Geospatial Techniques Based Analysis on the Impact of Resettlement on Land Use and Land Cover Change in Esira District, Dawuro Zone, Ethiopia

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Abstract

Resettlement program is considered as a response to tackle the problems of food insecurity, unproductive agriculture, and the ill-being of resettled community. However, large implementation of the program gives rise to socio-economic and environmental related issues particularly natural resource degradation, which causes land use and land cover (LULC) change in the study area. This study was carried out to analyze implication of resettlement on LULC change in Esira district by applying geospatial techniques. Accordingly, to achieve the intended objectives, three sets of Landsat images with different study period were used. Thus, five major LULC classes were identified using maximum likelihood supervised classification techniques. Post classification change detection technique was also used to identify land transformation from one LULC class to other classes. The finding of the study shows that, from 1990 to 2019, there was increment in settlement and cropland with respective values of 11.9% to 32%, and 21.7% to 28%. In expense of this, grassland, forest and bare land were decreased from 29.2% to 14.7%, 26.2% to 16.6% and 12.8% to 8.33%, respectively. Fragmented and unplanned resettlement program would result in natural resource depletion particularly deforestation. So, based on the findings, well-planned resettlement program and sensible land use system is recommended.

Keywords: Esira district, Geospatial techniques, LULC, Resettlement

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Ghana Journal of Geography Vol. 13 (1), 2021 pages 203-220

https://dx.doi.org/10.4314/gjg.v13i1.10

Introduction

Resettlement is voluntary or involuntary movement of people from original place to another new settlement area. It can be spontaneous or planned movement of people from their original dwelling to resettle in a new area where they adapt the social, biophysical, human and administrative system of the new environment (Akpanudoedehe et al., 2010). The socio-economic, environmental and political situations have resulted in population displacement in different parts of the world. According to UNHCR (2010) report, the movement of people from one place to the other has continued rapidly. Africa countries like Kenya, Tanzania, Sudan, Ghana, Senegal, Burkina Faso, Egypt and Ethiopia have practiced planned resettlement. While, several of these schemes done to improve the well-being of resettled community in general and the efforts have unsuccessful expectation. These expectations have been unrealistically high in many cases (Scudder, 2005).

In 1960s, Ethiopian government started state sponsored resettlement program that was implemented in Wollega, Illubabor, Keffa and Sidama. This was meant to reduce the then food insecurity problems and to minimize population pressure on land use (Shumete, 2013). During the Derg regime, the resettlement program further continued though it was characterized by dark spot in the resettlement history due to loss of lives and desertion of thousands (Kassahun, 2000). Furthermore, EPRDF regime embarked up on resettling around 440,000 household (approximately 2.2 million people) that were lived in drought-prone and food insecure areas of Amhara, Oromia, Tigray and Southern Nations Nationalities and Peoples Regional State (SNNPRS) to productive, relatively fertile and less populated parts of Ethiopia (FDRE, 2002). As part of National strategy, SNNPRS government has been undertaking resettlement program by reshuffling residents from zones and districts of high population pressure and shortage of land to the areas where there is relatively productive and low population pressure (Wolde-Selassie, 2003; Masresha, 2008). Thus, those people who come from their original home places lacked agricultural land resulting in crowdedness of large number of people in small piece of land. However, resettlement results in reshaping people's access to natural resource as well as a change in livelihood strategies of host community (Wolde-Selassie, 2003). In this regard, Tesfaye (2007) argued that resettlement is a solution to reducing population pressure on farming land in densely populated areas. This, he further argued would make favorable man-land ratio in sparsely populated areas and promote agricultural productivity by creating prosperous agricultural community as means to achieve self-reliance or food self-sufficiency of affected population.

However, Abbute (2004: 2) warns that, "Hasty execution of the resettlement might have humanitarian and ecological effects. Unless carefully planned, the scheme will diminish the flora; fauna and it will accelerate soil erosion and deplete the ecology." This quote suggests that resettlement results in considerable environmental impacts. This is because as large areas of forest and grasslands are cleared to construct houses, and expands agricultural land to increase their livelihood income. In the study area, those kebeles that were covered by forests, and served as sources of income in bee-keeping, collecting spices, wild fruits and timber production were cleared and the land was distributed among settlers. It also failed to adapt farming practices that fits to the agro-ecological conditions of the area and eventually resulted in change of land use and land cover (EWARDO, 2016).

Land use and land cover (LULC) change can affect socio-economic status of the rural community (Lambin and Giest, 2003). Agricultural productivity, which determines income levels of rural community, can be affected by the consequences of LULC changes. Unwise utilization of land for agriculture, overgrazing and cutting of forest for varieties of purposes including for construction and timber production results in LULC change. Therefore, understanding of the complex interaction of these changes in temporal and spatial patterns is a baseline to formulate policy for resettlement program, resource utilizations and environmental management. Therefore, the aim of this study was to determine the impact of resettlement on LULC change using geospatial techniques.

