Global Scientific JOURNALS

GSJ: Volume 9, Issue 9, September 2021, Online: ISSN 2320-9186
www.globalscientificjournal.com

SALALE UNIVERSITY

IMPACT OF LAND TENURE ON ELLEN COMMUNITY FOREST MANAGEMENT BY USING GIS AND REMOTE SENSING TECHNIQUES DEGEM WOREDA, NORTH SHEWA ZONE, OROMIA, ETHIOPIA

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January 22, 2021

Salale, Ethiopia

Summary

The general objective of this study was to assess forest cover change and analysis of the rate of deforestation in Ellen community forest area from 1985 to 2015 due to land tenure impact. Specific objectives are:-to assess the perception of local community toward community forest management, to investigate the spatial and temporal forest cover change in the study area and detect forest cover change in Ellen community forest area from 1985 to 2015 years and to assess the role of land tenure on community forest management.

Land tenure system in the current constitution shows positive impact to the community forest management. For this study mixed research design was employed. For the identification of land use/ land cover change landsat imagery of 1985TM, 2000 ETM+ and 2015 OLI/TIRS were used to determine the change in forest / land use/land cover using object based classification. Data collected from respondents resulted in positive impacts of land tenure in community forest management and also the object based classification result revealed that in 1985TM Landsat imagery, forest land (13.6%), grass land (22.16%), bush land (27.38%) and degraded land (2.14%) were identified with their respective percentage. The change result showed a rapid increase in forest cover by +10.91% between the first study periods (1985-2000) and also shows increment by 7.57% between the third (1985-2015) study periods. Similarly farm land decreased by -14.814% during the first and also by -3.686% during the second period. This study generally has shown that improving land tenure has positive impacts on community forest management which shows the increase in the area of forest cover from the study period.

Introduction

Forest is one of essential kinds of resources that human beings and other animals depend on. It regulates environmental and ecological changes in which soil, water, climate and rainfall are in good existence in a sustainable condition. Apart from its intrinsic value for many indigenous and other forest-dependent people, forests are also sources of livelihood. Forests provide edible and medicinal plants, bush meat, fruits, honey, shelter, firewood and many other goods, as well as with cultural and spiritual values to people (Meseret,2009). Well, managed forests have tremendous potential to contribute to sustainable development and to a greener economy (FAO, 2014).

According to the reports of FAO 2010, Ethiopia's forest cover was 12.2million_ha (11%), clearly underestimated compared to the International government on Climate Change (IPCC), which says that the area of Ethiopian forest cover is estimated together with the shrub land area is about 61.62ha. It was very ambiguous as definition of FAO.

Ellen community, forest area is one of the remnant high forests in Ethiopia. Ellen community forest was started to governed/managed from 1974 E.C/1982 by the local community. It is found at 8 km far from the woreda town in the north direction. The area is situated in the northern part of Oromia north shoa zone rising up to 3162m.a.s.l and northing $09^0$51'.217''´and easting $038^0$37'.599''´. The area largely consists of natural but a degraded forest with about 5% plantation area of mainly *Cupressus lusitanica* and *Eucalyptus globules*.

GIS and remote sensing are increasingly used in combination for the spatial data analysis of forest resources. Remote Sensing is a powerful technique for surveying, mapping and monitoring earth resources. Information derived from remote sensing particularly in the form of forest covers mappings and forestland changes and rate of deforestation is essential to detect changes, predict as well as monitor the results and useful for rational planning activities (Hellden,1987).

Ellen community-based forest is one of the high forest cover (large area) in the north shoa district and governed by local community from 1980 G.C to current time. However, community management is not as much as effective as state management and the forest coverage is flexible from decade to decade. This paper is wanted to discuss about Ellen community forest status.

Materials and Methods of the study

Description of the Study Area

The study was conducted in the Degam Woreda, North shoa, Oromia, Ethiopia on Ellen community based forest management. The forest area is geographically located at latitudes and longitudes of $09^0$51'N and $38^0$38'E respectively.

