

Impact of Land Use/Land Cover Change on Rural Communities Livelihood of Ethiopia

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Review Article

Received: 28/11/2017

Accepted: 19/01/2018

Published: 26/01/2018

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Keywords: Deforestation, Agriculture,
Sustainable, Climate, Grassland

ABSTRACT

Land use/land cover is dynamic in nature and it provides a comprehensive understanding of the interaction and relationship of anthropogenic activities with the environment. Changes in the condition and composition of land use/land cover affect climate, bio-geo-chemical cycles and energy fluxes and livelihoods of people. More recently, tropical deforestation has drawn attention to human impacts on the environment. The loss of tropical rainforests in the Amazon basin, and the associated loss of biodiversity and accelerated extinction of species have captured the global imagination. Ethiopia, situated in the horn of Africa, has a long history of intensive agriculture and human settlement particularly in the highlands due to the presence of favorable climatic and ecological conditions. However, the high population pressure and the concomitant depletion of the scarce resources have made agriculture of the country unsustainable, forcing its expansion into marginal areas such as steep slopes, swampy plains, and traditionally untapped part of the environment and putting tremendous pressure on soil, vegetation and water resources. As a consequence, considerable land use/land cover changes have occurred in Ethiopia during the second half of the 20th century which has an adverse impact on the communities' livelihood. The major impact of LULCC on rural livelihood that identified by many studies include: its impacts on environment thereby rural communities' vulnerability to climate vagaries; its impact on land resources with related to land degradation, soil erosion, and productivity decrement; its impact on biomass energy Supply; Vulnerability of rural communities towards erratic rain fall and water sources problem with related to LULCC; impact on access to quality water; its negative impact on livestock rearing which related with grazing land shrinkage for agricultural land expansion, and also its impacts on ecosystem goods and services especially related with deforestation

INTRODUCTION

Land is the fundamental factor of production that supports all living organisms, human existence and ensures survival^[1]. Most human-associated sustenance activities, such as food production, shelter, infrastructure development and extraction of natural resources, depend on land. However, land resources are becoming increasingly scarce on a global scale, as a result of continued exploitation and mismanagement. Two concepts are closely related to land exploitation: land cover and land use. Lambin and Geist define land cover as the biophysical state of the earth's surface and immediate subsurface including biota, soil, topography, surface and ground water, and human modification such as roads and buildings. In contrast to land cover, land use can be defined as the purpose for which humans use and exploit the land cover. It involves both the manner in which biophysical attributes of the land are manipulated and the reason for that manipulation, for instance, why that land is being used. Typical examples of land uses include agriculture, livestock herding, urban and infrastructure development. Furthermore, FAO (1995) defines land use as the number of operations performed on land, which are used by humans to generate benefits from natural resources^[2]. Changes in land cover caused by land use are largely the results of two factors: conversion and modification^[3]. Land conversion comprises the replacement of one land-cover type with another and is measured by a shift from one land-cover type to another, such as agricultural expansion and deforestation. In contrast, land cover modifications include more subtle changes that affect the character of the land cover without changing its overall classification^[4,5]. According to Turner and Meyer and Stern et al land use/land cover change are affected by a variety of human driven forces, namely demographic factors, technology, level of affluence, political structure, economic factors, and attitudes and values^[6]. These driving forces can change

over time due to many reasons (for example economic cycles or population attitudes). Accordingly, the transition rate from one type of land use to another may also be influenced. However, change in land use and land cover can lead to major environmental consequences such as the loss of biodiversity, water pollution and soil degradation ^[7]. Moreover, land-use change also has a profound impact on food security and increased human vulnerability especially in Africa ^[8].

Land is the major natural resource that economic, social, infrastructure and other human activities are undertaken on. Thus, changes in land use/land cover have occurred at all times in the past, are presently ongoing, and are likely to continue in the future ^[5]. Thus, land resources play an important role in shaping rural livelihoods.

