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Review of Trends and Management of Mountain Environment: Land Use and Land Cover Changes in the Northern Highlands of Ethiopia

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Abstract
Mountains supply enormous variety of goods and services to people living in and out of such areas. It is a source of fresh water, hotspots of biodiversity and destination for tourists and recreational activities. Nonetheless, mountain ecosystems are very much sensitive to human actions and interventions. In Ethiopia, environmental problems in mountain areas associated with loss of land resources (vegetation, soil and water) and biodiversity are apparent due to anthropogenic impact , particularly, over the last five decades. The main pressure arises from change in land use system and climate. Thus, this study aimed at reviewing various studies conducted in relation to trends and managements of mountain environment in the northern highlands of Ethiopia. Studies reviewed were those which were conducted in the Northern (Tigray), North Eastern (Wollo) and North Western Highland (Gojjam and Gonder) mountain areas. The assessment was made using researches carried out based on different time interval data (1860s, 1950s, 1970s, and 1995s). Then, summarized and synthesized data was presented using tables, figures and textual narrations. The result of the analysis shows that the northern mountain landscape (Tigray) was extremely degraded between 1868 and 1970s; however, there has been now a general tendency of improvement. The progress is the result of intensive rehabilitation activities as well as initiatives by farmers. In the areas that were previously least degraded, are now degrading very fast whereas those which were already much degraded in 1868, has benefited from improved land management. On the contrary, the general trends of mountain resources both in north eastern (Wollo) and north western (Gojjam and Gonder) shows the prevalence of continuous land resource degradation and ineffectiveness of environmental management process.
Keywords: land Cover, Land Use, Management and Mountain Environment

1. Introduction

1.1. Background

Mountains supply enormous variety of goods and services to people living in and out of these areas (MA, 2005). Due to elevation range covered, such landscapes contain several climatic and life supporting system that would not be easily available at lowers elevation areas (Korner, 2004). It is a source of fresh water (which is captured, stored and purified), hotspot of biodiversity where more plant and animal species are inhabited as well as destination for tourists and recreational activities (Adrienne, Sibyl & Felix, 2011). As a result, land use and human activities in these regions has far ranging environmental implications on mountain area which eventually determines life and activities of both in highland and lowland ecology.

In the same way, mountain ecosystems are very much sensitive to human actions and interventions. Over the last 50 years mountain ecosystem particularly, that in developing countries have undergone dramatic changes (Christina, Baylis and Lipper, 2012). In Ethiopia, environmental problems such as loss of environmental resources (vegetation, soil and water) and biodiversity are becoming apparent phenomena in the mountain areas of the country (Berhan, 2010). The main pressure arises from change in land cover, land use system (due to agricultural land expansion trough the conversion of mountain areas, natural environment and marginal lands) and natural climate (EEA, 2002 & Eyayu et al, 2010).

Cognizant of this fact, the Ethiopian government has commenced environmental management policies and programs (in the forms of water shade management and biodiversity conservation) as a solution to curb environmental problems. Almost in all of the most recently development plans, the government included the issues of environment as a key factor to ensure sustainable economic growth in the country. Thus, the primary objective of this paper is to critically review concepts, empirical evidences and methodologies in relation to pattern, trends and managements of mountain environment in Ethiopia. The specific objectives that guide the review process towards the achievement of the overall purpose are to:

1. Review different studies conducted on trends of mountain environment in Northern highland regions of Ethiopia and draw broad based conclusion
2. Review mountain environment management and its impacts in the context of Northern highland parts of Ethiopia

1.2. Description of Areas Covered In the Paper

This paper reviewed studies conducted in relation to pattern, trends and managements of mountain environment in the context of northern highlands of Ethiopia. More specifically, the Northern (Tigray), North Eastern (Wello) and North Western Highland (Gojjam and Gonder area) were areas considered in this review. These areas were selected for one thing most highland or mountain landscapes of the country are found in these regions and for the other thing, the existences of high population density (100 to 108 people/ square kilometer) in this area (CSA, 2007). That was because of the fact that population density has impacts on the conditions and managements of mountain environment (McGinley, 2008). The altitude of areas covered in the studies ranges from 1600m to 4431 meter above sea level which is characterized by mountain areas according to UNDP (2014). The temperature records in the study area ranges from 11°C to 28.5°C with annual average rainfall range fall between 1135 to 1500 mm.