Methods and Materials

Description of Study Area

This study was conducted in Esira district in Dawuro zone, which is located in Southern Nation Nationality and People Regional State of Ethiopia. The district is found 575kms from Addis Ababa, the capital city of Ethiopia and 350km from Hawassa, the regional capital city. The district shares boundary with the Tocha district to the North, the Loma District to the South, the Mareka District to the East, and the Konta special District to the West. Astronomically Esira District located between $6^0$57' 00" to 7^0 04' 00" North and 36^0 02' 00" to 37^0 16' 00" East (Fig.1).

The topography of the Esira district includes different physical features like valley, plain, hills and mountains. The elevation of the district varies from 549m to 2443m above the sea level (EWARDO, 2016). According to FAO soil classification, the district endowed with 6 different soil types; namely, dystric-fluvisol, dystric-gleysol, dystric-nitisol, eutric-cambisol, leptosol and orthic-acrisols. The mean annual temperature varies from 17.6 to 27.5°C, the average annual rainfall also varies between 1401mm and 1800mm. The shortest rainy season is between February and March whereas the longest is between May and September (EWARDO, 2016). Based on the CSA (2007), Esira district has a total population of 60, 920, of whom 30, 846 were men and 30, 074 were women. The study area is inhabited by several ethnic groups that can be grouped into both indigenous ethnic groups and highlanders' (settlers from other part of the country). The study area is endowed with fertile land, which is suitable for high-value crops, livestock, agriculture, and economically mportant resources like Perennial plants bamboo and another tree. Agriculture is the major means of livelihood in the study area (EWARDO, 2016).

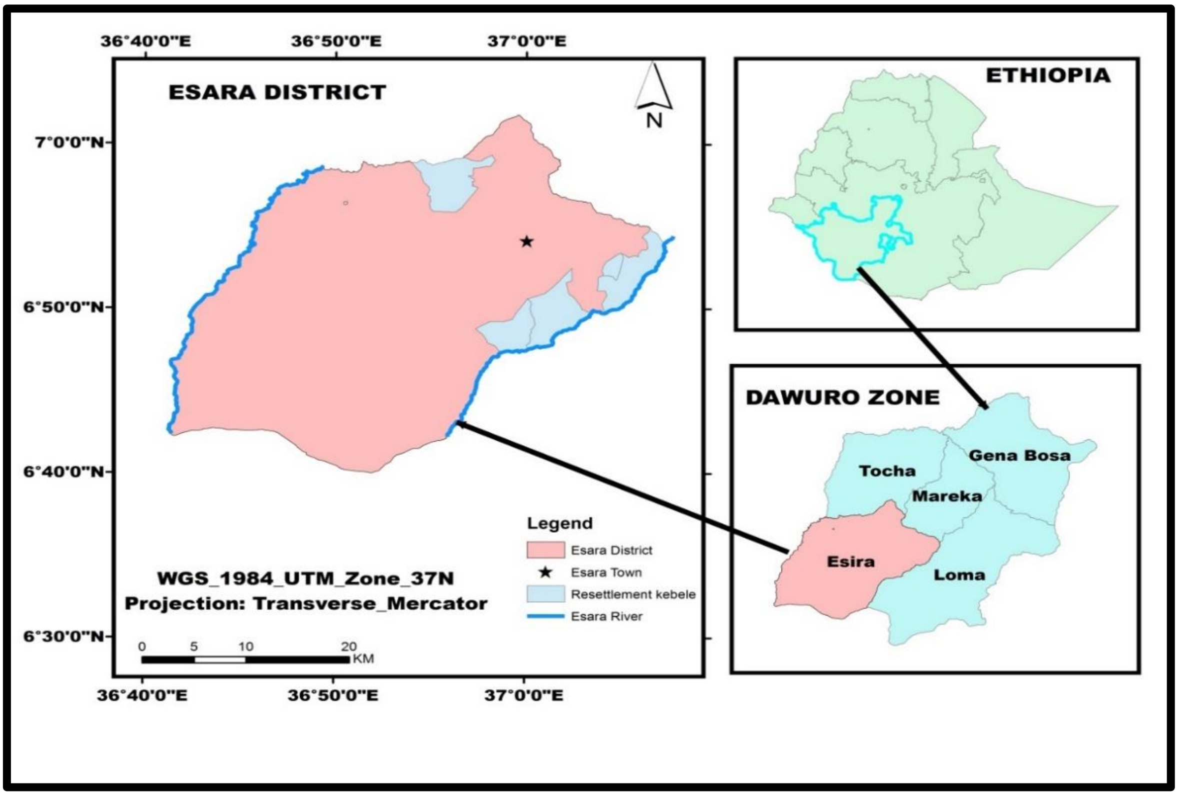

Figure 1: Location map of Esira district of Dawuro zone, Ethiopia.