By and large, land use/land cover change is increasingly recognized as an important driver of environmental change on both spatial and temporal scales. According to Agarwal LULCC is dynamic, widespread and accelerating process, mainly driven by natural phenomena and anthropogenic activities ^[9]. Geist and Lambin also stated as constantly changes in response to the dynamic interaction between underlying drivers and proximate causes. Only few landscapes remain on the earth that are still in their intact natural state, the major causes of LULC dynamism being primarily associated with agricultural activities. Land use land/cover (LULC) is perhaps the most prominent form of global environmental change phenomenon occurring at spatial and temporal scales ^[10]. Large scale environmental phenomena like land degradation and desertification, biodiversity loss, habitat destruction and species transfer are consequences of land use by converting natural land covers ^[11]. The relationship between land cover and use change and its causative factors is complex and dynamic. The land cover and use change is mainly manipulated by both natural and socio-economic factors. Some studies suggested that demographic dynamics contribute more than any other process to land cover changes ^[12]. While others suggested the superiority of economic factors ^[13]. Other socio-economic factors of land cover change include poverty, tenure security, and availability of market and credit facilities ^[10]. Land use/land cover change is a general term for the modification and conversion of the earth's surface by human factors and natural events such as, flooding, fire, and climate fluctuations. Land use/ land cover is dynamic in nature and it provides a comprehensive understanding of the interaction and relationship of anthropogenic activities with the environment ^[14]. Changes in land use/land cover are the direct and indirect consequences of human actions to ensure essential resources. The most important issue for earth's human population is the long term threats to future production of food and other essentials by the transformation of productive land to other uses, such as conversion of agricultural land to residential use and the degradation of land by over grazing ^[15]. Most of the earth's surface is already modified, except those areas that are peripheral in location or are fairly inaccessible ^[16]. According to Ringrose et al. landuse/ landcover change in Africa is currently accelerating and causing widespread environmental problems ^[17]. The changing pattern of land use/land cover reflects changing economic and social conditions. For instance, in Ethiopia agriculture had always played a central role in the country's economy. Agriculture accounts for 46.3% of the GDP, 83.9% of exports, and 80% of the labour force of the country (CSA, 2005). Agriculture and human settlement represented long history and intensive particularly in the highlands of Ethiopia due to the prevalence of favorable climatic and ecological conditions i.e., sufficient rainfall, moderate temperature, and well developed soils ^[18]. Changes in the condition and composition of land-cover affect climate, bio-geo-chemical cycles and energy fluxes and livelihoods of people ^[19]. Globally cropland showed fivefold increase from 1770 up to 1990 and pastureland also increased by above six fold from 1700 to 1990. In contrast forest cover was decreased from 5000-6200 million hectares in 1700 to 4300- 5300 million hectares in 1990 ^[5]. But direction of land use and land cover change is not similar for all parts of the world. In the last two decades, the area of temperate forest was increasing by almost 3 million hectares, while the tropical forest was decreasing by 12 million hectares per year (MEA, 2005). In contrary, in Eastern and Western Africa only reduced and fragmented forestlands were left ^[20].

More recently, tropical deforestation has drawn attention to human impacts on the environment. The loss of tropical rainforests in the Amazon basin, and the associated loss of biodiversity and accelerated extinction of species have captured the global imagination. According to the Forest Resources Assessment of FAO 2000; the current loss of forest accounts roughly about 0.146 million km² per year. Richards (1990) estimate that over the last 300 years, about 20% of forests and woodlands, 1% of grasslands and pastures (most pastures came from grasslands) have lost, while cropland areas increased by 466%. Currently, croplands occupy roughly 15 million km² of the Earth's surface, while grazing lands cover approximately 34 million km². Thus, more than one-third of the global land surface is devoted to agricultural land, which has now become one of the largest biomes on the planet, for example roughly equal to the global extent of forests ^[21]. Such large-scale changes in land use and land cover can have significant consequences such as the depletion of valuable ecosystem goods and services. For example, forests are the source of fiber and valuable pharmaceutical products, and provide important services such as the regulation of climate and surface water, and protection of the soil. Furthermore, tropical rainforests provide a valuable habitat for an enormous number of plants and animals on this planet. **Table 1** shows the vegetation cover disturbances of Ethiopia as an example of tropical deforestation.