1.3. Data an Methods

Data Sources

This paper principally depends on reviewing different articles, books and literatures which have been made in areas of mountain environment; watershed management, land use and land cover change in the context of northern parts of Ethiopian. The search for available literature was carried out using Google scholar as the main search engine; articles from scientific journal were searched using a range of key words which relate to Ethiopian mountain, mountain management, watershed management, land use and land cover change. After retrieving information about major studies the materials were arranged for analysis. A total of 97 publications related to the broad topic of mountain environment were found. These publications were further reduced to 32 publications that particularly address the specific.

Data Combination

Assessment of trends and management of mountain environment was made using researches carried out based on different time interval data (1860s, 1950s, 1970s, and 1995s). Then a summary of the major trends and managements of mountain environment obtained from different literatures was analyzed using tables, figures and textual narrations. For each time interval and area category, the results are presented in figures and tables explaining changes within the investigated area using available literature. Finally, the results of the reviewed materials are discussed and used to draw broad based conclusions for the trend, and management of mountain environment in the northern parts of Ethiopia.

2. Result and Discussion

2.1. Introduction

This section discusses pattern, trend and managements of mountain environment in Northern Highlands of Ethiopia by revisiting empirical evidences from a variety of research publications (articles, proceedings, case studies and books) specifically written on land cover change and land management at catchment scale**.** Subsequently, such materials were synthesized and reviewed critically on the basis of their fact and geographical areas covered. For simplicity of analysis and comparison purpose the northern highland of the country is divided in to three ecological zones as the Northern (Tigray), North Eastern (Wello area) and North Western Highland (Gojjam and Gonder area) were areas considered in this review. In view of that, these paper reports findings of studies undertaken on issues related to mountain environment.

2.2. Trends of Mountain Environment in the Northern Ethiopian Highlands

Mountain areas are landscape which are situated over 1500 meter above sea level (UNDEP, 2014). It contain environment which provides life supporting goods and services to human beings both who are living in and outside of the mountain areas (MA, 2005). However, Ethiopia has experienced sever land resource degradation, particularly, in the highland parts of the country. The greatest sources of environmental change on mountain areas are caused by human conversion of ecosystems and land use systems. Changes in land use are main drivers of environmental alteration on geographical and chronological basis (Eyayu Molla et al., 2010). The major effects of these land use changes are reflected on the status of mountain natural resources such as soil, water, forests, climatic system and biodiversity (Houghton, 1994). This means in other wards that, trends of mountain environment with respect to land resources can be measured by land use and land cover change.

Land use and land cover change is a cause for environmental changes in mountain areas is because of the fact that it contributes to local climate change, biodiversity loss, land degradation and the pollution of environment (water, soils and air) (Ellis & Pontius, 2007). Furthermore, land cover changes affect mountain areas ecosystems in two major ways. The first one is its direct impact on aquatic and terrestrial ecosystem alteration in both high and lowland areas and the second one is changing the climate by contributing to carbon emission. Therefore, the interest in land use and land cover change as a measure of environmental condition of landscape is because of the fact that it has huge and significant effect on mountain natural ecosystem

characteristics and processes (Jonathan 2000). In view of that, the forthcoming session provides illustration based on data obtained from various articles made on the issue.

2.2.1. Trends of Land Cover Change in the Northern Ethiopia

Mountain land resource degradation (such as forest, water, soil and air) in northern Ethiopia (Tigray region) as a result of human action has been apparent for centuries (Munro et al., 2008). Deforestation, agricultural land expansion and unsustainable use of environmental resources and sloppy nature of the land have aggravated the degradations process of the natural ecosystem (Nyssen et al., 2004).

