

Full Length Research Paper

Reported driving factors of land-use/cover changes and its mounting consequences in Ethiopia: A Review

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Received 21 March, 2019; Accepted 23 April, 2019

Obviously, there is land-use/cover change with multifaceted driving factors and associated adverse impacts out there in different parts of Ethiopia. Evidence from published journals justifies this fact but not yet compiled in a manner to convey information on the trend of change and its criticality with the aim to handle the problems. Thus, filing up all the driving factors and its adverse out come from different corners of Ethiopia together under one reviewed journal would help for policy measures and management aspects. In view of this, critical driving factors of land-use/cover change and all its possible consequences bridged together by reviewing highly relevant published journals. Deforestation, high human and livestock population, investment (coffee, tea plantations), agricultural activities ranging from small-scale subsistence agriculture to large-scale commercial agricultural schemes, urban sprawling, charcoal production, woodland collection, poor law enforcement, land rotation searching for better grazing land, resettlement (spontaneous and planned), prevalence of drought, were the leading drivers of land-use/cover change in Ethiopia. In response to these driving factors, the following are major identified adverse effects such as loss of biodiversity and ecosystem service degradation, deterioration of wetlands, creation of new landscape, rainfall variability, reduction in stream flow, increase frequent extreme in weather, conflicts of interest due to resource scrambling, soil and land degradation, prevalence of drought, increase in runoff and sedimentations, increased risk of desertification and woody land cover reduction. In general, these systematic reviews hopefully uncover all the existing scenarios and give mental picture of wide range driving factors of land-use/cover change and associated problems for stakeholders across the country as they might develop ways to end/reduce further vulnerabilities.

Key words: Land-use/cover change, driving factors, adverse impacts, Ethiopia.

INTRODUCTION

Obviously, there is land-use/cover change with multifaceted driving factors and associated adverse impacts out there in different parts of Ethiopia. Evidence

from published journals justifies this fact but not yet compiled in a manner to convey information on the trend of change and its criticality with the aim to handle

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the problems. Hence, understanding factors that drives land-use/cover change and its impacts in general is important for modeling, predicting environmental change and help respond to the change in most positive way to benefit the people (Tilahun and Teferi, 2015; Rawat and Kumar, 2015). Different places have different pushing factors and its consequences too. Causes for land-use/cover change are broadly grouped in to two namely; Natural and human with diverse driving forces. However, we sense natural effects like climate effect in the long run but impacts due to human intervention is most of immediate when compared with natural effects (Woldeamlak, 2002). Filing up all the driving factors and its out come from different corners of Ethiopia together under one reviewed journal would help for policy measures and management aspects. Hence, these systematic reviews could identify its wide range discrepancy, level of criticality and give mental picture particularly for experts dedicated in conservation role.

Change in land-use/cover in some localities might bring some benefits but less weighted when compared with consequences in the long run particularly in rural areas. The adverse impact of land-use/cover change also varies from place to place as the fashion of the people in approaching and causing land-use/cover change varies.

To better understand the driving factors of land-use/cover change and its wide range adverse impacts, these study systematically reviewed recently published journals related with these issues. In the courses of review, different places of the country were characterized depending on the existing situations: from identification of driving factors to consequences of its change. This study therefore bridges drivers of land-use/cover change to intermingled adverse impacts of its change in Ethiopia. It was also aimed to bring together the potential consequences of various places under one theme so as to make easy understanding of management strategies and assist policy makers for better interventions. To this end, driving factors and its consequences each treated/reviewed section by section and pinpointed under one file in way to support better management strategies.

Data sources and methods

Driving factors and adverse impacts of land-use/cover change were logically assessed and each multifaceted driving factors and adverse impacts were pinpointed by reviewing reliable literatures touching different parts of the country. Information used to reinforce the evidence with the logical reasoning were collected from different ranges of journals dealt with land-use/cover change using geospatial data backed by GIS and Remote Sensing technology and other methods to minimize uncertainties in the study. Two themes/components separately assessed and some overlapping of publication citations could be appeared repeatedly mainly to support the discussion more lively.