Table 1. The vegetation cover disturbances of Ethiopia.

Vegetation Type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
High forest	270897	118355	99 601	73 025	57 182	48 235	66 036	76 412	73 875	76 723
Wood land	83 720	77 929	75 460	79 195	83 379	85 365	86 611	91 038	95 633	96 323
Shrub land	44 678	51 432	56 752	59 377	77 242	70 164	68 051	65 548	61 854	58 685
Total	399295	247716	231813	211 597	217803	203764	220698	232998	231362	231 731

In Sub-Saharan African dry lands, rain fed agriculture dominates the region and supports various rural livelihoods [22]. It is characterized by low crop yields, which results from scarce and unreliable rainfall amounts that combine with extensive agriculture and results in the overexploitation of forests, woodlands and rangelands [23]. As such, poverty and hunger are predominant, as more than 50 percent of Africa's poorest people are concentrated on "low potential" lands that are prone to degradation [24].

Objective of the Paper

This paper aim to synthesize different literatures and provide information that could be useful for understanding impacts of land use/land cover change upon rural livelihoods.

General Impacts of Land/Use Land Cover Change

Land use/landcover change (LULCC) are associated with large negative impacts on ecosystems observed at local, regional and global scales. High rates of water, soil and air pollution are the consequences of observed LULCC. Biodiversity is reduced when land is changed from a relatively undisturbed state to more intensive uses like farming, livestock grazing, selective tree harvesting, etc. [25]. In response to the increasing demands for food production, agricultural lands are expanding at the expense of natural vegetation and grasslands [3]. These changes in land use/land cover systems have great impact, among others, on agrobiodiversity, soil degradation and sustainability of agricultural production [5]. Land degradation in most developing countries is becoming a major constraint to future growth and development of rural livelihoods. About 40-75% of the world's agricultural land's productivity is reduced due to land degradation [26,27]. This has strong impact on the livelihood of rural communities [28]. Ethiopia, situated in the horn of Africa, has a long history of intensive agriculture and human settlement particularly in the highlands due to the presence of favorable climatic and ecological conditions. However, the high population pressure and the concomitant depletion of the scarce resources have made agriculture of the country unsustainable, forcing its expansion into marginal areas such as steep slopes, swampy plains, and traditionally untapped part of the environment and putting tremendous pressure on soil, vegetation and water resources [29]. As a consequence, considerable land use/land cover changes have occurred in Ethiopia during the second half of the 20th century [30,31].

Impacts of Land Use Change on Rural Livelihood

Livelihood concepts and definitions

The concept of livelihood is about individuals, households, or groups making a living, attempting to meet their various consumption and economic necessities, coping with uncertainties, and responding to new opportunities [32].

Formally, a livelihood can be defined as "the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household" [33].

Thus, Livelihood Resources (Capital) can be divided into:

- Human capital – skills, knowledge, ability to work and good health;
- Social capital – networks and connectedness, trust, collaboration, attitudes, values and norms;
- Financial capital – savings, access to credit and loans, labor income, pensions, remittances, livestock, etc.;
- Physical capital – infrastructure, tools and equipment; and
- Natural capital – natural resources and their goods and services, for example land, water, forests, and air quality.

Livelihood strategies are determined by livelihoods assets and policies, institutions and processes (PIPs). Assets and PIPs determine the livelihood options available to people and the feasibility of different livelihood strategies.

