Research Article IJAER (2017); 3(4): 418 - 426

International Journal of Agricultural and Environmental Research
FREE AND OPEN ACCESS
Available online at www.ijaaer.com
ISSN 2414-8245 (Online)
ISSN 2518-6116 (Print)

LAND USE PATTERN AND ITS IMPLICATION ON HYDROLOGY, CLIMATE AND DEGRADATION IN ETHIOPIA; A REVIEW

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Abstract

Land cover refers to the physical and biological cover over the surface of the land and it is a term used for the human modification of the earth terrestrial surface. In Ethiopia studies on land use land cover pattern and its effect was done at watershed and catchment level only. There is argument on land use land cover pattern in Ethiopia. Some researchers reported vegetation coverage was improved due to afforestation and plantation programme, while many others came up with the result of vegetation coverage was reduced in expense of agricultural land and settlement/build up area expansion. Surface runoff and evapotranspiration were affected by reduction of vegetation coverage which affects catchment hydrological cycle (increase wet river flow and decrease dry river flow).Land use land cover dynamics was reported both as causal and effect, and deforestation was the main cause of climate change in Ethiopia and also vegetation cover removal was stated as the major cause of land degradation and soil erosion which affects land productivity. More detailed study on land use land cover dynamic pattern and its effect on ecosystem at national or basin level to decide and give direction for policy makers whether it is increased or decreased when compared to before 2 or 3 decades is recommended. Also to alter the negative impact of land use land cover change on hydrological response, land degradation, soil erosion and climate change protecting existing vegetation coverage is mandatory in addition to new plantation programmes.

Key Words: *Land use land cover, hydrology, climate and land degradation*

INTRODUCTION

Globally, Land Use-Land Cover (LULC) change is as old as human kinds (Turner *et al*., 1993). In East Africa, nearly 13 million hectares of original forest were lost over 20 year period, and the remaining forest is fragmented and continually under threat (FAO, 2010). Since the 1970s concerns over land use and land cover change emerged in the research agenda on global environmental change (Lambin, *et al*, 2003). The interest in land use and land cover change is driven by impacts on fundamental ecosystem characteristics and processes, including the productivity of the land, the biological diversity, and hydrological cycles and climate (De Sherbinin, 2002). Population pressure as one of the major drivers of land use and land cover change through destruction of the vegetation cover, mainly for agricultural expansion (Amsalu *et al*., 2007; Bewket, 2002; Gebresamuel *et al*., 2010; Zeleke and Hurni, 2001).

Knowledge of land use and land cover change, both on a local scale and a wider scale, is essential in decision-making in relation to a wide range of issues, such as for reversing land degradation, deforestation, and climate change. Improving the understanding of land use and land cover dynamics can lead to the projection of future land use and land cover change and to more appropriate policy interventions for achieving better land management (Lambin *et al*., 2001). Studying historical trends aids in the understanding of possible future choices and is fundamental to development planning and the analysis of land-related policies (de Sherbinin 2002). In Ethiopia, LULC changes were registered at local level that adds up to the changes at national level. Most of these changes were from the natural forest to agricultural land and was due to human intervention (Woldeamlak, 2002; Daniel, 2008). Ethiopia has experienced recorded anthropogenic interference on ecosystems through land use change for four to five decades (Hailu, 2000).

Many researchers have studied land use and land cover change at catchment and watershed level in relation to hydrologic cycles, climate change, land degradation that is difficult to conclude land use land cover dynamics pattern and its impact Because of this, the review was intended to assess different research findings done in different parts of Ethiopia on the land use land cover change pattern and its implication regarding hydrological cycle, land degradation/soil erosion and climate change.

Land Use Pattern In Ethiopia

N**orthern Ethiopian Highlands:** Arable land expansion by forest clearing to get more cropland for an increasing number of people and to compensate for low agricultural productivity has been the principal form of land cover change for Ethiopian highlands as a whole and for the northern highlands in particular (Mekuria et al., 2007). Nyssen et al. (2009) reported vegetation cover is improved in between 1868 and 2008 and Alemayehu et al,. (2009) reported vegetation coverage (wood shrubs, grass lands and shrub lands) was degraded at the expense of crop land expansion from 51% in 1965 to 55% in 1994. Munro et al. (2008) stated that vegetation cover before and during 1970s was strongly degraded when compared to that of 2006. There was an expansion of cultivated land in Gum-Sellasa and a reduced area of cultivated land in the Maileba watershed.