Data and Materials

In order to achieve the stated objectives of the research study, both primary and secondary data types were used. Accordingly, Landsat imageries, such as Landsat TM (1990), Landsat 7 ETM$^+$ (2000), Landsat 8 OLI (2019), GCP and socio-economic data were used. ArcGIS10.3 was used for clipping, geometric calculation, accuracy assessment and preparation of maps. Similarly, ERDAS Imagine 2015 was also used for sub-setting, geometric and radiometric corrections, image enhancement, layer stacking, and classification of LULC classes (Kindu et al., 2013).

Table 1: Data type and source (Satellite imageries of LULC sources)

Data Type	Date	Source	Use/application
Landsat5 TM	1/5/1990	USGS	LULC map
Landsat7 ETM+	1/5/2000	USGS	LULC map
Landsat8 OLI	15/1/2019	USGS	LULC map
SRTM	-	GLCF	Slope and elevation map
GPS data, FGDs, key informant interview	-	Field survey	Accuracy assessment

Source: Field survey, 2019

Data Collection Techniques

Data collection techniques used for this study were; GPS, FGDs, key informant interview and personal observations. GPS data collection has been applied for accuracy assessment on classified LULC maps of the study area; ground control points (GCP) were taken to perform accuracy assessment of the classification. FGDs, was held with elders and *kebele*[1] leaders and other stakeholders with having a member of 7 to 10 in each group of the cluster. In furtherance, 10 key informants were purposively selected and these were experts working on settlement, risk management, agriculture, land administration, and environmental issues in the district offices of Esira. Alemayehu (2011) indicated that purposive sampling is used primarily when there is a limited number of people that have expertise in the area being investigated. The expert involvement and FGDs in this process was required to get better information about the resettlement held in the district and its impact on LULC change. Field observation was also applied for identifying and understanding the actual change in land use and for recording information about different natural features and sites, by simply observing their characteristics, which are located in the study area. The field observations also support the researchers at the time of determining the scale of the change.

Image processing

Pre-processing of the satellite image before image classification and change detection is very essential because it enhances the image quality or improves the image that shows distortion

[1] *Kebele* is an administrative tier at a grass-root level.

and enhances image relevant for further processing and analysis task (Mather, 2006). This typically involves the initial processing of raw image to correct for geometric distortions and eliminate noise present in the image. Accordingly, haze reduction or radiometric correction and resolution merging were made on raw satellite image using ERDAS imagine. All bands of each satellite images are stacked together and merged with Landsat ETM^+ which is panchromatic with the resolution of (15m) to have better visualization. The logic behind this operation was to change low spatial resolution image to high-resolution image. This would make visual interpretation easier for feature identification and for further analysis. Moreover, to select the best band combination for the identification of the different land cover classes in the study area, the false color composite for Landsat TM bands 4-3-2 (R-G-B), Landsat ETM+ 4-3-2 (R-G-B) and Landsat 8 OLI bands 6-5-4(R-G-B), were used in the identification of five LULC classes. Finally, in order to make the entire images in the similar coordinate system, the three study period images were projected to UTM, Zone 37N, and WGS84.

Supervised classification

In this study, supervised classification based on maximum likelihood algorithm was utilized to classify the satellites images. Supervised classification is the process of using a known identity of specific sites through combination of fieldwork, maps, and personal experience in the area, which represents homogenous examples of land cover types to classify the remainder of the image. These areas are commonly known as training sites (Jensen, 1996). Maximum likelihood classification (MLC) is a better algorithm especially in LULC monitoring approaches. This is because it assumes that images are normally distributed and pixels are composed of a single land cover or land use type. This classification technique quantitatively evaluates both variance and covariance of the classes of spectral response patterns when classifying unknown pixels after computing the probability in each category. The pixel would then be assigned to the most likely class that is to the highest probability values. Each pixel is assigned into the class by highest probability or maximum likelihood (Anderson et al., 2009).

Change detection and Post classification

Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times. Essentially, it involves the ability to quantify temporal effects using multi temporal data sets (Singh, 1989). Digital change detection encompasses the quantification of temporal phenomena from multi-imagery date that is acquired by satellite-based multi-spectral sensors. In general, change detection involves the application of multi-temporal datasets to quantitatively analyze the temporal effects of the phenomena (Lu and Weng, 2007). Many change detection methods have been developed and used for various applications. However, this study used the post-classification change detection method.