Interrelations of land use/land cover and rural livelihood

Land and people are the most important natural resources that are mutually interrelated and interdependent for their sustainable development [34]. According to FAO, land is an essential natural resource, both for the survival and prosperity of humanity, and for the maintenance of all the terrestrial ecosystems. Although it is a fixed, scarce, tangible and immovable resource,

it is a degradable and transferable entity that is only sustainable when it is properly used by humans. Therefore, Livelihoods based on agriculture are closely linked with and dependent on the environment. But agricultural activities also powerfully shape the environment. Agriculture is, in fact, a human activity that affects the greatest proportion of the earth's surface. It is specifically through land use that the interaction of livelihoods and the environment is most clearly demonstrated. Land use acts as an interface between the two as it forms a unifying concept in which socio-economic and agro-ecologic variables coincide ^[35].

Livelihoods vs. land use

According to Soini E, Livelihoods are sustained and improved by new commodities from efficient land use ^[36]. A limited resource also leads to differentiation of livelihoods due to unequal access to land and natural resources. When the cultivation of land cannot support livelihoods, off-farm income becomes crucial. Land use has been considered the most important factor that influences the livelihood of rural communities. In Ethiopia, inappropriate agricultural practices, deforestation and overgrazing affect the crop and livestock productivity of the rural poor, hence also their livelihood. These alterations of ecosystem services due to changes in land use/land cover negatively affect the ability of biophysical systems to support human needs ^[37].

Impacts of LULCC on environment and rural communities' vulnerability to climate vagaries

Land use/land cover changes are important elements of the global environmental change. Though land use and land cover changes are usually local and place specific, their impacts collectively add up to global environmental change, which changes include: desertification, biodiversity loss, global warming and eutrophication. The release of carbon dioxide to the atmosphere from the global terrestrial biosphere has become a serious problem threatening the health of the environment ^[4]. Millions of hectares of tropical forest are cleared annually for agriculture, pasture, shifting cultivation and timber. One result of these changes in land use is the release of CO₂ from the cleared vegetation and soils. According to Houghton, in the century we live in, deforestation may release 5-53 percent of the carbon that would be stored in the global atmosphere. There are large uncertainties in the estimates of carbon fluxes in and out of terrestrial ecosystems, and land use and land cover change (LULCC) is one of the main contributors. Land cover changes caused by both natural and human interventions contribute towards this climate change. Change in land use may occur when the atmosphere is polluted with carbon (if forest is burned) or the release of carbon from the types of land use (methane may be released from grazing land). On the other hand, there is a better understanding that forests burnt in certain parts of the world are important contributors to greenhouse gases and contributing to climate change. Thus, climate change adversely affects the rural community through increased variability with regard to temperature, rain, frequency and intensity of extreme weather events, changes in rain patterns and in water availability and through perturbations in ecosystems. The main effects on agricultural production are expected to be an increased variability of production, decrease of production in certain areas and changes in the geography of production. Rural communities, who are dominantly dependent upon natural resources, have always been adjusting their livelihood against the vagaries of climate. With the global climate change, these communities have been placed in greater vulnerability as the weather and extreme events have become more unpredictable ^[38]. Climate change poses a considerable threat to poor farmers and rural communities in developing countries. Even a small increase in local temperatures could lead to reduced crop yields for those living at lower latitudes, especially in seasonally dry and tropical regions. More frequent and extreme weather events, such as droughts and floods, are expected to make local crop production even more difficult. Climate change is expected to put an estimated 49 million more people at risk of hunger by 2020 ^[39].

Impacts of LULCC on land resources, and its adverse effect on rural communities livelihood

Land degradation which appeared in the area particularly in agriculture is a result of rapid LULCC changes. Land use/ land cover change and conversion can lead to deterioration in the properties of soils and degradation of land that affect the cultivated land. Since land use/ land cover patterns are interrelated with the types and properties of soils. The rate and severity of soil erosion and land degradation partly depend on land use pattern. The problem of soil erosion starts with the removal of land cover for various purpose ^[37]. The land use affects the soils. The land use/ land cover is by far most important determinants of erosion in the highlands of Ethiopia ^[40]. Among others the one factor that affect the productivity of the land are land use type. Vegetation cover and dead plant biomass are also used to reduce soil erosion by intercepting and dissipating raindrops and wind energy. However, once forestland is converted to agriculture, erosion rates increase because of vegetation removal, over-grazing, and continuous cultivation.