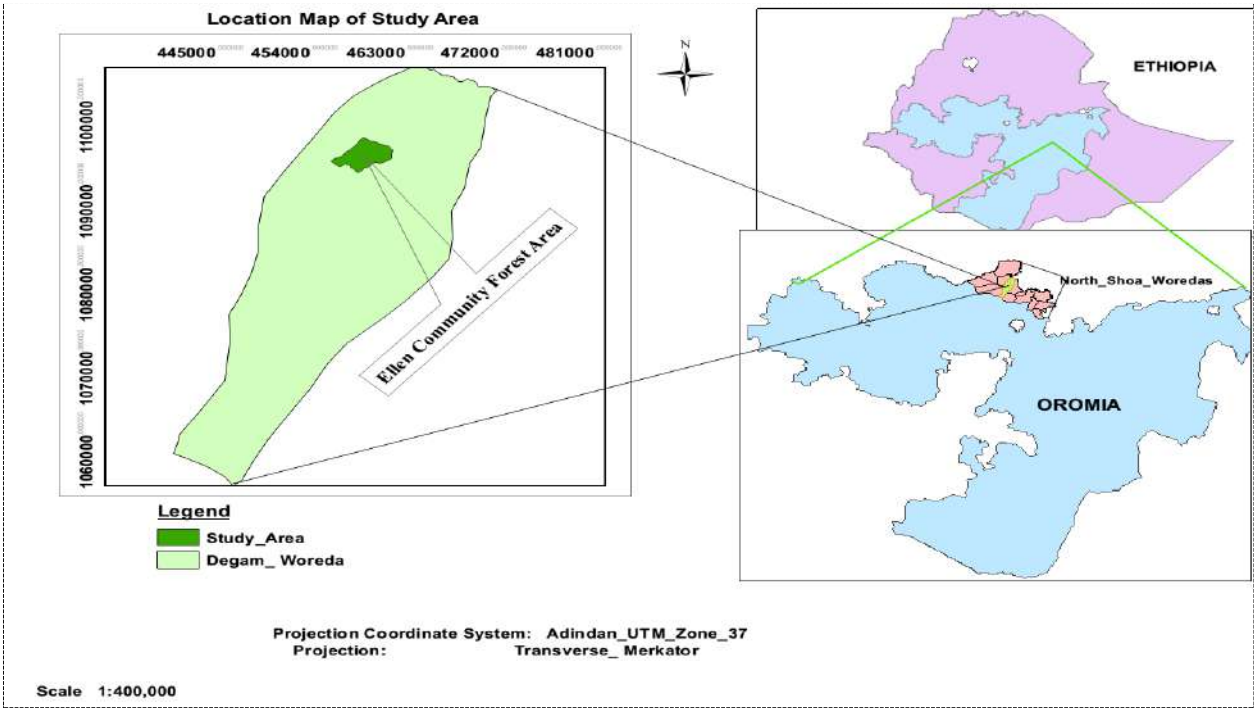

Figure 1: Map of the Study Area

The largest part of the woreda is highlands with large plains in between at an altitude range of 1500-3541masl. The major mountain in the woreda is Gara Guda, 3541masl. But in the case of the specific study area, Ellen community forest is one of the area coverage forests in Degam woreda as well as North shoa zone. Data extracted from Digital Elevation Model shows that the topographic landscapes of the study site belongs to rugged, made up of mountain chains with an altitude of 2100 masl at the foothills of a mountain range of over maximum elevation of 3300 masl. A mean annual temperature of 15-21^0c and annual rainfall 900-1400mm with a bimodal distribution, small rains during Belg season between February and April and big rain from the end of June to the beginning of October (BOFED, 2011). According to the data obtained from the woreda, the major livelihood of the rural population of the woreda is based on subsistence agriculture characterized by mixed farming system/crop production & livestock husbandry.

The yield obtained by small-scale farmers is below the expected potential yields mainly due to a number of production constraints, such as erratic rainfall, crop disease, insects & suboptimal agronomic practices.

Data Sources and Materials

To carry out this study both primary and secondary sources were used. Landsat TM, ETM+, and OLI/TIRS satellite data for1985, 2000 and 2015 downloaded from USGS Website by identifying the path and raw of the images were downloaded (p169,r053) in January and utilized in this study. These remotely sensed images are used and processed to identify the forest cover dynamics within last 30 years in the study area. In order to minimize seasonally and sun positions, the images acquired within the same seasons within which no more destruction and satellite available from January to February (in the dry season in case of Ethiopia).

Other types of primary data used to gather information from respondents and as well as relevant secondary sources are used for this paper.

Table 3:1 List of data sources and material, *Satellite data, Software & Materials used*

Satellite data				
Sensor	Resolution	Path and Row	Sources/ website	Date of data acquisition
Landsat TM	30m x30m	169/053	USGS	15,January, 1985
Landsat ETM+	30m x30m	169/053	USGS	11,February, 2000
Landsat OLI	30m x30m	169/053	http://www.libra.develpmentseed.org)	14,Februar, 2015
GIS data				
DEM data of the study area from SRTM image is used				
Topographic map of the area for change detection				
Some software & materials				
✓ ERDAS Imagine 2010: Used for Resembling, and Image analyzed.				
✓ ArcGIS 10.1: Used for GIS data analysis and mapping				
✓ Global mapper for subsetting and DEM generating for the study area				

Data Analysis Methods

This study employed both qualitative and quantitative methods of data analysis. In order to clearly assess the changes of forest cover in the study area, determination of type and size of classes are extensively necessary. Accordingly, based on the information's obtained from visual interpretation of remotely sensed satellite image and using field observation over all five land use and land cover classes were identified for this study. The classification of each land use and land cover map has passed through both pre-processing and post classification techniques.

Before the classification accomplished correcting the data for sensor geometric distortion and atmospheric noise was performed using ERDAS IMAGINE 2010 software. For each land use and land cover classes signature was prepared using training area and significant spear ability is obtained. After supervised classification was obtained accuracy assessment were done by comparing the classified image with 150 ground control points means 30/ individual class collected during field survey.

The comparison of land use and land cover statistics were assisted to identify the amount of changes per hectares, percentages, extent, and rate of changes between 1985 and 2015 time span. The observed change was simply calculated by subtracting the recent data from the former/previous one (i.e. 1985-2000, 2000-2015 and 1985-2015). Land use land cover conversation rate and extent were computed in terms of percentage and area change. The forest cover conversion matrix analysis was conducted in ERDAS IMAGINE 2010. For Landsat TM 1985 and ETM+ 2000 images, visual observations of the spectral information of the known land cover categories observed from unsupervised classified Landsat OLI/TIRS image and from visual observation of the supervised classified OLI/TIRS image were used.

Classification Accuracy Assessment

A thematic map derived with a classification may be considered accurate if it provides an unbiased representation of the land cover of the region to describe in a particular way. A set of reference pixels representing geographic points on the classified image is required for the accuracy assessment. The accuracy assessment was implemented on the 2015 Landsat images of the study area using ground control points from field observations as the major sources of reference data set of reference points were generated to assess the accuracy and validate image classification of the 2015 and was prepared for further analysis. For all land classes, there were collected and sampled of about 150 GCPs or 30 GCPs/class from the field using handheld GPS.

The overall kappa statistics calculated from the error matrix and validate. The kappa value is a measure of the agreement between classification and reference data with the agreement due to chance removed. None of the kappa values in any of the images were very high. Landis and Koch (1977) ranked the kappa values, ranging from -1 to 1, into 3 groups: 1) those greater than 0.80 represented strong agreement between the classification and reference data: 2) those between 0.40 and 0.80 represented moderate agreement; and 3) those less than 0.40 represented poor agreement.

Change Detection

Change detection involves the use of multi-temporal data sets to discriminate areas of land the cover change between dates of imaging, (Lillesand and Kiefer, 2000). It involves the application of multi-temporal data sets to quantitatively analyze the temporal effects of the phenomena (Lu *et al,* 2007). Change detection has the advantage of showing both changes, no change as well as 'from to' information. In this study, the researcher focused to detect and analyze how many hectares of the farm land area increased. The change in trend was calculated from change detection by dividing the net change by the time of the study.

Post Classification

To examine the land –use/land cover change and forest cover change detection and the rate of its changes, post classification comparison change detection method was employed. This kind of change detection method identifies where and how much change has occurred. In this study, three dates of satellite imagery was used to determine the change by generating quantitative information on spatial and temporal distribution. Four aspects of forest cover change detection characteristics such as, detecting the changes that have occurred, identifying the nature of the change, measuring the temporal and areal extent of the change, and assessing the spatial pattern of the change were investigated.

RESULT and DISCUSSION

Forest cover

Based on the final training sample site, which were generated during field work stage, all the available images were classified into five land-use/cover types by applying supervised classification method and maximum likelihood algorithm with the support of ERDAS Imagine 2010 software. Relation to this, the year 2015 land-use/land cover classification result was evaluated by employing accuracy assessment technique using ERDAS IMAGIN software to investigate how the result reflects the reality on the ground. Likewise, the years 1985, 2000 and 2015 forest cover maps are also extracted independently from each land use land cover maps.