Limitations

One cannot find a published scientific research in every corners of the country in all aspects. This area is not yet fully researched and scientific research findings on these issues are at the infant stage in most cases. Hence, for areas where there is lack of published research findings, other variables like agro-climatic conditions, livelihood styles , population settlements and land-use/cover - patterns were considered in order to inference and minimize bias against established knowledge. The study also assumes the present scenarios as valid for the future and doesn't consider shift in technology that best welcomes the adverse changes and converts it to other fortune. This is because of the fear that the future is uncertain and mostly in state of changing (Verburg et al., 2010) that might bring fallacies against the established knowledge. Hence, the assessments and implications of different review are based on the existing status-quo keeping other possible opportunities and change kept constant.

Driving factors of land-use/cover change in Ethiopia

There are many studies pin-pointing the driving factors of land-use/cover changes identified via different scientific approaches. The driving factors were multifaceted by their nature due to different governing reasons and vary largely from place to palace.

Causes for land-use/cover change attributed to resource scrambling and forest land grabbing often misquoted as bare land or lacks signs of agriculture for investment like coffee, tea plantations and agricultural activities (small-scale subsistence agriculture to large-scale commercial agricultural schemes), poor law enforcement, resettlement (spontaneous and planned), land tenure policy, shifting cultivation have been significant drivers identified in SW Ethiopia and to some extent in Gambella and Benishangul regions (Brhane and Zemenu, 2018; Obang et al., 2017; Alemayehu, 2015; Azeb et al., 2018; Azeb, 2018; Henok et al., 2016; Kefelegn et al., 2017; Teshome et al., 2019; Semeneh et al., 2016; Yenenesh et al., 2018; Kero et al., 2018). Figure 1

While over grazing and charcoal production as means of livelihood income are dominantly seen drivers in Afar and Somali regions. These regions almost share common agro-climate, livelihood and living style fashion (Anteneh et al., 2018). The recent studies made by Wakshum et al. (2018), identified *Prosopis juliflora* invasions effects as one of the unique driving factors of land-use/cover change in South Afar, Northeast Ethiopia.

Common causes in eastern parts of Ethiopia particularly in Diredawa administration and Harari regional state were collection of woods for fuel consumption, population growth, agricultural expansion, charcoal production,

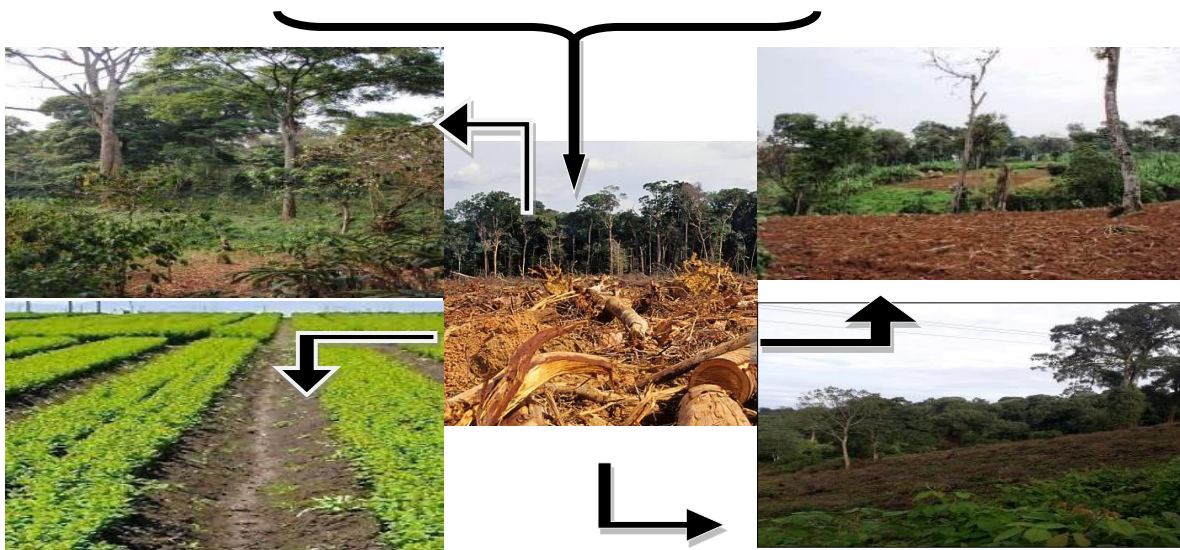


Figure 1. Sheka forest and cover change indicating how dense forest cover converted to other land-use/cover type (Atlas of maps land cover change 1973 to 2013).