Land degradation comprises the temporary or permanent decline in the productive capacity of land. Degradation adversely affects the productive, physiological, cultural and ecological functions of land resources, such as soil, water, plants and animals ^[41]. Scherr et al. reveal that by 2020 land degradation may pose a serious threat to food production and rural livelihood, particularly in poor and densely populated areas of the developing countries ^[42]. Land degradation occurs in a number of forms, including depletion of soil nutrients, salinization, agrochemical pollution, soil erosion, vegetative degradation as a result of over grazing, and deforestation to increase farmland. All these types of degradation cause a decline in the productive capacity of the land, and thus reduce potential yields.

Impacts of LULCC on rural communities in terms of biomass energy supply

One of the problems regarding forest cover in Ethiopia is the use of biomass energy sources. One obvious consequence

of land use/land cover change, particularly of deforestation is the shortage of fuel wood^[37]. As population increases household energy consumption also increases. For the poor in rural areas, it is not only a source of energy but a means of income generation too. In Ethiopia, 85 percent of domestic energy consumption is derived from forest products.

Vulnerability of rural communities towards the adverse effects of LULCC on rain fall and water sources

Land use/ land cover change also has impacts on local and regional climate and water resources. The LULCC also affect runoff, evapo-transpiration and surface erosion in a watershed. Land cover has various properties that help to regulate water flows both above and below ground. The destruction of vegetation cover affects rainfall amount. For example, tree canopy and leaf litter can help reduce the impact of raindrops on the ground, hence reduce soil erosion, while roots hold the soil in place and also absorb water. In the absence of vegetative cover, soil erosion will result and there is low productivity. A massive removal of forest in the Amazon has led to a decrease in evaporation and precipitation in the^[16]. LULC changes also, especially vegetation cover, affect water and energy balances. According to Turner et al. certain land use types have significant impacts beyond the proportion of their spatial extent. Land use/ land cover characteristics and water cycle have many connections. The type of land cover, obviously, can affect both rate of infiltration and run off amount by following the coming precipitation. According to Turner et al. both surface and ground water flows are significantly affected by type of land cover^[11]. Low level vegetative cover could also affect infiltration and could lead to reduced ground water levels and therefore the base flow of streams. Vegetation plays an important role in maintaining atmospheric circulation. This would alter the thermal dynamics of the atmosphere and suppresses rainfall, which would in turn, dry out more land, lakes, streams and rivers.

Impacts of LULCC on rural communities in terms of access to quality water

Water is an essential commodity for survival and the improvement of quality of life. Human population growth and land use changes have deteriorated water quality. Different land uses impact the water quality and makes it unfit for use. Proper land use management is required in order to prevent the pollutants loads into water resources^[43]. Land conversion for agricultural and urban development impacts stream and river ecosystem dynamics by changing hydrological regimes and increasing sediment and pollution loads^[44]. Surface water quality has deteriorated noticeably in many countries in the past decades due to poor land use practices indicating by the strong relationships between declining water quality and increasing agricultural development at catchment scale^[45]. Agriculture often has great effects on water quality. Chemicals like herbicides, insecticides, and fertilizers, particularly when more is applied than is needed, can run off into waterways or seep into groundwater^[46]. Water quality in agricultural systems is associated with the amount of soil lost as runoff into surface water and with the amount of plant nutrients (Nitrogen and Phosphorus) and pesticides that reach surface waters^[47]. Thus, particularly the rural communities those did not get tap water for household consumption prone to chronic health problems related to water quality.