In contrast, Gebresamuel et al. (2010) studied in two watersheds of the highlands of Tigray and came up with a conclusion of there was a decrease of cultivated land by 5% (Maileba watershed) and 9% (Gum Sellasa watershed) from 1964 to 1994 due to area enclosures which are among the rehabilitation efforts that are being undertaken in the area by the government. In Eastern Tigray after implementation of integrated watershed management since 1987 was resulted with positive improvements like better vegetation cover, reduced soil erosion, increased soil moisture availability and subsequent crop production increment, with reduced sedimentation and runoff in the lower catchment and small reduction of cultivated land between the years 1994 and 2005 from 55% to 52% respectively (Alemayehu *et al*.,2009).

North-eastern Ethiopian Highland: North-Eastern Ethiopian highland, Wollo, is a region that is particularly affected by heavy grazing and clearing of vegetation (Tekle, 1999). Crummey (1998) found out Wollo environment is marked in 1997 by many more trees, and probably by considerably greater woody biomass, mainly from the planting of eucalyptus trees, than it was in the 1930s. Tekle and Hedlund, (2000) reported the reduction of shrub lands by 51% and of forests by 31% between 1958 and 1986 in the southern Wollo (Kalu District). The increase in cultivated land was very insignificantly increased by 2%. The rate of shrub land contraction was faster between 1986 and 2000 than during an earlier period between 1957 and 1986 (Tegene ,2002).

North-western Ethiopian highlands: The north-western highlands of Ethiopia comprise an area in the upper Blue Nile Basin, which is mainly known as the Abay Basin (Alemayehu, 2010). Remarkable decrease of woodlands by 46% and shrub lands by 41% between 1957 and 1982 with 13% expansion of farmland in Gojjam, Chomega watershed (Beweket, 2002). However, there was a general improvement between the years 1982 and 1997 in forest cover, woodland and shrub lands by 27%, 86% and 8%, respectively. There was a slight reduction of cultivated land (by only 2%) between the years 1982 and 1997. Gebrehiwot *et al*. (2010) reported that at the Koga watershed, the forest cover remained similar (1%) between the years 1986 and 2001. However, there was a small reduction in cultivated land from 68% in 1986 to 67% in 2001. In Dembecha area in Gojjam, which had a long history of land degradation, 99% of the natural forest cover was lost between 1957 and 1995. Forest coverage showed subsequent reduction from 27% in 1957 to 2% in 1982 and 0.3% in 1995 (Zeleke and Hurni, 2001). Similarly, the bush land has shown a persistent decline from 5% in 1957 to 3.8 % in 1982 and to 0.4% in 1995. On the other hand, the forest cover increased to 2% from 1982 to 1995 due to tree plantation by a government afforestation programme. Nurelegn, (2014) reported that between the last 38 years in the Ribb Watershed, about 57.4 % of forest, 52.3 % of bush lands 63.5 % of areas of water bodies were converted to cultivated and settlement lands, grazing lands and wet lands, whereas the cultivated and settlement lands, grazing lands and wetlands were increased in area by 36.2%, 50.9% and 66.3% respectively. The trend of cultivation land increment at the expense of natural forest coverage took place mainly between the years 1957 to 1982 with a 78% increase, with only 10%

occurring from 1982 to 1995. The expansion of cultivated land from 1982 to 1995 was extended to steep slopes of up to a 30% gradient, which was supposed to be used either for perennial crops or kept under forest cover rather than for cultivation (Zeleke and Hurni, 2001).

Central Ethiopian Highlands: Studied historical forest cover in the Ethiopian central highlands focusing around Ankober, Shewa using European traveler's accounts for reconstructing the long term landscape condition he indicated that deforestation in the central highlands of Ethiopia has long been going on since the late 19th century. Wøien,(1995) used aerial photo, interpretation along with GIS tools, taken in 1957 and 1986 to study woody plant cover changes in Northern Shewa province near the town of Debre Sina. The result showed that an increase of woody plant cover from 4.4% in 1957 to 9.2% in 1986. According to Wøien (1995), the change in vegetation is most likely a result of afforestation and land rehabilitation programmes that were established in the region around 1981. In Beressa watershed, North Shewa and showed decline of natural vegetation cover from 15% in 1957 to about 7% in 1984 with small increase in cultivated land by 3% (Amsalu, *et al.*, 2007). They also reported a progressive decline of natural vegetation cover from 6.8% in 1984 to 2.4% in 2000. However, a very large area has been covered with plantations through government afforestation programmes, which was 1.2% of the total area in 1984 but increased to 10.6% in 2000. The cultivated land had increased from 57% in 1984 to 61% in 2000.