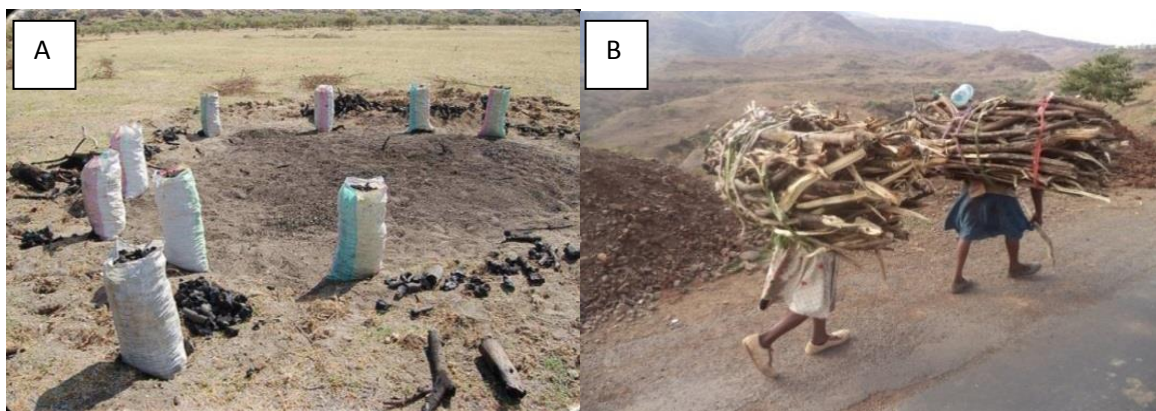


Figure 2. (a) Illegal charcoal production in Arsi Negele district. Source: Mikias (2014); (b) Deforestation in activities in Kanchama, Arbaminch zone. Source: Habtamu et al. (2017).

livestock ranching and settlement expansion (Amisalu and Toru, 2018). Factors like farmland expansion, population pressure, deforestation and collection of woods for construction and charcoal production for fuel consumption, poor land tenure policy and land fragmentations have been significant driving factors in Southern Nations, Nationalities and Peoples Regional (SNNPR) state, central and southern Oromiya regional states (Berhan and Woldeamlak, 2014; Habtamu et al., 2018; Habtamu et al., 2017; Mikias, 2014; Gebrekidan et al., 2014; Hagos, 2014) Figure 2a and b.

Driving factors prevailed in Tigray and Amhara regional states were associated with deforestations, high human and livestock population, charcoal production, agricultural expansion, prevalence of drought, resettlement (Samuale

et al., 2014; Kebrom and Hedlund, 2000; Binyam et al., 2015; Miheretu and Yimer, 2017; Negasi et al., 2018; Mesfin et al., 2016; Worku and Csaplovics, 2015).

Expansion in urbanization and urban sprawling by itself is cause and effects of land-use/cover change in most of parts of the developed and developing countries (Hassan et al., 2016; Mohan et al., 2011; Duguma, 2017). Currently urban expansion mostly unplanned advancement is the highest among zonal, regional and capital city of the country often resulted in converting rural landscape to urban landscape. This urban sprawling considered usually as sign of economic influence despite the expansion is at the expense of encroaching potential rural areas (Afera et al., 2018; Sisay et al., 2016).

Unlike to other places, land-use/cover change in pastoral areas were largely imposed by large number of livestock population leading to overgrazing, recurrent drought due to rain fall variability, poor policy, land rotation for searching better grazing land (Teka et al., 2018).

Adverse impacts of land-use/cover change in Ethiopia

Causes for land-use/cover change dynamics were diverse as extensively reviewed above and likewise, its adverse impacts are also diverse and differ largely from place to place. A review from different journals evidenced that there are a wide range of adverse impacts so far identified due to land-use/cover changes. The adverse impacts ever identified/reviewed hereunder were attributed to environmental qualities while some others are associated to socio- economic impacts.

Major underlying consequences due to land-use/cover change in Gambella, Benishangul and most parts of Southwestern Ethiopia were loss of biodiversity and ecosystem service degradation (Figure 1), deterioration of wetlands, creation of new landscape, rainfall variability, reduction in stream flow, increase frequent extreme in weather, conflicts of interest, soil lose and decline in soil fertility (Henok et al., 2016; Mathewos and Bewuketu, 2018; Getachew et al., 2014)

