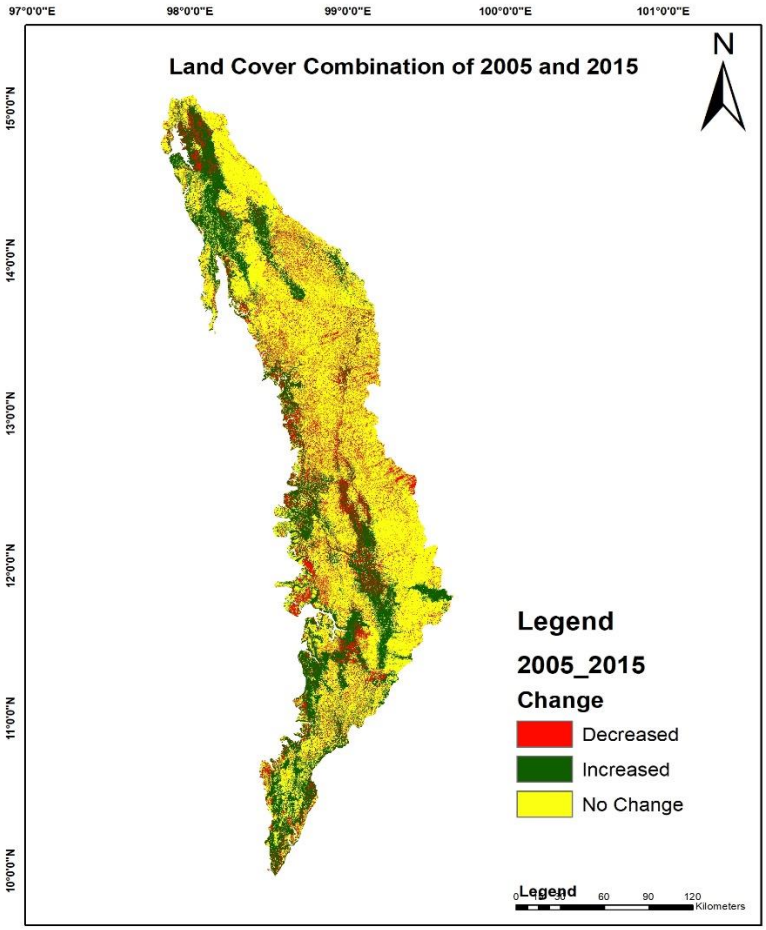


Figure 8. The Spatial Multidata Changes of Study area

The spatial changes in the multi-data assessment displays in Figure 8. There are three datasets of the spatial and temporal changes of the multi-data. They are 1) no changing area, 2) decreased area, and 3) increased area. Among the decreased area, 80 percent is the closed forest area, and these are replaced by the open forest.

CONCLUSION

Tanintharyi Region in the southern coastal strip of Myanmar and bounded by the mountain on the east and by the water body of the west. The natural resources and mineral of sea and land are flourished. The results of spatial and temporal changes are showing the decreasing closed forest and replacing open forest and other wooded lands. The deforestation area is the wider and wider year by year because of human activities. The attribute combination data proved the changing land cover classes within 10 years' period. The net change confirms the spatial and temporal change assessment of land cover classification.

REFERENCES

Arveti, N., Etikala, B., & Dash, P. 2016. Land use/Land cover analysis based on various comprehensive geospatial data sets: A case study from Ananthapuramu area, South India. Advances in Remote Sensing, 5(2), 73–82.

Belal, A. A., & Moghanm, F. S. 2011. Detecting urban growth using remote sensing and GIS techniques in Al Arabiya governorate, Egypt. Egyptian Journal of Remote Sensing and Space Sciences, 14(2), 73–79.

Carmelo, R. F., Giuseppe, M., & Maurizio, P. 2012. Land cover classification and change detection analysis using multi-temporal remotely sensed imagery and landscape metrics. European Journal of Remote Sensing, 45(1), 1–18.

Courage, K., Jonah, G., & Hitomi, M. 2013. Monitoring urban spatial growth in Harare Metropolitan Province, Zimbabwe. Advances in Remote Sensing, 2(4), 322–333.

Eastman, J. R., & Fulk, M. 1993. Land sequence time series evaluation using standardized principal components. Photogrammetric Engineering and Remote Sensing, 59 (6), 991–996.

Gupta, D. M., & Munshi, M. K. 1985. Urban change detection and land-use mapping of Delhi. International Journal of Remote Sensing, 6(3–4), 529–534.

Islam, K., Jashimuddin, M., Nath, B., & Nath, T. K. 2018. Land use classification and change detection by using multi-temporal remotely sensed imagery: The case of Chunati wildlife sanctuary, Bangladesh. The Egyptian Journal of Remote Sensing and Space Sciences, 21(1), 37–47.

Kafi, K. M., Shafri, H. Z. M., & Shariff, A. B. M., 2014. An analysis of LULC change detection using remotely sensed data; a case study of Bauchi City. 7th IGRSM International Remote Sensing & GIS Conference and Exhibition, IOP Conference Series: Earth and Environmental Science, 20. Kuala Lumpur, Malaysia.

Mamun, A. A., Mahmood, A., & Rahman, M. 2013. Identification and monitoring of the change of land use pattern using remote sensing and GIS: A case study of Dhaka City. IOSR Journal of Mechanical and Civil Engineering, 6(2), 20–28.

Mas, J. F. 1999. Monitoring land-cover change: A comparison of change detection techniques. International Journal of Remote Sensing, 20(1), 139–152.

Prakasam, C. 2010. Land use and land cover change detection through remote sensing approach: A case study of Kodaikanal taluk Tamilnadu. International Journal of Geomatics and Geosciences.1, (2), 150–158.

Reis, S. 2008. Analyzing land use/land cover changes using remote sensing and GIS in Rize, North-East Turkey. Sensors, 8(10), 6188–6202.

Singh, A. 1989. Digital change detection techniques using remotely-sensed data. Sensing, 10(6), 989–1000.

Sreedhar, Y., Najaraju, A., & Krishna, G. M. 2016. An Appraisal of land use/land cover change scenario of Tummalapalle, cuddapah Region, India-A Remote Sensing, and GIS Perspective. Advances in Remote Sensing, 5(4), 232–245.