Post classification change detection technique uses independently classified image from end of two-time interval in pixel-by-pixel comparison to detect changes in land cover 'from–to' other land cover class. It requires the comparison of independently classified images of the same study area over different times. In addition to the algorithms, which are applied on the classified images to determine the pixels with a change between the two dates, statistics can be compiled to express the specific nature of changes between the two images (Lillesand et al., 2004). The area of change is identified through cross tabulation of two independently classified images. Therefore, analysis of LULC change in the study area was compared based on three satellite images. The percentage of LULC change detection was made using the formula (Kindu et al., 2013):

$$\text{LULC change}(\%) = \frac{(A_{tn} - A_{\text{tn}-1})}{A_{tn-1}} \times 100 \;-\;-\;-\;-\;-\; (\text{Eq. } 1)$$

Where: A_{tn} - area of specific LULC class at time t_n

A_{tn-1} - area of the same LULC class at time t_{n-1}

Classification Accuracy Assessment

According to Congalton and Green (1999), if the information obtained from satellite image is to be used for decision-making process, it is critical that some measure of its quality should be checked. The most obvious types of errors that occur in image classifications are errors of omission or commission (Alebachew, 2011). Accordingly, the classification accuracy of three satellite images; Landsat TM 1990, Landsat ETM+ 2000 and landsat8 OLI 2019 was checked by developing error matrix. Error matrix is a table, which contains rows and columns that indicate the relationship between the classes in the classified image and reference data. The reference data were collected from field survey and extracted from Google earth. The error matrix was obtained from reference data with the help of the application of ArcGIS10.3. Thus, Producer accuracy, user accuracy, overall accuracy and kappa coefficient were computed to assess accuracy of classified images of three different study periods (Table 2, 3, and 4).

Table 2: Confusion matrix (classification accuracy) of Landsat TM: 1990

LULC type	Reference Data					Row Total	Producer Accuracy	User Accuracy
	FL	S	GL	BL	CL			
FL	21	1	2	0	1	25	91	84
S	0	12	0	2	0	14	75	75
GL	2	0	12	1	2	17	80	70
BL	0	1	0	17	0	18	85	94
CL	0	2	1	0	19	22	86	86
Column Total	23	16	15	20	22	96	Overall A = 82%; KC = 0.77	

Where: F - Forest, S - Settlement, GL- Grassland, BL-Bare land, CL – Cropland

Table 3: Confusion matrix (classification accuracy) of Landsat ETM^{+}: 2000

LULC type	Reference Data					Row Total	Producer Accuracy	User Accuracy
	FL	S	GL	BL	CL			
FL	24	0	1	0	1	26	96	92
S	0	17	0	2	0	19	89	89
GL	1	0	14	1	1	17	78	87
BL	0	1	1	15	0	17	75	88
CL	0	1	2	2	23	28	92	82
Column Total	25	19	18	20	25	107	Overall A = 87%; KC = 0.84	

Source: Field survey, 2019

Table 4: Confusion matrix (classification accuracy) of Landsat8 OLI: 2019

LULC type	Reference Data					Row Total	Producer Accuracy	User Accuracy
	FL	S	GL	BL	CL			
FL	27	1	1	0	0	29	96	90
S	0	20	1	1	0	22	86	90
GL	1	1	19	0	1	22	86	86
BL	0	0	1	17	1	19	89	89
CL	0	1	0	1	24	26	92	92
Column Total	28	23	22	19	26	118	Overall A = 90%; KC = 0.88	

Source: Field survey, 2019

User's and Producer's Accuracy

User's accuracy refers to the number of correctly classified pixels in each class divided by the total number of pixels that was classified in that category of the classified image (row total). The user's accuracy of classified Landsat TM 1990, the maximum accuracy was 94% (bare land) which is correctly classified and the minimum accuracy is 75% (settlement) because of reflectance similarity with bare land. Whereas user accuracy of Landsat ETM^{+} 2000 ranged between 92% (forest) and 82% (cropland) more than classified Landsat OLI 2019, the maximum user accuracy is 92% (cropland) and minimum accuracy is 86% (grassland). Producer accuracy is the probability of pixel correctly classified with in the category. It is also known as omission error because it only gives the proportion of the correctly classified pixels. It is obtained by dividing the number of correctly classified pixels in each class divided by the total number of pixels in the reference data to be of that category. The producer accuracy computed for classified Landsat images of TM 1990, ETM^+ 2000 and OLI 2019 ranged between 75-91%, 75-96% and 86-96%, respectively (Table 2, 3, and 4).

Overall Accuracy

The overall accuracy is calculated by dividing the total number of correctly classified pixels (i.e., the sum of the correctly classified pixel class along the diagonal) by dividing the total number of reference pixels. Thus, the overall accuracy computed for classified Landsat images of three-study period (TM 1990, ETM+2000 and OLI 2019) were 82% 87% and 90%, respectively.