South-central Ethiopian highlands: This area covers most parts of the central and southern Central Rift Valley regions of the Ethiopian highlands. During the 19th century, most parts of the south Central Rift Valley was covered by remnants of high forests (Chaffey, 1979). However, starting from the late 19th century, the continuous change of socio-political, economic, and cultural conditions has affected the natural indigenous forest cover of southern Ethiopia, (Mc Clellan, 2002). Hagos, (2014) evaluated the land use land cover dynamics seen in between 1973 – 2009 in *Huluka* watershed, Central Rift Valley of Ethiopia which drains to Lake Langano, by collecting qualitative and quantitative data using Geographic Information System (GIS) and Remote Sensing (RS) technique. Field observations, discussion with elder to validate sensed data. The result of the study showed that cultivated and open lands had shown continuous and progressive expansion mainly at the expense of grass, shrub and forest lands. Cultivated and open land 25% and 0% in 1973 was increased to 84% and 4% in 2009 respectively while grass, shrub and forest land decreased from 29%, 18% and 22% in 1973 to 3.5%, 4% and 1.5% in 2009 respectively.

Dessie and Kleman (2007) conducted a study in the south Central Rift Valley region of Ethiopia and found that 16% of the total study area was covered with forests in 1972, but this cover diminished to only 2.8% in 2000, losing about 82% forest cover within 28 years. The main causes of the land cover change are thought to be the increasing expansion of small-scale farming. Moges and Holden, (2009), at the Umbulo catchment came up with a similar trend of land cover change that reveals the loss of 100% of high vegetation between 1986 and 2000. Dessie and Christiansson (2008), studied land use land cover in South central rift valley by using qualitative descriptions, travelers' accounts, in 1800s and 1930 and concluded there was significant forest decline had been very likely in parts of the south Central Rift Valley region at the expense of the introduction of coffee farming and land tenure arrangement that transferred the major part of the land to state ownership. Another study by Dessie and Kleman, (2007), by using satellite images taken in 1972 and 2000 in the Awash watershed, concluded that almost 82% of the forest cover was lost between 1972 and 2000.

A combination of methods including satellite image analysis and Participatory Field Point Sampling (PFPS) was used by Garedew *et al.* (2009) in Arsi Negele, Ethiopian Central Rift Valley, to study land use land cover dynamics from 1973–1986. The study by both methods resulted with decreasing woodland cover and a corresponding increase in cropland area. Also he reported that a reduction of wood lands and increment in crop land from satellite images taken in 1986 and 2000, in Arsi Negele, Keraru watershed.

Muzein (2006) used remote sensing and GIS to study the land use and land cover changes in the Central Rift Valley in the Zeway-Awassa basin, including the Arsi Ngele and the Awassa watershed. The study found a substantial forest and wood land cover loss by 27% at the expense of cultivated land expansion by 113% from 1973 to 1986. Moges and Holden (2009) studied land cover change between 1965 and 1972 using aerial photo interpretation in the Umbulo catchment, the southern Ethiopian highlands, and came up with the result of an increase of 137% for cultivated land at the expense of woodland and shrubland which shrank from 65% to 44%. Mengistu, (2009) also studied land use land cover change in the Abaya-Chamo sub-basin of the southern Ethiopian Rift Valley, and reported the farmland and settlement had increased by about 72% while the forest cover decreased by 17% within less than a decade.

Dwivedi *et al*. (2005) was carried out a study in areas between Chencha Wareda and Gamo Awraja which are part of the southern Ethiopian highlands, based on their satellite image analysis, an estimated cropland area of 4688 ha in 1994 increased to 5717 ha during 1997. This is a remarkable crop land expansion within a three-year period.