Forest cover map

Land use/land cover unit of the study area were categorized into five types; these are: forest land, bush land, grassland, farmland and degraded land. The three dates of land use/land cover classification maps of the study area were presented by the next figure.

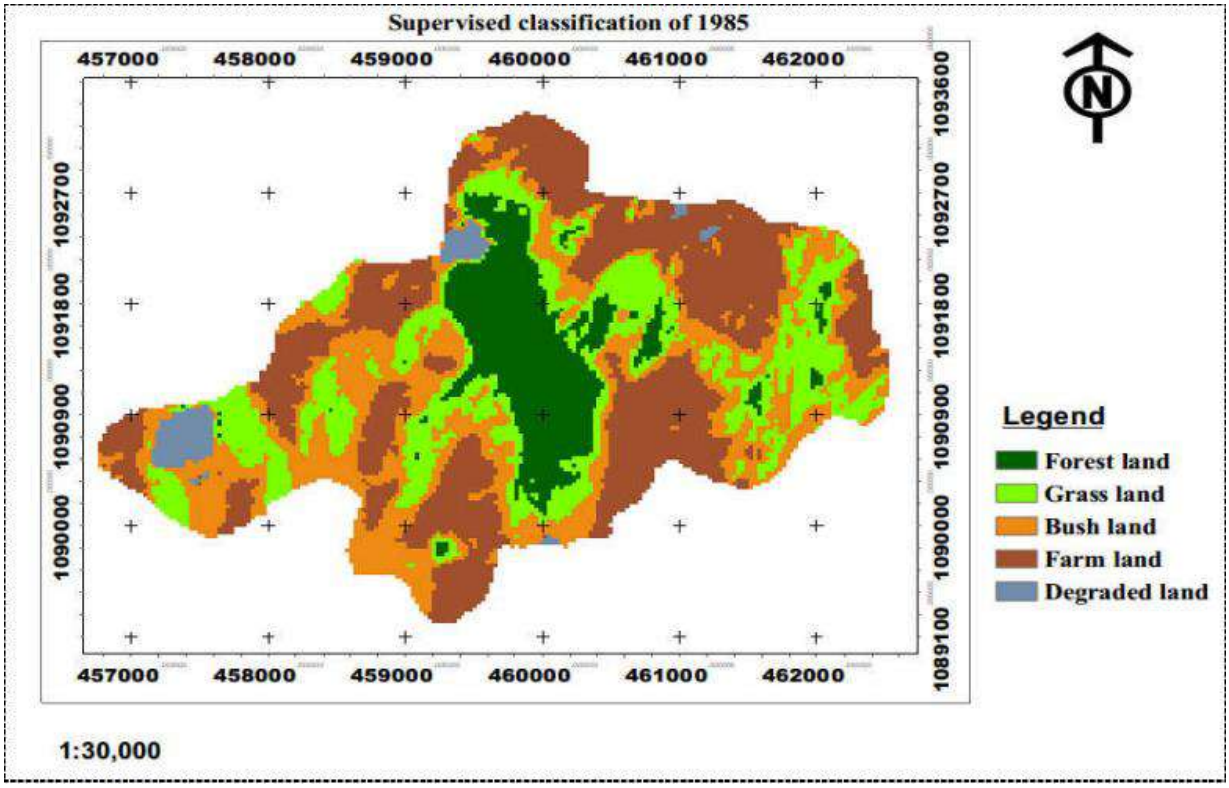

Figure 2: Land-use/ land cover map of 1985

From the 1985 land use and land cover map interpretation, the areal coverage of forest land was accounted for 13.6% from the total study area.

Farm land is the dominant coverage by area which covers 34.39% and the least area covered by degraded area, of which covers about 2.47% the grass land and bush lands were occupied about 22.16% and 27.38%, respectively (Figure above). From the above figure, it was easy to understand that before and at 1985 year the area was colonized by farming land/productive area and also grass land and bush land area. This implies that there were no attention to forest and other natural resource management and farmer's attention at that time was only increasing productivity. During the year of 1985 and before land tenure system was not well known and it was only touched about the land and state forest.