Kappa coefficient

The Kappa coefficient, which measures a classification agreement, can also be used to assess the classification accuracy. It expresses the proportionate reduction in error generated by a classification process compared with the error of a completely random classification (ENVI, 2013; Congalton and Green, 1999). The Kappa coefficient (k) is calculated using the information in the error matrix table (Table2, 3, and 4) and using equation given by Congalton and Green (1999).

$$K = \frac{N \sum_{i=1}^{r} x_{ii} - \sum_{i=1}^{r} (x_{i+} * x_{+i})}{N^2 - \sum_{i=1}^{r} (x_{i+} * x_{+i})} - - - - - \text{(Eq. 2)}$$

Where: r = is the number of rows in the matrix; Xii = is the number of observations in rows i and column I (along the major diagonal); Xi+ = the marginal total of row i (right of the matrix); Xi+1 is the marginal totals of column i (bottom of the matrix); N is the total number of observations.

Therefore, to get the kappa coefficient of the classification process, the Congalton and Green (1999), formula is applied.

$$K = \frac{(total * \sum of correct) - \sum of the all (rowtotal * columntatal)}{totalsquared - \sum of the (rowtotal * columntotal)} \text{-------------- (Eq.3)}$$

Kappa's of the classified images were also computed with the same procedure and formula. Accordingly, kappa coefficient of classified Landsat TM image of 1990, ETM+ 2000 and OLI 2019 were 0.77, 0.84 and 0.88, respectively. Thus, the Kappa results of this study showed a strong agreement for each of the 3 classified images and the overall accuracies were within the acceptable range for further LULC change analysis (Kindu et al., 2013).

Results and Discussions

Land Use and Land Cover Changes (1990-2019)

Land use and land cover change is a general term for the modification of Earth's terrestrial surface with natural and human interference to obtain food and other essentials for thousands of years. The current rates, extents, and intensities of LULCC changes are far greater than ever in history; driving unprecedented changes in ecosystems and environmental processes at local, regional and global scales (Ellis, 2010). Considering spectral characteristics of the satellite images and prior knowledge of the area, five major LULC classes were identified. This includes forest, grassland, settlement, cropland and bare land. The identified LULC classes and coverage in each date of images are discussed in the subsequent sections.

Table 5: LULC classes with area in hectare (ha) and percentage (%) of three study period

LULC Type	1990 Area(ha)	%	2000 Area(ha)	%	2019 Area(ha)	%
Forest Land	28315.4	26.2	26439.4	24.5	17964.1	16.6
Grass Land	31497	29.2	23462.5	21.7	15860.4	14.7
Crop Land	23245.7	21.7	29592.4	27.4	30449.9	28
Settlement	12 926.6	11.9	18567.3	17	34547.2	32
Bare Land	11819.4	12.8	9742.3	9.3	8982.3	8.33
Total	107803.9	100	107803.9	100	107803.9	100

Source: Field survey, 2019

The percentage share of settlement and farmland in the study period increased progressively. In 1990, settlement covered 11.9% of the areas, whereas at the end of the study period in 2019 it occupied 32% of the area. Similarly, cropland occupied the second largest share of LULC classes of the study area (Table 5). In contrast, the percentage share of forest and grassland decreased in respective study periods (1990, 2000 and 2019). This indicates settlement and cropland have extensively expanded at the expense of forest and grassland. Similarly, Shiferaw et al. (2011) confirmed that limited access of off-farm activity has made the farmers to involve in clearing of forest for expanding their cultivation land into steep barren and other types of land cover class. Likewise, similar study elsewhere, alarming rate of population growth resulted for the change of land cover class through time (Turner, 2009). Because of extensive expansion of settlement (20.1%) and cropland (6.3%), negatively contributed for the decrease of forest and grassland by 9.6% and 14.5% respectively in the last 3 decades (Table 5).