Western and south-western Ethiopian highlands: The Fincha hydropower dam was constructed in 1973 within the Fincha watershed, which is a tributary to the Blue Nile and land use change in the Fincha watershed, western Ethiopia, was studied by Tefera and Sterk (2008), mainly focusing on hydropower-induced land use change from the Fincha hydropower dam. According to their study forest cover declined by 51.6% between 1957 and 1980 with a corresponding expansion of cropland by 18.7% and decreased grazing land by 50.8%. The trend of land use land cover dynamics in Fincha watershed shows a rapid forest reduction from 1957 to 1980, but a slight increase of forest cover from 1980 to 2001, likely to be due to reforestation activities carried out since the 1980s (Tefera & Sterk, 2008). Reid *et al.* (2000) conducted their study on land use land cover from 1957 to 1973 and 1973 to 1987 in south-western Ethiopia at Gibe Valley showed cultivated land had expanded from 21% in 1957 to 25% in 1973 and reduced to 13% in 1987. The wooded grassland showed a small decline of around 7% from 1957 to 1973, but it increased nearly by 18% between 1973 and 1987. On the other hand, the riparian woodland increased by 21% between 1957 and 1973 and decreased by 12% between 1973 and 1987. Amanuel and Mulugeta, (2014) conducted a study to detect and Quantify Land Use Land Cover Dynamics, in Nadda Asendabo Watershed, South Western Ethiopia, using landsat images taken in 1973,1986 and 2004 and the result showed that showed an increase in agriculture land and built-up area from 19.16% and 1.46% in 1973 to 52.11% and 3.40% in 1986, 65.60% and 8.88% in 2004 respectively. The increase in agricultural land and built-up area was mainly at the expense of forest land, grass land, reverine forest and bush land.

Implication of Land Use Land Cover Dynamics In Ethiopia: Land use and land cover changes affect ecosystems in two major ways. The first is the direct effect on aquatic and terrestrial ecosystem change and the second is changing the climate by contributing to carbon emission. Therefore, land use and land cover change affects fundamental ecosystem characteristics and processes, including the productivity of the land, the biological diversity, and hydrological cycles and on climate (De Sherbinin, 2002).

Effect of Land Use Land Cover Dynamics on Hydrology of the Catchment

Understanding the hydrologic response of watersheds to physical (land use) and climatic (rainfall and air temperature) change is an important component of water resource planning and management (Vorosmarty *et al*., 2000). The impacts of land use change on river basin hydrology are interlinked with impacts of climate change. Land use and land cover change modifies the hydrological cycle of a watershed area by altering both the balance between rainfall and evaporation and the runoff response of the area and subsequently affects water resources (Mengistu, 2009). Sahin and Hall, (1996) reported vegetation cover removal results in an increase in surface runoff and a decrease in evapo-transpiration that may also in turn lead to lower rainfall in semi-arid areas.

Getachew and Melesse, (2013) conducted a study on the impact of land use change on the hydrology of the Angereb Watershed, Ethiopia and the result showed that the mean wet monthly flow for 2011 land cover increased by 39% compared to the 1985 land cover. On the other hand, dry average monthly flow decreased by 46% in 2011compared to 1985 land cover. Similarly, Tufa *et al*. (2015) investigated the influence of land-use/land-cover changes within Ketar watershed, lake Ziwaycatchment, Ethiopia and their impacts on the hydrological regime and came out with the result mean wet monthly flow for 2010 land cover increased by 3.8% compared to the 1986 land cover. On the other hand, average monthly flow in dry season is decreased by 12.3% in 2010 compared to 1986 land-cover. The analysis result of land-use and land-cover change show that, an outspread of agricultural land and settlement and reduction of forest land and grass land in the study area.

A study conducted by Hurni *et al*. (2005) in the Ethiopian and Eritrean highlands assumed about 5–30 times higher runoff in spread agriculture than the originally forested land. Vegetation removal in the upper steep slope of Umbulo catchment, the southern Ethiopian highlands, by the year 1972 started to generate larger amounts of runoff that drained to the flat lower slope of the catchment and accumulated as a small temporary water reservoir (<5ha). This temporary water reservoir (lake) emerged late in the 1980s but disappeared in 2002 (Moges and Holden, 2009).

Land use land cover change study by Bewket (2002) in the Chemoga watershed reported the sudden appearance of a pond in 1998, using satellite image analysis, presumably created by the increased water yield due to a decrease in vegetation cover in the upper stream. the clearing of forests was assumed to bring high surface runoff and less evaporation that leads to higher water yield induced by land cover change and later creates a temporary water reservoir/pond due to decline of vegetation cover, clearly indicating the land cover change effect on the hydrological flow of the watershed (Alemayehu, 2010).