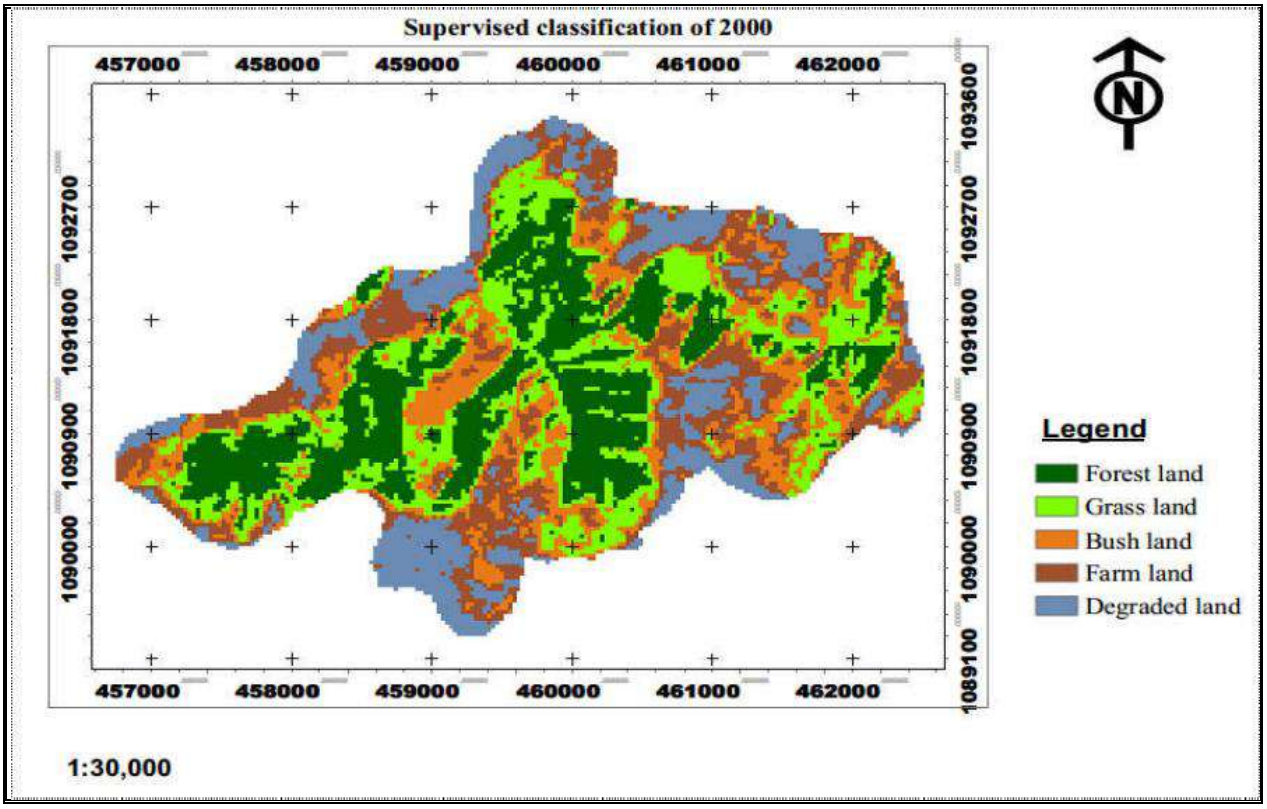

Figure 3:- Land-use /land-cover map of 2000

From above figure, the total land coverage, forest were accounted for about 291.6ha (24.51%) in the year 2000. Bush land and grass land take the share of 211.68 ha and 254.43 ha respectively. The remaining area was covered with farm land and degraded land with the coverage's of 232.68 ha and 197.17ha. From the above interpretation the area of forest and degraded land area increased, and the area of farm land decreased. That is why, degraded based on over farming and forest area increment based on the rehabilitation of degraded area by local households to return it back.

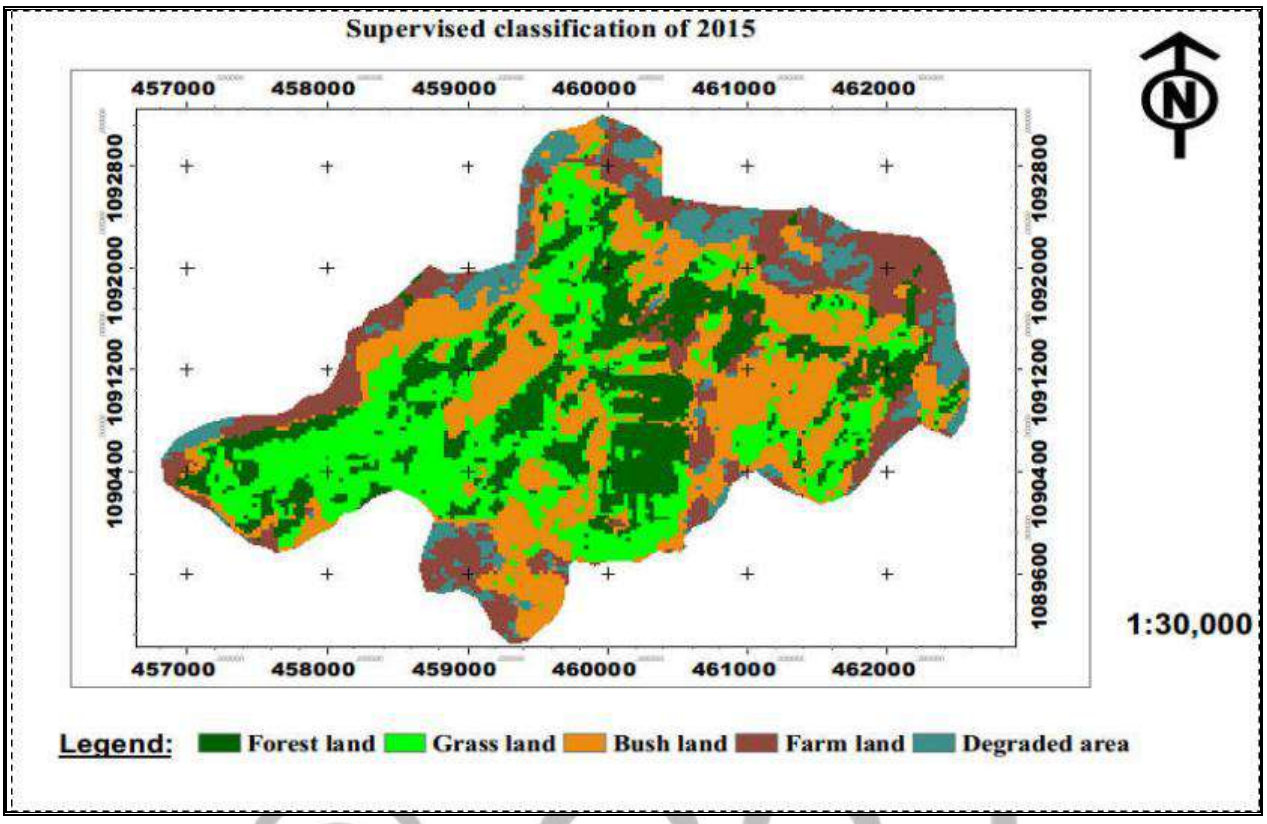

Figure 4:- Land-use /land-cover map of 2015

In 2015 the forest area coverage units was about 248.535ha or 21.17% of the total area. Land category under grassland and bush land coverage is accounted as about 303.202ha and 330.637ha respectively, and farmland and degraded area covers around, 186.525ha and102.263ha respectively.

The results of land-use/ land cover map (Table 1) show that the area of forest land declined in both first and third periods. But the rate of decline in the 2015 much smaller than first year. Farm land class shows a sharp decrease in the second period and third period, due to the shifting of farm land to forest land, grass land, degraded area. Forest was decrease in some extent with in the third period due to shift of forest types to grassland or bush land. No class show general trend of increase in all periods but both grass land and bush land shows general increase in both first and second periods (Table 1). This is just the general impression of land cover dynamics based on comparison of individual land cover maps.

Table 1: Summary statistics of land-use land cover of the study area

Class Name	Years					
	1985		2000		2015	
	Area/ha	%	Area/ha	%	Area/ha	%
Forest land	161.46	13.60	291.6	24.51	248.535	21.17
Grass land	263.25	22.16	254.43	21.384	306.202	25.823
Bush land	325.26	27.38	211.68	17.791	330.637	28.16
Farm land	408.51	34.39	232.92	19.576	186.525	15.89
Degraded area	29.43	2.47	197.19	16.573	102.263	8.71
Total	1187.91	100	1187.82	100	1187.162	100

Classification Accuracy Assessment

The accuracy assessment was implemented on the 2015 Landsat images of the study area using ground control points from field observations as the major sources of reference data set of reference points were generated to assess the accuracy and validate image classification of the 2015 and was prepared for further analysis. The Kappa coefficient lies typically on a scale between 0 and 1, where the latter indicates complete agreement, and is often multiplied by 100 to give a percentage measure of classification accuracy.