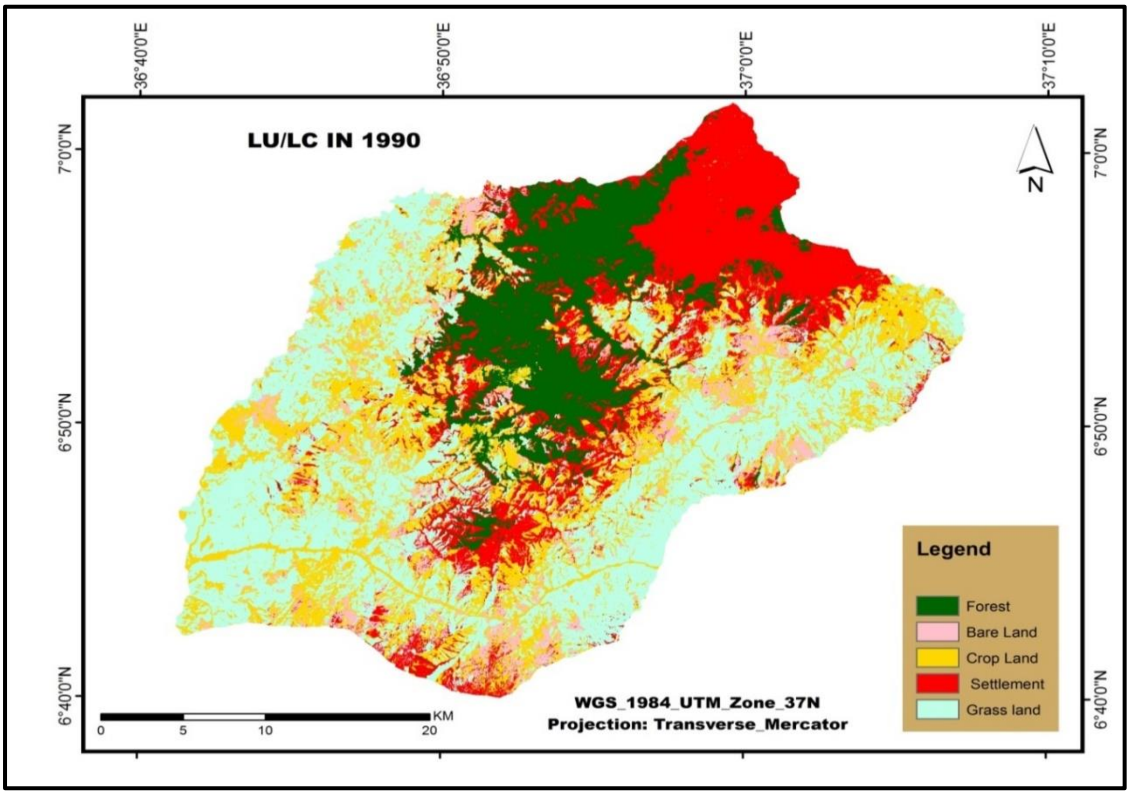

Fig. 2: LULC map of Esira district of Dawuro zone, Ethiopia in 1990.

Land use and land cover classification of 1990 TM satellite image (Fig. 2) shows that, almost half of the study area during this period was covered with grassland which accounts for (29.2%) and forest which accounts (26.2%) of the total area. According to Tesfaye et al. (2014) who grouped both natural forest and synthetic forests under forest category, similarly this study also classified both synthetic and natural forest as one category, which is named forest. Cropland, Settlement and bare land shares 21.7%, 11.9% and 12.8% respectively (Table 5). The idea acquired from elders of the study area during FGDs confirmed that, the most dominant LULC class of study area before the resettlement held was forest and grass land. This included shrubs and bush land but through time the coverage of both forest and grass land decreased as result of growing demand of land for different purpose.