Lake Haramaya, in the eastern Ethiopian highlands, reportedly disappeared, due to water abstraction, deforestation and clearing of land for farming on its watershed. The expansion of farming around the lake catchment resulted in increased siltation of the lake that decreased the lake's volume and surface albedo, which in turn increased the rate of evaporation (Alemayehu *et al*., 2007). The disappearance of water bodies (especially major lakes) and increase in degraded lands (37 %) were noted as major destructive changes in Haramaya area (Meshesha, 2013).

Effect Of Land Use Land Cover Dynamics On Climate Change: Land-use change is related to climate change as both a causal factor and a major way in which the effects of climate change are expressed (Dale, 1997). As a causal factor, land use influences the flux of mass and energy, and as land-cover patterns change, these fluxes are altered. Projected climate alterations will produce changes in land-cover patterns at a variety of temporal and spatial scales, although human uses of the land are expected to override many effects. Land use refers to the management regime humans impose on a site (e.g., plantations or agro forestry), whereas land cover is a descriptor of the status of the vegetation at a site (e.g., forest or crop). Land-use effects on climate change include both implications of land use change on atmospheric flux of CO2 and its subsequent impact on climate and the alteration of climate change impacts through land management. Effects of climate change on land use refers to both how land use might be altered by climate change and what land management strategies would mitigate the negative effects of climate change (Dale, 1997). In Ethiopia many researchers are stated climate change as a cause of land use land cover and effect of land use land cover doesn't quantified. Land cover changes affect weather and climate variability by altering biophysical, biogeochemical, and energy exchange processes at local, regional, and global scales. Interactions between climate and land systems are as unique as the regional and sectorial driving forces behind them (Loveland et al., 2012). Land use and land cover play critical roles in the interaction between the land and the atmosphere, influencing climate at local, regional, and global scales (Brown et al., 2014). Land-use and land-cover changes are affecting global atmospheric concentrations of greenhouse gases. The impact is expected to be most significant in areas with forest loss or gain, where the amount of carbon that can be transferred from the atmosphere to the land (or from the land to the atmosphere) is modified. Even in relatively un-forested areas, this effect can be significant.

Changes in land cover can alter the reflectance of the earth's surface and induce local warming or cooling; generally, as albedo increases, surface temperatures decline. Desertification can occur when overgrazing of savanna vegetation alters surface albedo and surface water budget and thus changes the regional circulation and precipitation patterns. Overgrazing can also increase the amount of suspended dust that, in turn, causes radiative cooling and a decline in precipitation.

A recent USGS report suggests that from 2001 to 2005 in the Great Plains between 22 to 106 million metric tons of carbon were stored in the biosphere due to changes in land use and climate (Zhu *et al*., 2011). Even with these seemingly large numbers, U.S. forests absorb only 7% to 24% (with a best estimate of 16%) of fossil fuel CO_2 emissions. Since land use land cover change is observed and reported by many scholars in Ethiopia climate change was resulted due to carbon storage in the biosphere. In fact land use change – mostly deforestation and forest degradation in the tropics – currently accounts for close to 20% of annual global human-induced greenhouse gas emissions when reforestation and afforestation are excluded, or about 11% of global emissions when they are included (McKinsey and Company, 2009). Continued forest loss and degradation means forgoing some low-cost opportunities to combat climate change and adds to the economic risks of climate change (Kissinger *et al*., 2012).

In Africa, including Ethiopia, local or subsidence agriculture and state farm agriculture expansion in the expense of forest are major driving force of deforestation. When large areas of forests are cleared, reduced transpiration results in less cloud formation, less rainfall, and increased drying. Simulations of the deforestation of Amazonia indicate that evapo transpiration and forests would be replaced by either desert or pasture (Dickinson 1991).

A long-term trend analysis (mid-1970s to 2000s) concluded amongst other things, that continued rapid population growth and the expansion of farming and pastoralism under a drier, warmer climate regime could dramatically increase the number of at-risk people in Ethiopia during the next 20 years, although many areas of Ethiopia would maintain moist climate conditions, and agricultural development in these areas could help offset rainfall declines and reduced production in other areas (Yirgu *et al*., 2013). Expansion of cultivated land in expense of forest and shrubs were reported in different parts of Ethiopia, which is major cause of climate change worldwide (Amanuel and Mulugeta, 2014; Tefera and Strek, 2000; Muzein, 2006; Garedew *et al*., 2009; Hagos, 2014; Amsalu *et al*., 2007; Nurelegn, 2014 and many others).