To understand the condition of land use land cover change as a measure of environmental conditions in the region, many studies were conducted on the Tigray region on issues related to mountain management, land use land cover change as well as the effects of mountain land resource managements. One of these was a study conducted by Nyssen et al. (2014) to assess environmental conditions and human drivers for north Ethiopian mountain landscapes changes over 145 years. To that end, researchers have used 361 matched pair photographs taken between 1868 up to 2011. Different landscapes that were photographed in 1868, 1905–1907, the 1930s, the 1940s, 1972/1975 and 1994 were photographed again in the same season and at the same angle between 2006 and 2011 (Ibid). The study investigated the current status of mountain environmental conditions (vegetation, soil cover) with the same landscape more than 100 years ago, using pairs of landscape photographs (figure 1 &2).
Nyssen and his associates concluded that the condition of the land resources in 1860s and 1970s were very much degraded as compared with 1930s and recent environmental situations, as it has been seen in *Figure 1* bellow. The extreme environmental degradation in 1970s was as a result of very long trends of deforestation, increase in human population and extractive land management (Nyssen et al., 2014). The researchers further conclude that in the least degraded areas, such as the recently settled Simien Mountains, degradation is on-going while already degraded areas in 1960s and 1970s are improving.

Figure 1: Bare landscape in 1868 and improved condition in 2008 in Bolago , Tigray

Source: Nyssen et al., 2009.

Munro et al. (2008) made a similar research in the central Tigray region, with 30 year intervals using photos taken in 1975 and 2006, employing semi-quantitative methods. The study elucidated that the condition of vegetation cover in 1970s was strongly degraded, resulting from the combined effect of recurrent drought, impoverishment, poor land husbandry and war.

Similarly, research conducted by Thadiparthi & Mekonen (2011) on the same issue between 1964 – 2007 in Laelay-Koraro using sets of aerial photographs taken in 1964 and 1994, and satellite image taken in 2007 shows that land degradation was 60s and late 90s, while it is improving thereafter. As it is indicated in *table 1* the study has revealed that a significant change in land cover type between 1964 and 1994. Vegetations especially wood land, grass land and mixed crop lands are completely transformed into other land use type. The rate of transformation was in favor of agriculture, bare and degraded land expansion. There was also a great decline of forests and vegetation cover in the study area during the 30 years period. A rapid improvement in land cover has been observed at present as a result of the intervention in resource conservation and management practices.

Table 1. Land cover change; 1964 – 2007 in Laelay-Koraro in middle highland Tigray, Ethiopia

Land cover change	1964		1994		2007		% change (1994-64)	% change (2007-94)
	ha	%	ha	%	ha	%		
Forest cover	9725	15.1	2249	3.5	9053	14	-76.87	302.53
Wood land	7917	12.2	0.001	0	4081	6.3	-100.00	
Shrub land	8060	12.5	9369	14.58	9697	15	16.24	3.50
Grassland	7850	12.2	1959	3	1130	1.8	-75.04	-42.32
Wooded grassland	8032	12.4	2375	3.7	3703	5.7	-70.43	55.92
Cultivated land	10110	15.75	12203	18.98	14175	21.9	20.70	16.16
Mixed tree cropland	5630	8.7	0.001	0	2312	3.5	-100.00	
Bare land	3625	5.6	14763	22.8	8320	12.9	307.26	-43.64
Degraded land	3017	4.7	20982	32.5	9355	14.5	595.46	-55.41

Source: Thadiparthi & Mekonen (2011)

All the three different studies conducted on northern mountain areas (Tigray) based on almost similar methods (analysis of repeated photographs, aerial photographs and satellite image), show continuous mountain environment degradation particularly loss of vegetations from 1868 until 1970s was already highly degraded while some improvements was observed in recent periods. However, study conducted by Abineh et al (2015) Kilite Awulalo mountain areas of Tigray Ethiopia by using satellite image between 1972 and 2014 came up with relatively different thought than the previous three studies conducted in the region. As it is indicated in table 2 forest cover in the area had relatively in a better condition between 1972 and 1984 (8.7%), then declined continuously to date. At the same time bush land was reduced endlessly all the way to the present date, while agricultural land expansion increasing from time to time.