This implies that the Kappa value of 0.8146 represents a probable 81% better accuracy than if the classification resulted from a random assignment. The result obtained in this study fits to the view of Anderson (1971) who stated the minimum level of accuracy in the identification of land use/land cover categories from remote sensor data should be at least 85%.The classification accuracy of the study meets this requirement.

The highest user accuracy from the classes was for forest land and farm land, and followed by bush land and degraded area. The grass land class showed relatively lower users accuracy (76.67%). The reason was the spectral signature of grass land was mixing largely with grass land (Table1). In general, the overall accuracy of 88.67% was achieved with a Kappa coefficient of 85.83% (Table 1 above)

Table 2: Confusion matrixes for land sat image of 2015

Class name	Forest land	Grass land	Bush land	Farm land	Degraded land
Forest land	93.33	6.66	0	0	0
Grass land	6.67	76.67	1.67	0	0
Bush land	0	3.33	90.00	6.67	0
Farm land	0	0	6.67	93.33	0
Degraded land	0	0	0	10.00	90.00
Producer Accuracy	93.33	88.46	79.41	84.85	100.00
User Accuracy	93.33	76.67	90	93.33	90
Over all classification Accuracy	88.67%				
Kappa coefficient	85.83%				

Detection of land cover changes by different methods

Change between 1985 and 2000

The major cover changes observed during this two period had been there was reduction in the area of both bush land and farm land by 212.40 and 175.92 ha respectively, and also grasslands by 1.53 ha and a considerable increase in the overall areas of forest land and degraded area by 126.203 and 126.28 ha respectively. As indicated in (Table 3), the reduced bush land and farm land had been changed to forest land and degraded area.

Though the overall change on bush land and farm had been negative, and there had also been farm land conversion to forest and degraded area (Table 3) in this period. Therefore, the removal of bush land to different purposed had been the most important scenario worthy/detailed respect of considering in this particular period.

In this period, the expansion of degraded land was directly linked to population growth and no more conservation as well as no more rehabilitation traditions at the area within that period. Uncontrolled farming system (crop production and livestock rearing) in the past time left scrubs on the land and it takes long periods to rehabilitate, unless its chance would be converted to degraded parts of land class. On the other, forest coverage highly increased within the periods, due to high conservation measures of local people.

Table 3:- Land-use /land cover change matrix between 1985 and 2000

Final state(2000) / Area/ha	Initial state(1985)					
	Forest land	Grass land	Bush land	Farm land	Degraded area	Total class
Forest land	67.32	45.9	30.657	14.76	2.79	161.427
Grass land	85.41	69.93	43.56	30.69	18.45	248.04
Bush land	72.18	57.15	51.21	45.63	46.62	409.467
Farm land	49.77	68.22	67.86	104.22	83.07	373.14
Degraded area	12.95	5.31	3.78	2.61	3.78	28.43
Class total	287.63	246.51	197.067	197.91	154.71	0
Gain in ha	220.31	176.58	145.857	93	150.93	0
Loss in ha	94.107	178.11	358.257	268.92	24.65	0
Net change in ha	126.203	-1.53	-212.4	-175.92	126.28	0

***Note**: The numbers in the class total row indicate initial state where as the class total column indicates the final state. The diagonals indicate areas remained unchanged*

Change between 2000 and 2015

This period shows no more reveres of the trend of the previous period. The area covered by forest and grassland were increased while the area covered by bush land, farm land and degraded area cover land class types reduced. The major change observed in this period were decrease in the overall area of farm land from 373.19ha in 2000 to 202.3875 ha (by 170.8025 ha) in 2015 and an increase in the areas of forest land from 161.427 ha in 2000 to 288.3305ha (by 126.9035 ha) and, increase in grass land and bush land (Table 4). During these periods, no more deforestation practiced at the area.

Table 4: Land use/land cover change matrix between 2000 and 2015

Final state(2015)	Area/ha	Initial state(2000) Forest land	Grass land	Bush land	Farm land	Degraded area	Total class
	Forest land	110.76	111.983	49.41	13.23	2.9475	288.3305
	Grass land	64.1925	84.915	60.975	26.5725	13.05	249.705
	Bush land	40.05	43.2675	79.38	26.64	12.7125	538.0355
	Farm land	23.9175	33.3225	72.45	44.415	28.2825	202.3875
	Degraded area	5.805	13.4775	42.975	51.03	32.9175	146.205
	Class total	244.725	286.9655	305.19	161.8875	89.91	0
	Gain in ha	133.965	202.0505	225.81	117.4725	56.9925	0
	Loss in ha	117.5705	164.76	458.6555	157.9725	113.2875	0
	Net change in ha	16.3945	37.2905	-232.8455	-40.5	-56.295	0

***Note**: The numbers in the class total **row** indicate initial state where as the class total **column** indicates the final state. The diagonals indicate areas remained unchanged*

Change between 1985 and 2015

While considering the whole range of time under consideration, the reduction in the area covered by bush land and farm land were remarkable, despite to the forest and grassland expansion observed in the second time period due to high shift of farm land to forest land and grassland. In some case there may be conversion of highly farmed area to degraded land. Image differencing of the two extreme times, 1985 and 2015 indicated that, the area covered by forest and grass land increased by gaining the area from other land class types 161.52 to 246.3075 ha (84.7575 ha) and 250.8075 to 303.975 ha (53.1675ha) respectively. On other hand, bush land and farm land covers reduced from 412.3275 to 315.225 ha (97.1025 ha) and 371.1865 to 153.0675ha (218.028 ha) respectively. This extent of land was transformed in to farmland as a function of population growth; Part of the original farmland was also transformed in to grassland owing to deforestation during the second time period (Table 5).