Impacts of LULCC on rural communities in terms of livestock rearing

Land use/ land cover change have an impacts on grazing land since it is affected by forms of land degradation such as over cultivation, over grazing, deforestation and others. According to Tamirie, Ethiopia has about 60 million hectares of land for grazing. This has reduced to less than 55 million due to grassland conversion in to other land use/ land cover. An important factor contributing to the decline in fodder resources is the ever increasing human population, which resulted in an increase in cropland at the expense of traditional grazing areas such as bush lands, natural pasture and forests which have been aggravated since recently. It is important to understand effects of spatial and temporal changes of land use/land cover and demographic structure of their effects on landscape pattern that affect the grazing land. ILRI (1999) indicate that human population is increasing drastically at about 3% a year, while cattle population is drastically cut by mortality caused by drought and the interaction of drought with high stocking rate. Livestock crash more regularly now, because of fewer grazing land. Past grazing lands have now either people in them, or are degraded or otherwise insufficient for sustaining livestock herds under stress. (ILRI, 1999). The land currently under cultivation was a grazing area few years ago. Due to response to the changes, unsuitable and marginal or fragile lands are now brought under cultivation. The deteriorating environmental conditions have also adversely affected the availability of feed resources, leaving the country's herds poorly nourished. Whether it is due to conversion of land to cultivation, or due to overgrazing, the removal of vegetation cover reduces the protective cover of the soil and minimizes the re-growth and restocking capacity of vegetation. According to Hoekstra et al. an expansion of cultivated land at the expense of bush land, grazing land, forest land caused by ever increasing human population, has strongly affected the number of livestock and quality of products. In addition, shrinking of grazing land would force the livestock to move into upper slope. This intern induces over grazing and soil erosion latter treats to productivity.

Impacts of LULCC on ecosystem goods and services

Among the main effects of human activities on the environment are land uses and resulting land cover changes. Such changes impact the capacity of ecosystems to provide goods and services to the human society^[48]. LULCC may have significant impacts on the functioning of socio-economic and environmental systems that results the interplay between socio-economic, institutional and environmental factors^[49]. People living in and around the forest depend upon forest for a variety of goods and services. These includes collection of edible fruits, flowers, tubers, roots and leaves for food and medicines; firewood for cooking (some also sale in the market); materials for agricultural implements, house construction and fencing; fodder

(grass and leaf) for livestock and grazing of livestock in forest; and collection of a range of marketable non-timber forest products. According to Abermound about one billion people in the world use wild foods (mostly from plants) on a daily basis ^[50]. Moreover, over 300 million people obtain a substantial part of their livelihood in the form of Non Timber Forest Products (NTFPs) from wild forests ^[51].

Thus, increasing degradation of forest is hampering the basic human right to life and livelihood of the local communities, especially the indigenous community whose life is closely linked with the resources and environment amidst which they live ^[52].

CONCLUSION

Land is the major natural resource that economic, social, infrastructure and other human activities are undertaken on. Hence, changes in land use/land cover have occurred at all times in the past, are presently ongoing, and are likely to continue in the future. However, Changes in the condition and composition of land use/land cover affects the livelihood of rural communities directly or indirectly. As a result this review goes through different studies to synthesize different literatures and provide information that could be useful for understanding the impact of land use/land cover change upon rural livelihood. So, many studies revealed the impacts of LULCC on rural communities' livelihood in different ways. The major impact of LULCC on rural livelihood that identified by many studies include: its impacts on environment thereby rural communities' vulnerability to climate vagaries; its impact on land resources with related to land degradation, soil erosion, and productivity decrement; its impact on biomass energy Supply; Vulnerability of rural communities towards erratic rain fall and water sources problem with related to LULCC; impact on access to quality water; its negative impact on livestock rearing which related with grazing land shrinkage for agricultural land expansion, and also its impacts on ecosystem goods and services especially related with deforestation.

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