Table 2: land cover change in from 1972 -2014 in Kilite Awulalo, Tigray Ethiopia

Land cover change	**1972**		**1984**		**2014**		**% change (1984-72)**	**% change (2014-84)**
	ha	%	ha	%	ha	%		
Forest cover	19968	19.7	21706	21.42	11916	11.76	8.7	-45.1
Bush land	58007	57.23	47900	47.26	45000.1	44.4	-17.42	-6.05
Cultivated land	13138	12.96	20856	20.58	30402	30	58.74	45.77
Bare land	9747.72	9.61	9675	9.55	13974	13.78	-0.75	44.43

Source: Abineh et al (2015)

In the same way, study conducted by Gebresamuel et al. (2010) of Maileba and Gum Sellasa watershed in the highlands of Tigray region indicates that there was a decrease of cultivated land by 5% (Maileba watershed) and 9% (Gum Sellasa watershed) from 1964 to 1994. The likely reason suggested was area enclosures which are among the rehabilitation efforts that are being undertaken in the area by the government. The vegetation cover results are, however, in agreement with other studies mentioned above with a decline of forest cover, woodlands and shrub lands.

2.2.2. Land Cover Change Trend in Northern Eastern Ethiopia

A research conducted by Kibrom Tekle, and Lars Hedlund (2000) on land-cover changes between 1958 and 1986 in Kalu District, Southern Wello, shows a decrease in land coverage by shrub lands, riverine vegetation and forests, and an increase in remaining open areas, settlements, floodplains, and a water body. According to their study shrub land was decreased by 51% or 15.5 km2, and open areas or bare lands, excluding cultivated areas and settlements have increased by 333% (more than 3 fold) or 14.3 km2. In the same way, forest cover declined by 32 % or 2.7 km2 between 1958 and 1986. However, areas under cultivation remained more or less unchanged. Mostly the land cover changes observed in this study were the result of clearing of vegetation for fuel wood, grazing lands, new cultivation areas.

Another investigation carried out in the Derekolli catchment of the southern Wollo by Tegne (2002) explained a continuous decreasing trend of shrub lands and forest cover. The rate of shrub land contraction was faster between 1986 and 2000 than during an earlier period between 1957 and 1986. Belay (2002) further reported that shrub land shrank by 63.2% between 1986 and 2000, while the shrub-grassland and grassland expanded by 29.8 and 191%, respectively. Tegene explained how overgrazing by livestock and subsequent bush encroachment may have led to a drastic decline of the shrub land and a subsequent gain of the shrub-grassland and grassland. The expansion of cultivated land further decreased from 7% from 1958 to 1986 to 1.5% between 1986 and 2000. According to the author, there was no more land available suitable for cropping; even some of the previously cultivated areas were taken out of crop production primarily because of the steep slopes and shallow soils.

2.2.3. Trends of Land Cover Change in the North Western Ethiopia

Gete, & Hans (2001) conducted a study on Demebecha areas of Gojjam in the northwestern parts of Ethiopian highland to evaluate land cover dynamics of the environment. The evaluation process was carried out using a geographic information system (GIS) and a remote sensing approach with field verification. Researchers

concluded that Vegetation cover has completely declined, the proportion of degraded lands has increased, the total annual soil loss rate is high and soil productivity is reducing.