Table 5: Land-use/land cover change matrix between 1985 and 2015

Final state(2015)	Area/ha	Initial state(1985)					
		Forest land	Grass land	Bush land	Farm land	Degraded area	Total class
	Forest land	52.335	50.22	51.2325	4.1175	3.615	161.52
	Grass land	72.6975	84.375	58.4325	27.1125	8.19	250.8075
	Bush land	66.4875	95.58	68.985	36.9225	21.195	412.3275
	Farm land	46.44	66.8475	134.46	80.7525	42.6865	371.1865
	Degraded area	8.3475	6.9525	2.115	4.1625	4.5	26.0775
	Class total	246.3075	303.975	315.225	153.0675	80.1865	0
	Gain in ha	193.9725	219.6	246.24	72.315	75.6865	0
	Loss in ha	109.185	166.4325	343.3425	290.343	21.5775	0
	Net change in ha	84.7875	53.1675	-97.1025	-218.028	54.109	0

***Note**: The numbers in the class total **row** shows initial state (2000), where as the class total **column** shows the final state (2015). The diagonals indicate areas remained unchanged.*

Forest cover analysis

In order to determine areas of the forest to be subjected to different change extract the area covered with forest type, therefore requires the extraction of polygons representing the forest areas. Accordingly, polygons representing the forest areas have been extracted. This was done by converting the classified forest areas raster data in to vector. The various data layers to be used in the subsequent analysis was therefore be extracted using these polygons. Figures (4, 5 and 6) show extracted forest in different time periods.