Amahara, North eastern parts of Benishangul, and South western parts of Tigray having similar agro-climate, landscape and livelihood of the communities experienced common problems. Hence, according to the evidence from different journal, the impacts dominantly seen were soil and land degradations, prevalence of drought, rainfall variability, decrease in wetland, increase in runoff resulting in soil and land degradation and sedimentations (Woldeamlak, 2002; Eleni et al., 2013; Woldeamlak and Solomon, 2013; Miheretu and Yimer, 2017; Negasi et al., 2018; Tesfa et al., 2018; Jacob et al. 2015; Mesfin et al., 2016; Menberu, 2014, Kassahun and Yitbarek, 2018). Figure 4

Southern Nations, Nationalities and Peoples Regional (SNNPR) state and around central and southern parts of Oromia regional state, major identified effects of land-use/cover were loss of biodiversity, soil fertility decrease, land fragmentations, forest resource deteriorations (Mikias, 2015; Mohammed et al., 2017; Shegena et al., 2016; Desalegn et al., 2014; Terefe et al., 2017; Adane and Mezgebu, 2017)

The problems dominantly reviewed in Tigray, Afar and Somali regional states were land fragmentations, fluctuations in rainfall patterns and extremisms, incidence of extremisms in weather conditions leading to drought, soil and land degradations, decrease in stream flow, wetland deterioration, increased risk of desertification (Samuale et al., 2014; Diress et al., 2010). Rugged topography with inappropriate agricultural practice is also the reasons behind land degradation particularly in

Amhara and Tigray regions. Whereas high livestock population pressure fueled with overgrazing in Afar, Harari and Somali regions facilitated the loss of soil due to erosion, decline in soil fertility and land degradation Figure 3.

There is significant woody land cover reduction in pastoral areas due to large livestock population. In areas where there is overgrazing, the density of wood land cover largely decreased and often resulted in shifting to other places (Teka et al., 2018). On the other hand, the invasion of woody plants referred to as *Prosopis juliflora* to rangelands becomes a potential threat to pastoral production in South Afar, Northeast Ethiopia (Wakshum et al., 2018). Currently, *Prosopis juliflora* is advancing in alarming rate to eastern parts of Ethiopia including Somalia, Afar, Harari regions and around Dire Dawa.

Study made by Yohannes et al. (2017), identified ecosystem deterioration due to land-use/cover change leading to disturbance of an aquatic animals and species around central rift valley lakes regions, Ethiopia. Despite all these effects, the degree of criticality however varies from place to place and ranges from localized to global level impacts. The important note here we should underline is that one impact by itself can be cause and effects for others if left for long period of time without any management schemes in placed. For example, poverty by itself is cause and effects of climate change (prolonged decrease in stream flow, rainfall variability) and this if left unmanaged lead to other adverse crises and effects like deterioration of environmental quality as a whole.

RESULTS AND DISCUSSION

This study is evidence based identifications of driving factors of land-use/cover change and its level of impacts on the environment and socioeconomic activities. We should not always attribute/give negative connotations to land-use/cover change for the fact it has also positive impacts. However, land-use/cover change induced by human for human need satisfaction often competed with yielding adverse impacts on human and the environment. Because of these, causes and effects are often complex to fully understand due to multi pushing factors such as natural and human induced factors and varies among localities, regions and largely at country level. Diversity in land-use/cover change caused by numerous factors and its adverse effects becoming a big challenge to make a distinction and the undergoing process is intermingled (Thi-Thanh-Hien et al., 2015). For instance, there are many direct and indirect impacts associated with forest deforestations. But if you ones sense the presence of deforestations, you can expect diverse associated consequences (Solomon, 2016).

In general, demographic, socioeconomic, and cultural changes were the leading drivers in most parts of



Figure 3. Overgrazing and its effects on wetlands (From Lecture Slides-Integrated River Basin Management MSc courses).



Figure 4. Soil and land degradation in North western parts of Ethiopia, Koga catchment. Source: Eleni et al. (2013).

Ethiopia resulting change in cover and land use pattern. In response to these driving factors of land-use/cover change, the adverse impacts ever identified and reviewed were attributed to environmental qualities while some others are associated to socio- economic, cultural and political impacts.

Resource scrambling and forest land grabbing for investment, agricultural activities (small-scale subsistence agriculture to large-scale commercial agricultural schemes), poor law enforcement, resettlement (spontaneous and planned), land lease policy, shifting cultivation have been significant drivers identified in south western parts of Ethiopia in general. Associated with these driving factors, loss of biodiversity and ecosystem service degradation, deterioration of wetlands, creation of new landscape, rainfall variability, reduction in stream flow, increase frequent extreme in weather, conflicts of interest, soil lose and decline in soil fertility were underlying causes ever reported in south western parts of Ethiopia.