Table 3. Land use trends on Northwestern Ethiopian Highlands between 1957 and 1995

Land cover change	1957		1982		1995		% change (1982-57)	% change (1995-82)
	ha	%	ha	%	ha	%		
Forest cover	7342	27.1	452	1.7	82	0.3	-93.84	-81.86
Grassland	4901	18.1	3865	14.3	3147	11.6	-21.14	-18.58
Grass- and bush land	1691	6.2	1149	4.2	400	1.5	-32.05	-65.19
Cultivated land	10,692	39.5	19,031	70.2	20,893	77.1	77.99	9.78
Bare land	17	0.1	69	0.3	168	0.6	3.05	8.88
Degraded land	0.01	0	414	1.5	580	2.1		40.10

Source: Gete & Hans (2001)

For example, the results presented in table 3 shows that the natural forest land diminished from 27% in 1957 to 2% in 1982 and 0.3% in 1995. The 93 % of total natural forest that existed in 1957 was cleared between 1957 and 1995. In the same way grass and bush lands were continuously declining.

On the other hand, *figure 2* shows that cultivated land increased from 39% in 1957 to 70% in 1982 and 77% in 1995. The greatest expansion occurred between 1957 and 1982 (about 78%) and slowed down between 1982 and 1995 (only 10%) because almost no land was left for further expansion. Throughout the period covered by the study, cultivation invaded upon the very last marginal areas and steep slopes with gradients more than 30%. Such a dramatic change in 4 decades and the increasing proportion of completely degraded lands, from virtually nil in 1957 to about 3% in 1995, clearly indicates the prevailing danger of land degradation in the area.

A study conducted Eyayu et al. (2010) on the mountain landscape of Tara Gedam and adjacent agro-ecosystem, South Gonder Zone, Northwest Ethiopia using aerial photographs taken in 1957 and 1980, and satellite image taken in 2003 supported by focal group discussions and field visits. The results indicated that land, over the last 46 years, covered by dense forest, woodland, shrub land and grassland decreased while cultivated and settlement land increased substantially. For example, the cultivated and settlement land coverage increased by 90.60% between 1957 and 2003. However, woodland, dense forest, riverine vegetation, shrub and grasslands coverage declined by 97.87, 71.04, 37.00, 9.02 and 3.03%, respectively. These could be mainly attributed to anthropogenic factors. Increasing demands of more land for cultivation and settlement, overgrazing, deforestation for fuel wood and construction have resulted in a dramatic shrinkage of the area under natural vegetation.

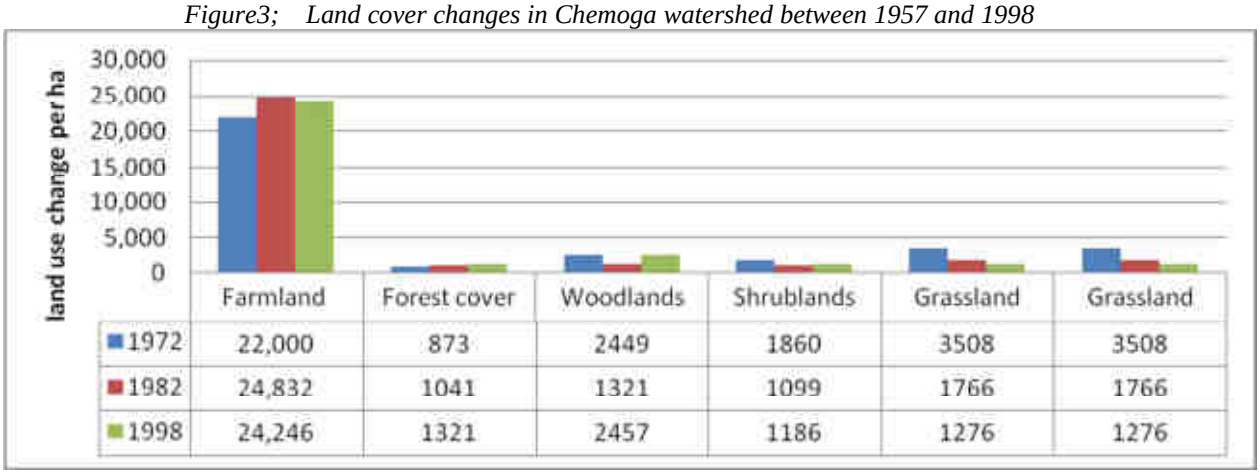
Figure 2. Agricultural land expansion to steep slopes Steep slopes (>45° slope) in 1995