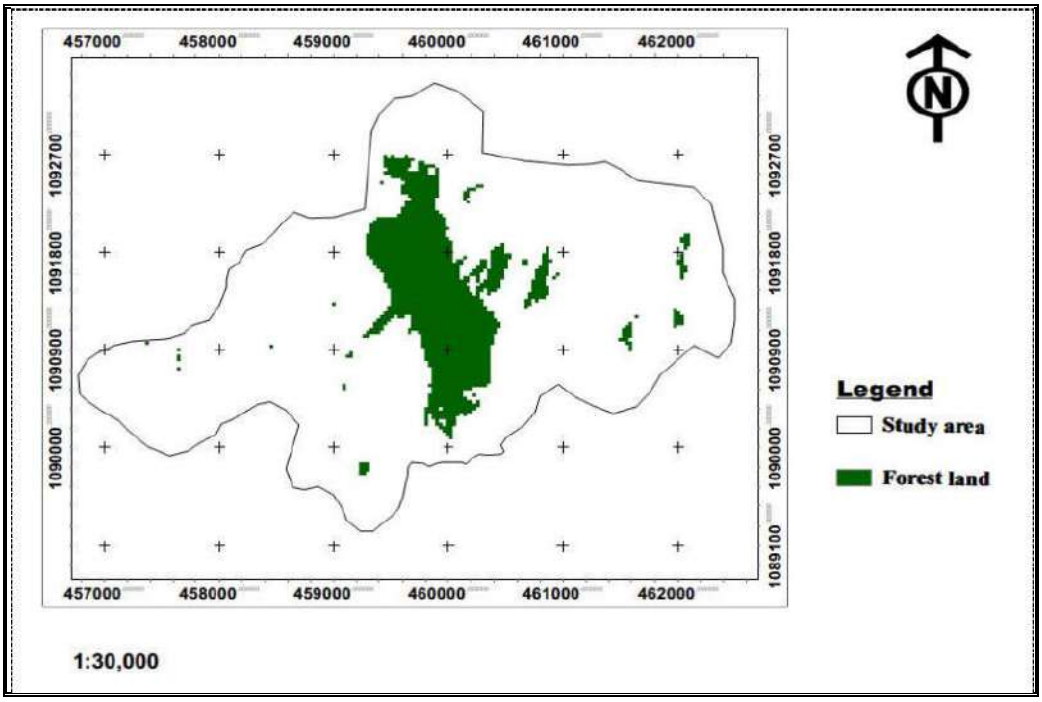

Figure 4: Forest Cover maps of 1985

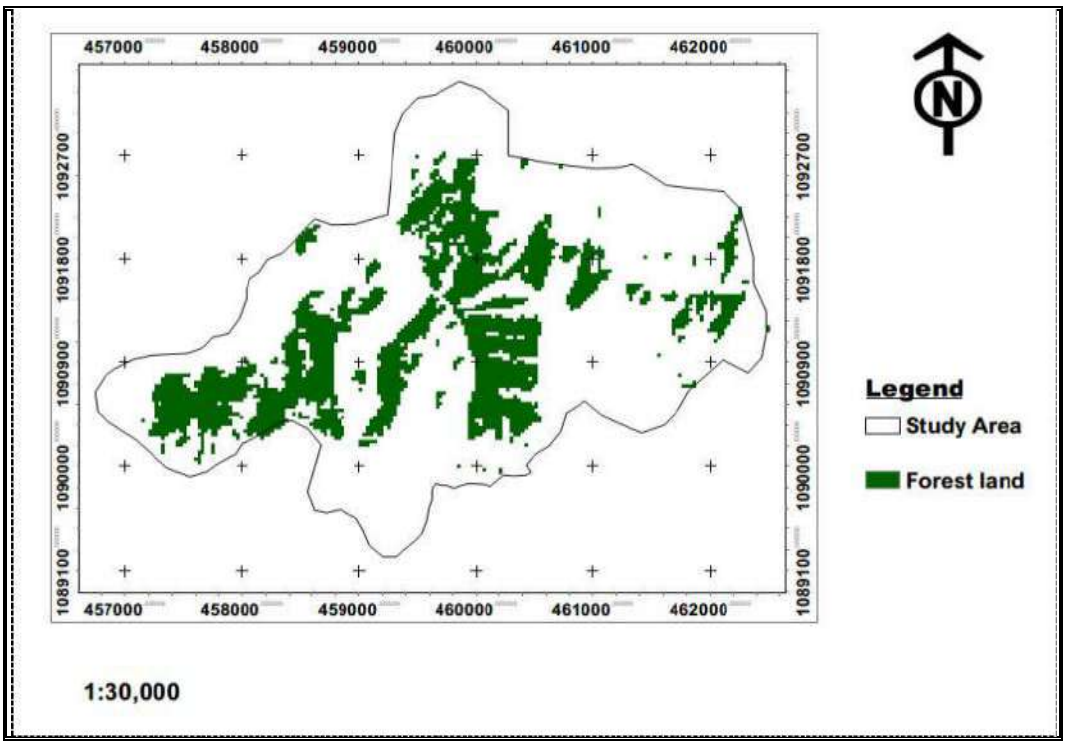

Figure 5: Forest cove maps of 2000

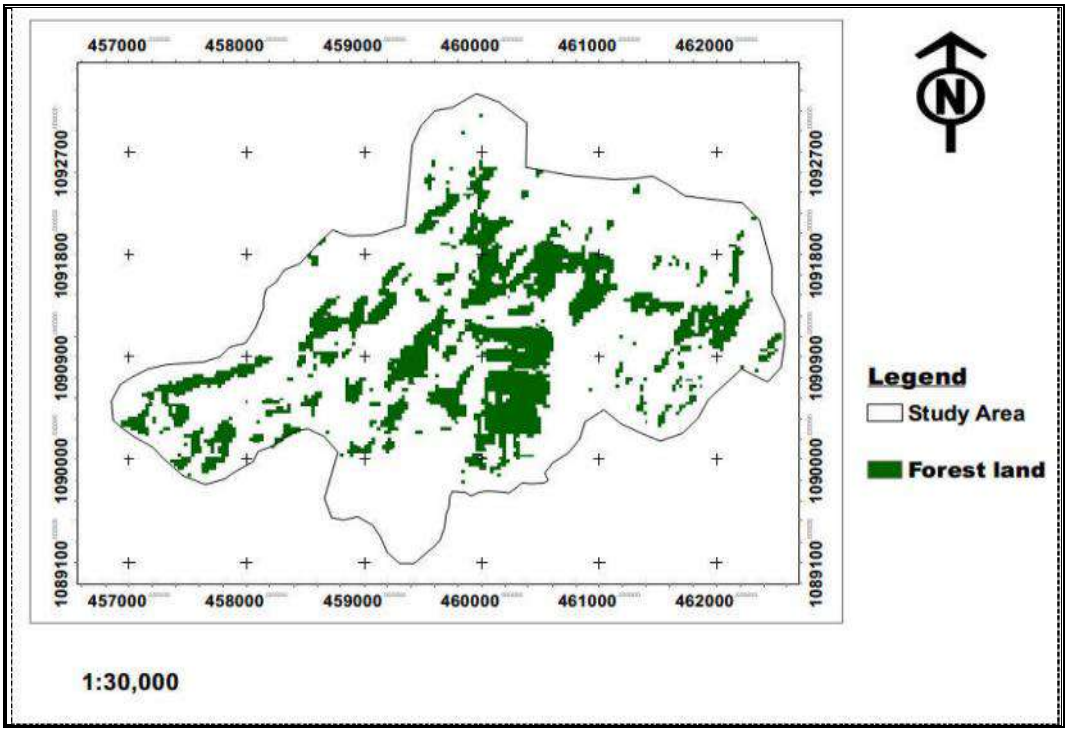

Figure 6: Forest Cover maps of 2015

The distribution of forest cover change has been done to makes it possible to visualize and analyze the spatial pattern of change, which would help to identify the various factors assumed to cause forest loss and determine their relative importance for the successive disturbance risk analysis and management strategy formulation. Second is that it highlights the seriousness of the forest cover change dynamics which strengthens the need for protected forest cover establishment by using remote sensing and GIS techniques with the integration of field survey.

In this study, three Landsat satellite images were used to visualize the distribution and rate of forest cover change within time span. During the analysis stage, digital image interpretation of forest cover area for each year was performed and total area of the forest cover and its percentage from each date were computed and summarized.

About 161.46 ha of the area were covered with forest resource in the year 1985 and the cover was accounted for 291.6 ha and 248.535ha in the year 2000 and 2015 respectively. The percentage share (relative to the total of study area) for each year forest cover value and with its trend indicate that in the year 1986, 13.60 % of the study area was covered with forest resources, while it was about 24.51 % in 2000 and this was declined to 21.17 % in the year 2015(Figure 7).

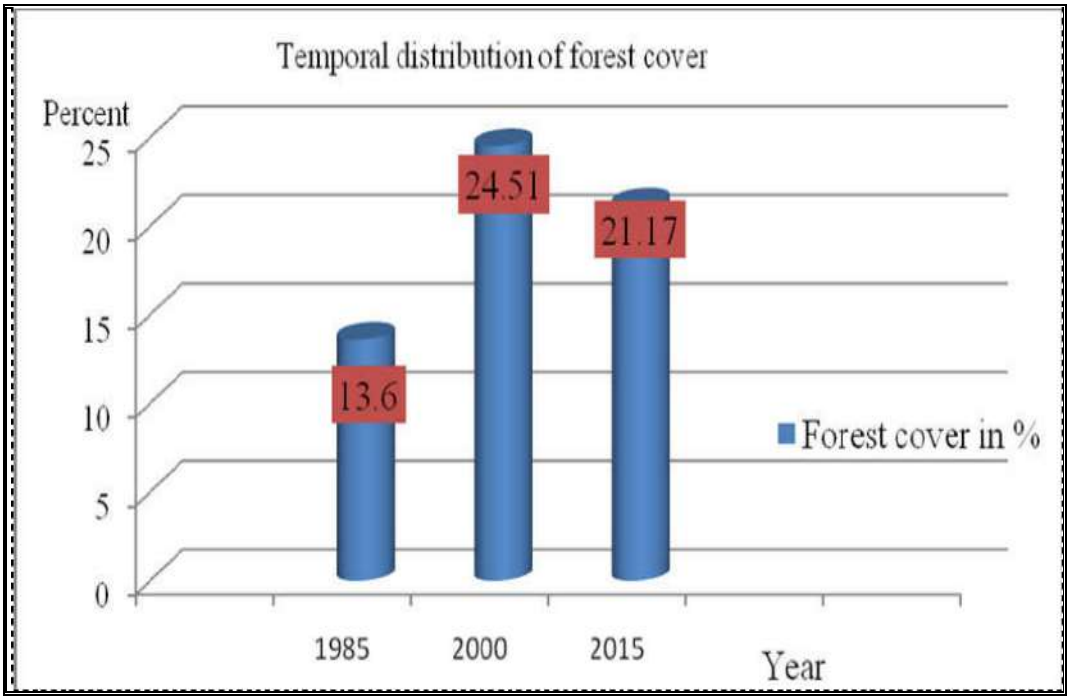

Figure 7: Temporal distribution of forest cover

Table 6:- Rates of forest cover change

Time interval (year)	Rate of forest loss		Rate of forest gain	
	Hectare per year	% per year	Hectare per year	% per year
1985-2000	No loss	*	130.041	1.3041
2000-2015	43.065	0.43065	No gain	*
1985-2015	No loss	*	87.075	0.87075

Note:" * "shows no percent indicated

The calculated result of (Table 6 above) shows that no average rate of forest covers loss from year 1985 to 2000 and but from year 2000 to 2015 the average rate of forest covers loss was 43.065 ha per year/0.43065% per year and there were no annual rate of forest cover loss from the entire period (1985 to 2015) but the gain was about 87.075 ha per year/0.87075% per year.