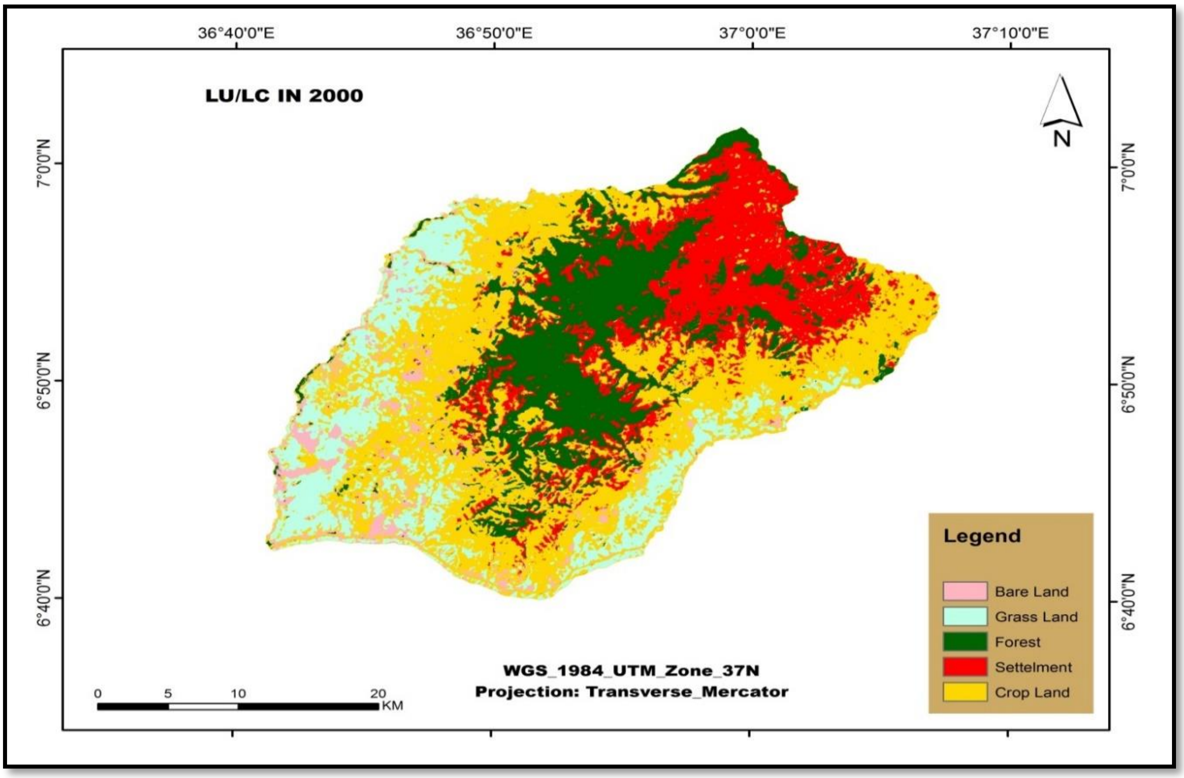

Fig. 3: LULC map of Esira district of Dawuro zone, Ethiopia in 2000.

As Table 5 and Fig. 3 showed, during the second study period (2000) the highest share of the LULC of the study area was covered by crop land (27.4%) followed by forest (24.5%) whereas the remaining classes; grass land, settlement and bare land accounts 21.7%, 17% and 9.03% of total area respectively. According to elders interviewed, the main influencing factor for the change in 2000 was the state sponsored resettlement program implemented in the district. Concurrently, the increased number of populations in the district resulted in high demand for expansion of cropland. Such conversion of forestland into crop production in relation to government and policy changes resulted in the reduction of ecosystem services of forests. Many studies in tropical countries confirm the impacts of government policy on forest due to extensive agricultural policy approach (Li et al., 2007; Hu et al., 2008; Lira et al., 2012).

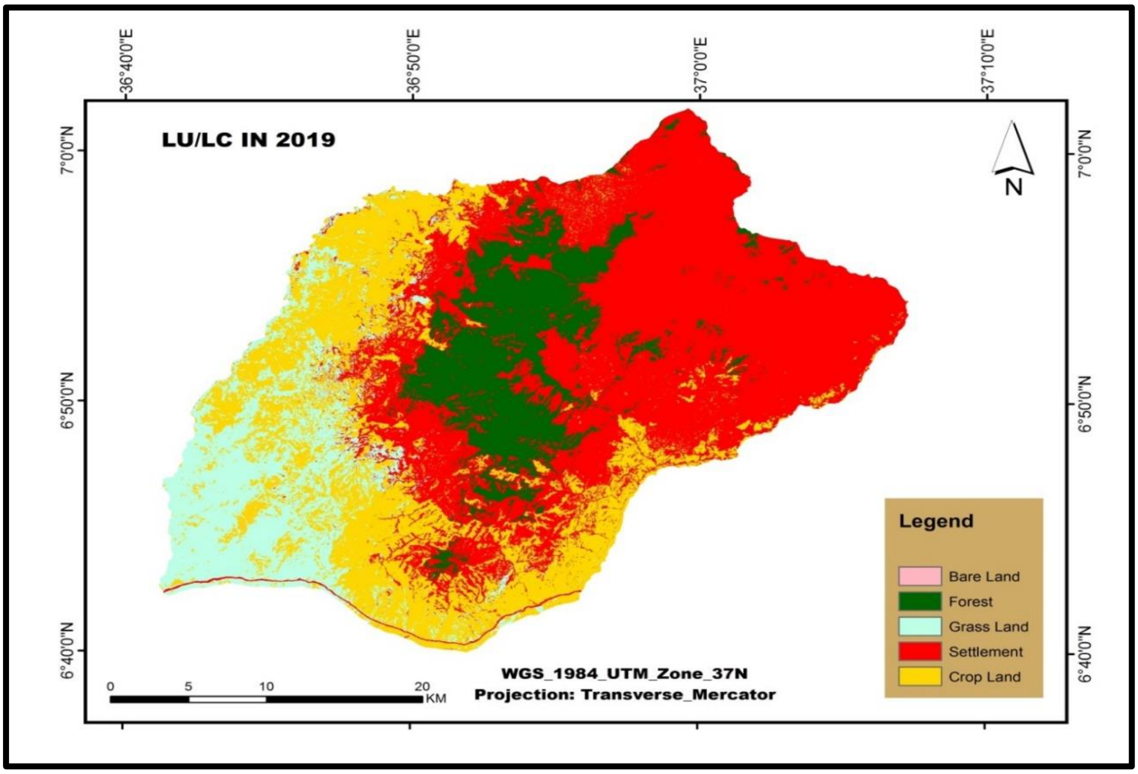

Fig. 4: LULC map of Esira district of Dawuro zone, Ethiopia in 2019.