Source: Gete & Hans (2001)

In the same way study conducted by Getachew et al. (2011) on Debre-Mewi watershed area in North Western Ethiopia, for three consecutive periods (1957, 1982 and 2008) also agree with the research results stated above. For example, In the three consecutive periods, the natural forest cover accounted for 4.48, 1.30 and 0.37%; shrub land cover 6.10, 6.01 and 2.39%; grazing land 18.39, 14.86 and 11.14%; and cultivated land 71.04, 77.83 and 81.51% of the total area of the watershed, respectively. Within the last 51 years, the natural forest cover declined by 91.74%, the shrub land by 60.79%, and the grazing land by 39.47%, whereas the cultivated land increased by 14.75%. All the three different studies conducted on Northern Western highland or mountain

areas (based on almost similar methods (analysis of repeated aerial photographs), show continuous mountain environmental resource degradation from 1957 until 1980s.

Figure3; Land cover changes in Chemoga watershed between 1957 and 1998



	Farmland	Forest cover	Woodlands	Shrublands	Grassland	Grassland
1972	22,000	873	2449	1860	3508	3508
1982	24,832	1041	1321	1099	1766	1766
1998	24,246	1321	2457	1186	1276	1276

Source: Woldeamlak (2002)

A Study by Woldeamlak (2002) on Chomega Watershed for the period of 1957 to 1998 came up with a different impression than what we have from other studies conducted in the region. As it is indicated on figure results show that The results show that during the last 41 years, forest cover increased at a rate of about 11 ha per annum in the 36,400-ha watershed. Woodlands and shrub lands decreased between 1957 and 1982 but increased between 1982 and 1998, approximately to their previous levels. Farmland and settled areas gained from the other cover types (13% increase) in the first period but lost around 586 ha (2% decrease) in the second. Grassland and degraded land decreased, accounting for 4.8% of the total area of the watershed in 1982 and 3.5% in 1998, as against 9.6% in 1957. Riverine trees suffered the greatest destruction, shrinking by 79% over the 4 decades; much of this decline was due to cultivation.

2.3. Managements of Mountain Environment in the Northern Highland

Mountain environmental resource degradation in Ethiopia is caused as a result of expansion of cultivated lands, deforestation, cultivation of steep slopes and marginal lands. In recognition to the fact since the 1970s, considerable efforts have been made to reverse the problem of land degradation as a means by Ethiopian governments. Intensive intervention (environment management) measures were introduced to improve land management practices between 1976 and 1990 (Edwards, 2010). In the 1980s, attention was given to rehabilitation of forest, grazing and agricultural lands. In the late 1990s, mountain environment management in the context of watershed or catchment development in Ethiopia has increasingly been employed with the aim of conserving environmental resources. Today there is a massive government investment and engagement in the management of mountain areas using watershed approach (Tongul, and Hobson, 2013). In view of that, the following section presents the condition and practices of mountain resource management in the northern, north eastern and northwestern ecological regions.

2.3.1. The Northern Mountain Landscape

Over the past decade, significant advances have been made by researchers in analyzing land rehabilitation efforts in the Tigray and Wello ecological regions. One of these is a study conducted by Nyssen & et al (2014). As it has been indicated in *figure 4* bellow and based on the findings of these researchers, there has been a general tendency towards a recent increase in vegetation cover compared with any other period over the last 145 years, with a second optimum around 1930s. This improved vegetation cover has been the result of land management has been taken care in the 1930s and the current intensive rehabilitation activities by the government as well as initiatives by farmers (Nyssen & et al, 2014). That is because of the farmers and decision makers in this area have more knowledge and better understanding of the environment and its impacts and of the importance of practicing management measures (Asnake & Hurni, 2015).