Effect of Land Use Land Cover Dynamics on Soil Erosion /Land degradation: According to (FAO, 1986), about half of Ethiopian highlands land area, close to 27 million hectares, was significantly eroded, and over one-fourth nearly or 14 million hectares of arable land was seriously eroded. Soil degradation in the Ethiopian highlands dates back several thousand years following the introduction of agriculture. Severe environmental degradation, mainly deforestation and soil erosion, is more prevalent in the northern and central highlands gradually extending to the southern parts of the highlands (Hurni, 1990).

Nyssen *et al*. (2004) reported that land use changes and drought have been considered the two major factors for land degradation and desertification in the Ethiopian highlands. Hurni (1993) stated land use change induced by population increase in the upper Blue Nile catchment has contributed to century-old land degradation. The removal of vegetation by conversion of land to cultivation reduces the protection of soil cover, minimizes the re-growth capacity of vegetation, and speeds up sheet and gully erosion (Zerihun and Mesfin, 1990). During the period 1985–2011, there have been major increase in degraded land, marsh, perennial cropland, and residential areas, while grassland, plantation, shrub land, water bodies, and temporal cropland have decreased Alemaya district, Eastern Ethiopian highlands during 1985–2011 (Meshesha, 2013). Teshome *et al*., (2013), conducted a study to assess the impact of land use/land cover on the physicochemical properties of soils of Abobo area, western Ethiopia and the result of the study revealed that soil OM, total N, CEC, PBS, exchangeable Mg and available micronutrients (Mn, Zn and Cu) contents of cultivated land was significantly lower than the adjacent forest land by 32.98, 33.33, 16.16, 17.81, 21.88, 29.47, 40.05 and 53.92%, respectively.

Gully development in the Umbulo catchment, Southern Ethiopian highlands, was extended from upslope to the middle and lower slopes at the same pace as the rate of forest reduction from the catchment, indicating the influence of land cover change for the formation of soil erosion, since vegetation was providing soil protection (Moges & Holden, 2009). Garedew *et al*. (2009) reported continued declining crop productivity and soil degradation was due to the destruction of woodlands in Arsi Negele from 1973–1986. Land cover change, especially deforestation, not only facilitates the physical removal of soil but also accelerates the deterioration of the basic soil properties (Gebresamuel *et al*., 2010). Change in LULC can also negatively affect the potential use of an area and may ultimately lead to land degradation (Biniam, 2015).

SUMMARY

Arable land expansion to the expense of forest and shrub lands to get more cropland for an increasing number of people and to compensate for low agricultural productivity has been the principal form of land cover change for Ethiopian highlands. In Northern, North-Eastern and North-Western Ethiopian highlands there are arguments that land cover deterioration continued or improved to late 19th century. Some researchers reported that vegetation cover is improved due to plantation of trees on steep slopes and area closure, while others stated that vegetation cover and shrub lands are decreased in expense of cultivation land due to population increment and to compensate production decrement. But in Central, Western and South-Western Ethiopian highlands almost all studies came up with the result forest, shrubs, woodlands and grazing lands were decreased in the expense of cultivation land. Land use and land cover change modifies the hydrological cycle of a watershed area by altering both the balance between rainfall and evaporation and the runoff response of the area and subsequently affects water resources. Vegetation cover removal results in an increase in surface runoff and a decrease in evapo-transpiration that may also in turn lead to lower rainfall in semi-arid areas. This resulted in the increment of mean monthly wet river flow and decrement in mean monthly dry flow at watershed and catchment level. Land use and land cover change, removal of vegetation, play a critical roles in the interaction between the land and the atmosphere, influencing climate at local, regional, and global scales. Land use changes and drought have been considered the two major factors for land degradation and desertification in the Ethiopian highlands. The removal of vegetation by conversion of land to cultivation reduces the protection of soil cover, minimizes the re-growth capacity of vegetation, and speeds up sheet and gully erosion. The consequence of land use change and the negative impacts on land degradation and climate change have also implication on land productivity and food security.

Land use change should be investigated at national level or basin level to give direction for policy makers whether the vegetation coverage is improved or decreased currently when compared to 19th and 20th century. Because in different parts of the country there is an argument on land use land cover pattern.

ACKNOWLEDGMENT

All my thanks goes to my family and all researchers who done land use land cover change studies in different parts of Ethiopia at different levels.

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