Land use and land cover classification of the year 2019 (Table 5 and Fig. 4) revealed that settlement covered maximum area which shares (32%), crop land is the second largest class which shares (28%), the area classified under this class includes the area, which is currently covered by perianal and annual crops and cultivated land. Surprisingly, in the previous study periods (1990 and 2000), the coverage of settlement was not more than forest or crop land because of continuous resettlement program over time, the coverage of settlement occupied the largest share during the last stage of study period (the year 2019). The remaining land cover classes such as forest, grassland and bare land shares 16.6%, 14.7%, and 8.33% of the total area, respectively. According to Zeleke and Hurni (2001), expansion of cultivated land at the expense of natural forest cover results in land degradation due to the expansion of cultivated land on steep slopes. In addition to this, key informants added that the expansion of cropland to ward surrounding natural forest affects the poor households who depend on forest as base for their livelihood.

Trends in Transformations between Land Use and Land Cover (1990-2019)

Land use and land cover classification identified from our study across the study period indicated the conversion of one land use classes to other with different range of change. LULC changes are dynamic and nonlinear, that is, the conversion from one land use to the other does not follow a similar pattern (Dessie and Kleman, 2007; Meshesha et al., 2014). This study identified that the transformation of forests land to other land uses is the leading one. In contrary, the dominant land uses that increased progressively over the study period at the expense of forest were settlement, and cropland. For example, settlement increased by 5.1% from 1990 to 2000 and by 15%, from 2000 to 2019 (Table 6). The overall increment of settlement from 1990 to 2019 was 20.1%. On the other hand, forest cover decreased by 10%, between the years 1990 to 2019. This is in conformity with many LULC studies conducted in Ethiopia (Tsegaye et al., 2010; Minale and Rao, 2012; Gebrehiwot et al., 2014; Meshesha et al., 2014).

Table 6: Changes in land use and land cover of Esira district during 1990-2019

LULC	1990-2000		2000-2019		1990-2019	
Type	Area(ha)	%	Area(ha)	%	Area(ha)	%
FL	-1876	-1.7	-8475.3	-7.9	-10351.3	-9.6
GL	-8034.5	-7.5	-7602.1	-7	-15636.6	-14.5
CL	6346.7	5.7	857.5	0.6	7204.2	6.3
S	5640.7	5.1	15979	15	21620.6	20.1
BL	-2077.1	-3.7	-760	-0.7	-2837.1	-4.47

Source: Field survey, 2019

Table 6 shown, between the years 1990 and 2000 grassland, bare land and forest area declined by 7.5%, 3.7% and 1.7%, while cropland and settlement area grew by 5.7% and 5.1% respectively. In the second study period, the increment of settlement area exceeded the others (15%). In contrary, the decrement of forest becomes large (7%) as compared to the first study period. In the later periods, the overwhelming expansion of cropland into forestland and pastureland is to support the population grown at a rapid rate during these periods (Josephson et al., 2014; Bewket, 2007). According to the information obtained from key informant and the satellite image analysis between the years 2000 to 2019 there was state sponsored resettlement, which enforced for dramatic expansion of settlement (18567.3) to (34547.2ha) resulted in decreasing of grassland and forest coverage of the district. The general trend observed in the study area implies a loss of forestland and grassland, while the cultivated areas and settlements area grew. Continued LULC change, coupled with uncertain climatic conditions, greatly affects natural resource and puts the land use system under stress, given the existing demographic changes in the country.

Conclusion

Ethiopia has experienced long history of population movement from environmentally fragile area to more secure and relatively fertile agricultural area. The movement of large number of settlers to a new area without proper planning before resettlement program resulted in LULC change. In this study, five LULC classes were identified including forest, grassland, cropland, settlement and bare land. In the last 29 years LULC dynamics have undergone considerable change in the Esira District. The LULC change analysis showed that farmland and settlement land were expanded. On the other hand, forestland and grassland declined over the study period in the study area.

Based on change detection statistics majority of changes occurred on grassland and forest through the expansion of settlement and cropland. The conversions of forested land and grassland in to cultivated land and settlement in study area were step-by-step and direct style. Crop production farming system and rapid population increment and state sponsored resettlement programs were attributed to the factors shifting of one land use type to other land use type in the study area. Therefore, site-specific community-based awareness on the appropriate use of available resources, the conservation and rehabilitation of environment as well as well-planned land use planning would be very effective for sustainable land use utilization.

Acknowledgment

The authors would like to thank Jimma University for providing grant support, and Esira district governmental officials for providing the necessary data for the success of this study project.

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