Nyssen & et al, (2014) further conclude that in the least degraded areas such as the recently settled Simien Mountains, degradation is on-going, the other areas which were already very degraded in 1868, 1970s have benefited from improved land management. The study demonstrates that when the environment is exhausted, human society has no option but to be creative in its relationship with the environment. When the environment is also severely degraded, reversing it is very unlikely.

Figure 4: agricultural land up to 1975 and dramatic reforestation thereafter

Source: Nyssen et al. (2014)

Study conducted in Northern highland on environmental management measures by Asnake & Hurni (2015) by considering 16 representative case studies is in agreement with what is stated by Nyssen & et al, (2014). For example the study indicated that physical environment – particularly soil and forest environments have shown substantial recovery in the Tigray region. Farm households were using physical soil and water conservation structures in the upper parts of a watershed to keep the soil on their cultivated land. The Ethiopian government encouraged farmers in these areas to plant different species and to actively manage the available resources. Since the 1970s, the government has placed emphasis to these areas as they were suffering from land resource degradation which have thus been able to practice environmental management measures properly. Researchers indicated that because of environment degradation (soil, vegetation, and water), affected farmers in Tigray were mobilized and supported by local and international NGOs in applying environmental management practices. In addition, the people have established various rules and regulations governing maintenance of and accessibility to available forest resources. Similarly, the water environment has improved. Most similar research studies conducted in these areas are in agreement with the same proposition.

2.3.2. The North Eastern Highlands

The north-eastern part of the Ethiopian highlands (Wollo) was one of the areas in Ethiopia that received early due consideration from land rehabilitation programmes since the area was the hardest hit by drought and famine in 1973 which was associated mainly with deforestation (Tekle, 2001). However, little success in terms of reversing poor land condition has been registered in the area (Tekle and Hedlund, 2000). Crummey (1998) in his study of matched pairs of ground photographs has argued that in Wollo there is an apparent increase of woody biomass in 1997 as compared to 1937. He noted also that the increase of vegetation was mainly from the planting of eucalyptus trees.

According to the study conducted by KIbrom and Hurni (2000) steps taken to rehabilitate degraded slopes in the study area were not successful because, in most cases, farmers were neither consulted nor included in planning land rehabilitation. Lack of local participation was a strong reason why people felt alienated and indifferent. This, in turn, must have contributed to the failure of most rehabilitation programs. Another recent study conducted in Wollo, Tigray and Gojam area by Asnake & Hurni (2015) came up with relatively different insight. The study concludes that there is improvement in a natural environmental condition (i.e. soils, forests, and water) as farmers and the government engaged in intensive soil and water conservation as well as forest resource management.

2.3.3. North Western Highland

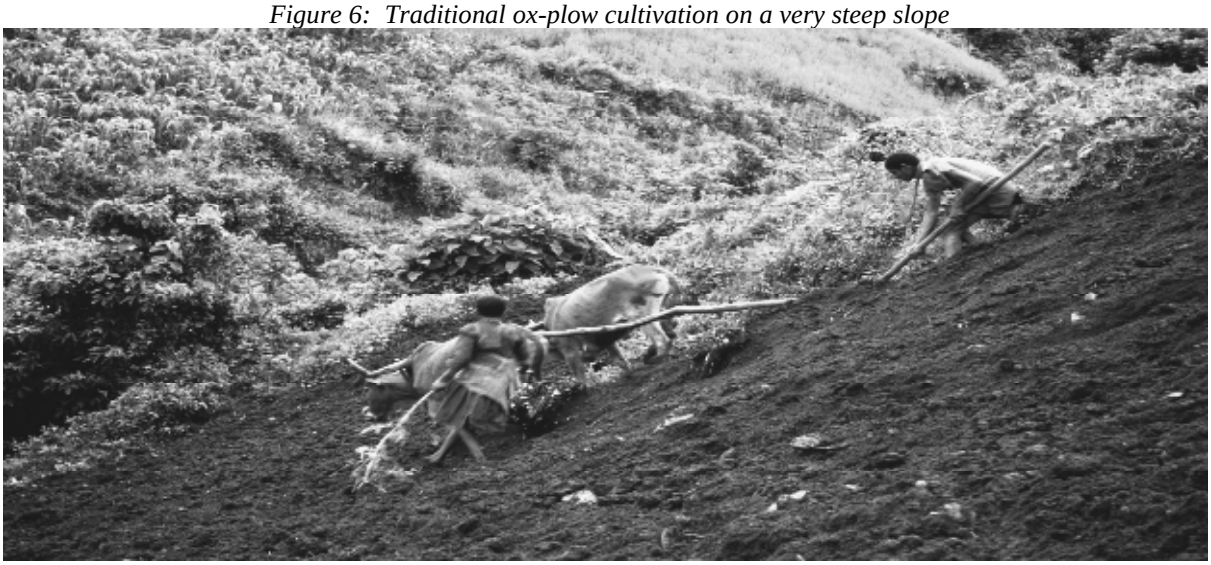
According to the study conducted by Gete (2001) around Dembecha areas of Gojjam, farmers used to practice shifting cultivation, which allowed them to fallow a given land 2 to 3 years at the beginnings of 1990s. However, overtime as a result of population dynamics first, farmers expanded onto steep slopes but still practiced shifting cultivation then they reached an upper limit where they could no longer expand or practice shifting cultivation. As it is clearly indicated in *figure 5*, the land management practice left the cultivated land without any special land management actions to protect farmlands from the impact of upslope runoff and damage from hammering rainfall.