Some driving factors like charcoal production and livestock production are common but it is one of the key livelihood incomes for Somali, Afar and Harari regions resulting in woody land cover reduction. Despite other places, these regions also uniquely threaten by the invasion of Woody plants referred to as *Prosopis juliflora* to rangelands as a potential threat to pastoral production. Unlike to other places, study made by Yohannes et al. (2017) identified ecosystem deterioration due to land-use/cover change leading to disturbance of an aquatic animals and species around central rift valley lakes regions.

Common driving factors so far identified in most parts of Oromia, Amahra and Southern and central parts of Ethiopia were agricultural expansion, population pressure and deforestation often resulted in land fragmentation, soil and land degradation, forest and woodland cover reduction. The ups and down curvature of the surface nature in Amahara and Tigray regions resulted in soil and land degradation often fueled by inappropriate agricultural

expansion, population pressure and overgrazing. As a result, increase in runoff, soil fertility loss and stream flow reduction is the case in most cases.

Unplanned urban expansion in the form of lease policy in every parts of the country is another big causes and effects of land-use/cover change. Due to urban sprawling, rural lands are now becoming parts of residential areas resulting in significant changes in land use patterns. In areas where there is shortage of rainfall particularly in pastoral areas, land-use/cover change were largely determined by large number of livestock population leading to overgrazing, recurrent drought due to rain fall variability, poor governing policy, land rotation for searching better grazing land (Teka et al., 2018).

The worst case scenario is that some changes in land-use/cover were irreversible or take long period of time to restore back (Afera et al., 2018; Thompson, 2017). For instance, loss of biodiversity and soil and land degradation may take several decades to restore back. This early warning might help to save UNESCO registered biosphere reserves in the unique landscape of Sheka and Majang zone, south western parts of Ethiopia. This place among other is a biodiversity-rich ecosystem area but threaten recently by investment (tea and coffee plantation), poor and narrowly conceived policy regarding land awarding to investors and tenure, settlement (mostly spontaneous) and cereal crop based agricultural expansions. Many research findings ensured all these identified common driving factors behind land-use/cover change and easy to think of mounting impacts on ecosystem services in general Figure 1.

Some effects of land-use/cover change are only confined to particular places but effect on the environment is common to all places despite the criticality varies (Hu and Nacun, 2018; Verburget al., 2010). Moreover, agricultural expansion is also common to all parts of the country as one of the major causal factors for land-use/cover changes. But one should not be misquoted in valuing only its positive aspects because the expansion is to compensate the soil infertility. Journals reviewed so far pointed out that one of the land-use cover change effect is loss of soil fertility due to erosion and this imposed farmers to practice extensive than intensive farming in most of the highland places. Hence, despite the expansion in agricultural practice; there is very limited yield to support the growing population demand.

Thus, this study was built from systematic meta-analysis based on wide range of reviewed studies including different perspectives, approaches and provides a common national framework for taking corrective measures with the aim to end the management challenges. Valid and timely information on land-use/cover change and its associated driving factors is indispensable strategies for national or regional based conservation strategies (Mathewos and Bewuketu, 2018; Teshome, et al., 2019; Temesgen et al., 2017). It is therefore important to bridge established knowledge with

designed policy for better environmental management.

CONCLUSIONS

The dynamics of land-use/cover change is complex due to its multivariate nature made up of intermingled proximate and underlying factors. This complexity is fueled by scattered findings across the country and challenged in drafting common and widely accepted frame work or applicable policy to manage the causes. For common understanding, all the causes and effects of each part of the country was reviewed. Generally, demographic, socioeconomic, and cultural changes were the leading drivers in most parts of Ethiopia resulting change in cover and land use pattern. In response to driving factors of land-use/cover change, the adverse impacts ever identified and reviewed were attributed to environmental qualities while some others are associated to socio- economic, cultural and political impacts. Thus, this review brought all the reported geospatial evidence based drivers, of land-use/cover change and its associated impacts, under one theme for better understanding and management of the problems in place. But, it should be noted here, that, these adverse effects in the future will be handed and cannot be threats due to technological advancement and thus might create fallacies against established knowledge. Moreover, these studies also don't considered future uncertainties as we are living in dynamic and steadily changing world.

CONFLICT OF INTERESTS

The author has not declared any conflict of interest.

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