This implied that the tenure impacts from feudalism to current time shows the positive outcomes, means that during the feudalism forest and land were in the hands of emperor and the power full *rist*. At that time the area covered by forest were encroached by local for fulfilling their basic needs. But during Derge regimes the system came to socialism of land and related resource and much better than feudalism. Derge land tenure system was touched some extent about the land and its properties, but has its draw back.

However, the forest protection started at that time, it has no more success, since it was in the hand of governments. In case of Ellen forest it has been started to conserve and rehabilitate at Derge regimes it was by the local agreement. Then the forest was under local community management until today with the strength of agreement of local community by assigning the forest guards from the local community.

Land tenure system plays great role for the forest management through different activities, such as display the ownership clearly, reduce conflict among the management committee and local community. Make high confidence of the farmers on the land and related resources, make good agreement and reduce encroachments and enforces the local community perception high toward community forest management.

According to Bolland *et a*l (2011), community-managed forests have lower and less variable deforestation rates relative to protected forest. Similarly this study also identifies that community based forest management is one of the essential, to protect and conserve forest and other land related natural resources, because the owner and the users are the local community. The rate of forest coverage in the study area was increasing from time to time, due to community participation increase toward forest management and protection in relation tenure security.

CONCLUSION

Peoples of Degam woreda base their livelihoods mainly on agriculture (85%). The woreda has diversified climatic condition, households in Elamu Aferso produce cereal crops like wheat and maize for markets where as those in Weyiba Gulalle and Ano Kere use barley and teff for the same purpose, for these kebeles enset is the staple crop though many other crops are used in addition. With the increasing population and shrinkage of land holding per household among the woreda small holders, integrating trees with crop and livestock becomes an emerging potent strategy. This technique of integrating crop, livestock, and trees on the same geographical location across space and time is known as agro forestry. However, agro forestry activity practiced in the area may have its own problems.

Livestock rearing is also practiced in the study area. The number and types of livestock tended in Elamu Aferso and Ano kere kebeles is higher than the number of livestock in Weyiba Gulalle as the information replied from the respondents.

However, no such large number of livestock reared at the area because more farmers based on mixed system both cropping and livesock rearing. During the past decade large numbers of the local households of the area have no committeemen in community forest management because, they have no deep understanding about land tenure and its impacts on the community forest management.

The other part of this study was evaluate Ellen community forest management based on the land use/land cover change detection using quantitative evidence of land use dynamics to examine change of forest cover after the forest area was delineated for the forest management by local people and others from 1985 to 2015. The study area is composed of five major land use/land cover types: forest land, bush land, grass land, farm land & degraded land.

The areal extent of forest land in the study area has been increased generally from the first period of study to the second period of study. The findings indicated that from the total area of forest land 1163.748 ha about 161.46 ha of land were covered with forest in at the beginning time (1985 G.C). This figure is increased to 291.6 ha in the year of 2000. This indicated that, at the beginning time delineation and rehabilitation there were conservation and rehabilitation practiced at the area.

Moreover, for the annual rate of forest cover change shows increment between 1985 & 2015, the result indicated that about 87.075 ha are gained from other land use land cover to forest land. These shows increment of forest cover and hence, according to the information obtained from the respondents it was due to the presence of tree plantations area and highly participation of local community in managing and conserving the forest due to land tenure effectiveness.

The findings from this study shows that the major factors for the increments of this community forest was due to the reduction of farm land area, less collection of fuel wood & charcoal production, less collection of wood for timber & very rare collection construction materials and etc. These circumstances and other leads to the increment of forest resources in the area.

Finally, findings of this study revealed that the impact of land tenure system on community forest shows positive outcomes when land tenure is secured and the ownership goes to local community from government owner. Besides this, findings results from land use/land cover change detection of the study area using GIS & Remote sensing techniques also confirmed that after the Ellen community forest area was delineated and started to manage by local community and forest management committee the areal extent of the forest cover of Ellen community forest is increased and area of farm land reduced.

That is why, as information obtained the initial purpose of Ellen forest was to rehabilitate the area affected by over farming activities. Hence, this type of data is very useful for the concerned bodies in improving impacts of land tenure system to community forest management and related.

Recommendation

Based on the findings of this thesis the following recommendations are given to promote sustainable forest management through voluntary popular participation of people in the area. From the whole study it had been recognized that the forest cover land of Ellen community forest area has increased through time periods of study.

To sustain the conserved forest resource area from degradation & to use these resources in a sustainable basis, the following feasible suggestions are forwarded based on the findings from the implementation of land tenure impacts on community forest management in the study area. Active participation of local communities in forest resource management is quite decisive.

Increased local involvement in protecting and managing forests and wood lands productivity can be increased by organizing community control over access and uses by using techniques that conserve soil moisture and enhance natural regeneration.

The low level of local people involvement should be improved in identification and demarcation of remaining wood lands and marginal lands in the area, since some households in the already demarcated forest, even an aware of whether it is demarcated or not. There should be a program that strength the institutional frame works to support field activities and promote policy changes. To bring effective result in conservation and afforestation the c program monitoring and detailed surveys are necessary.

Woreda's rural and agricultural development office, especially the forestry department should have to give recognition to traditional forest related knowledge as it is essential to forest resource management, and is intimately bound up with the ownership and control of hands and territories and the continued use, management and conservation of all types of forest.

Traditional knowledge must remain alive, culture must continue to develop, and indigenous contemporary knowledge and technologies must be respected. To protect community forest resources from destruction in the study area preparation of appropriate place for plantation tree and planting various types of indigenous vegetation should be carried out with a workable afforestation and reforestation program.

In some case aware of the local community about rule and regulation of management system was not enough, to change the local community perception highly toward the forest rehabilitation and conservation in a sustainable manner, better aware of rule and regulation must carried on.

The government also has to make the clear policy and good land tenure issue that highly support community forest management and foreign sources through bringing forestry issues on the political agenda and linkage to the main political and social problems.

Clear mechanism should be suggested that can halt activities of those who expand their farm land in to the forest. Woreda administration should check activities of those kebele administrators, particularly, for issues related to land and forest.

The concerned woreda level administrations and the communities as a whole must commit themselves for the implementation of forest legislations, particularly regulations and directives and for undertaking extensive forest development activities to achieve effective conservation of top fertile soil, and water resource the area in order to combat desertification problem.

Sharing new information within the local community makes local household intention to protect and manage the forest confidentially. Therefore, there must be on time meeting between community forest management committee and the forest guards and also fair distribution of the resources across the near forest households.

To save the environment and increased traditional management forest resource of the country in general and the study area in particular the researcher recommends the following two direction strategy. The strategies are decreasing demand and increasing supply of forest and forest products.

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