Figure 5: Marginal land cultivation without conservation measures

Source: Gete & Hans (2001), Photo teken by Gete Zeleke in 1995

Almost all steep slopes, even those greater than 100%, are under cultivation (see figure 6). No special protection mechanisms exist except some traditional ditches, which in most cases aggravate runoff, especially on steep slopes. Because of these processes, the area is heavily threatened by land degradation.

Figure 6: Traditional ox-plow cultivation on a very steep slope



Sourec: Gete & Hans (2001),

Asnake & Hurni (2015) expressed the same concern about loss of vegetation cover leading to lost ground in the study conducted very recently. Based on this study in Gojjam areas even though the idea of protecting mountain environment introduced in 1970s, people began practicing that only very recently. Mountain resources are still being degraded. According to the researchers that are because of the fact that there is lack of clear understanding about the benefits mountain resource management, active involvement and technical support from the government and full and genuine participation of farmers in communal environmental resources management activities were found to be main factors in the adoption of environmental management measures. Furthermore, in these areas where the government has placed little emphasis, the natural environment has degraded during that time coupled with top down planning approach for environmental resource

management affected resource management process.

3. Conclusion

This paper has set objectives at the outset to review and synthesize studies conducted relative to trend and management of mountain environment in the context of northern highlands (Northern, North Eastern and North Western Highland areas) of Ethiopia. Evidences show that in the northern mountain landscape (Tigray) was extremely degraded between 1868 and 1970s. The causes of the degradation in 1868 were because of vegetations were open resources that can be freely used. The extremely degraded environment of the 1970s was the result of a very long trend of deforestation, increase in human population and extractive land management.

In terms of mountain resource management the situation was worst at the start of the 20th century (1860s), intermediate optimum in 1930s, bad in 1970s and there has been a general tendency towards a recent increase in vegetation cover compared with any other period over the last 145 years. This improved vegetation cover is the result of 30 years of intense rehabilitation activities as well as initiatives by farmers. In the areas that were and are least degraded, such as the relatively recently settled Simien Mountains, degradation is on-going, whereas the eastern portion of the study area, which was already very degraded in 1868, has benefited from improved land management.

The general trends of mountain resources both in north eastern (Wollo) and north western (Gojjam and Gonder) shows the prevalence of continuous land resource degradation and associated problems. Vegetation cover in mountain areas has completely declined decrease with a matching increase in bare and agricultural lands to the extent that it reaches the pick of a mountain. It was because of lack of clear understanding about the benefits mountain resource management, lack of active involvement and technical support of the government and low participation of farmers in communal environmental resources management activities.

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