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Research Application Summary

Ecological and gender impacts of land use cover change in Southern Ethiopia: Review

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Abstract

The rapid rate of land use and land cover change and associated dramatic dynamics over the past decades, has caused the fear that it will be one of the major environmental challenges facing the Earth over the next century. Land cover change imposes adverse ecological impact particularly through modification of natural processes of biotic and abiotic interactions. The main objective of this review is to analyze land use land cover change (LULCC) and its adverse ecological and gender impacts in southern Ethiopia. In southern part of the country, most studies started by analyzing remotely sensed data of land cover from second half of 20th century. For this review, eleven journal articles data on analyzing satellite images of LULCC in southern Ethiopia accessed and reviewed from different agro-ecological zones were considered. Besides, additional 65 materials including journal articles, documents and reports were also included. In southern Ethiopia available evidences indicate that absence of land use planning, inadequate land tenure, and agricultural and settlements expansions are the major causes of LULCC. In agricultural suitable crop and agro-forestry land, settlements are common expanding types of land use in expense of forest lands. In range lands bushlands show decreasing trends in some areas and increasing in others while grassland, settlement and cultivation increased, however, scarcity of studies limit understanding general way of change. The LULCC impact on biotic and abiotic environment was assessed and remarkable impacts were identified. The LULCC was identified as major factor of shrinkage of forest cover and ecological degradation which contributed to plant and animal biodiversity threat and loss including deterioration in the soil seed banks, physical and chemical soil quality decline, decline in Soil Organic Carbon (SOC) and other plant nutrients and lower agricultural productivity. Nearly half share of income from forest products among forest dependent women indicate that loss of forests grossly affect women empowerment.

Key words: climate change, ecosystem, deforestation, Ethiopia, land degradation, range land, women

Resume

Le taux rapide de changement d'utilisation des terres et de couverture des terres et les dynamiques dramatiques associées au cours des dernières décennies suscitent la crainte qu'il s'agira d'un des principaux défis environnementaux auxquels la Terre sera confrontée au cours du prochain siècle. Le changement de couverture des terres impose un impact écologique défavorable, en particulier par la modification des processus naturels d'interactions biotiques et abiotiques. L'objectif principal de cette revue est d'analyser le changement d'utilisation des terres et de couverture des terres (LULCC) et ses impacts écologiques et de genre défavorables dans le sud de l'Éthiopie. Dans la

partie sud du pays, la plupart des études ont commencé par analyser des données télédétectées de la couverture des terres à partir de la seconde moitié du XXe siècle. Pour cette revue, onze articles de revues portant sur l'analyse d'images satellite de LULCC dans le sud de l'Éthiopie ont été consultés et examinés, provenant de différentes zones agro-écologiques. De plus, 65 documents supplémentaires, y compris des articles de revues, des documents et des rapports, ont également été inclus. Dans le sud de l'Éthiopie, les preuves disponibles indiquent que l'absence de planification de l'utilisation des terres, la tenure foncière insuffisante et l'expansion de l'agriculture et des établissements sont les principales causes du LULCC. Dans les terres agricoles adaptées à la culture et à l'agroforesterie, les établissements sont des types d'utilisation des terres courants qui s'étendent aux dépens des terres forestières. Dans les terres de pâturage, les broussailles montrent des tendances à la baisse dans certaines régions et à la hausse dans d'autres, tandis que les prairies, les établissements et la culture augmentent. Cependant, la rareté des études limite la compréhension de la manière générale du changement. L'impact du LULCC sur l'environnement biotique et abiotique a été évalué et des impacts remarquables ont été identifiés. Le LULCC a été identifié comme un facteur majeur de réduction de la couverture forestière et de dégradation écologique, contribuant à la menace et à la perte de la biodiversité végétale et animale, y compris la détérioration des banques de graines du sol, la baisse de la qualité physique et chimique du sol, la diminution du carbone organique du sol (SOC) et d'autres nutriments végétaux, ainsi qu'une baisse de la productivité agricole. Près de la moitié des revenus provenant des produits forestiers chez les femmes dépendantes des forêts indiquent que la perte de forêts affecte considérablement l'autonomisation des femmes.

Mots-clés : changement climatique, écosystème, déforestation, Éthiopie, dégradation des terres, terres de pâturage, femmes

Introduction

Clearing of forests is one of the main processes whereby humankind has modified the earth's surface that has been dominant feature and has led land cover change which is currently reaching critical proportions (Williams, 2016). Land cover dynamics is age old phenomena and has been continuous still today; the rate of change has been increasing from centuries and but more dramatic in the last few past decades (Gebreslassie, 2014). There is a fear that it will be one of the significant environmental challenges facing the Earth over the next century. This anthropogenic process affects many parts of the earth's systems like climate, biodiversity, biogeochemical cycle and hydrology which are fundamental to sustainability of lands and general ecological processes (Mustard *et al.,* 2004). Hence land cover change has been identified as one of the most important drivers of change in ecosystems and their services through disrupting normal ecological functions. Land cover dynamics is also one of the phenomenon that link the socio economic and environmental issues (Gebreslassie, 2014) since ecosystem service contributes important portion to the economic development and social welfare by maintaining and improving environmental quality (Ayenew and Tesfay, 2015). Land use change also affect income and livelihood source particularly for women. Undeniably, stable land cover/land use maintains ecological sustainability and constituents including soil, water, biodiversity and climate (Ayenew and Tesfay, 2015). To analyze the ecological and gender impact of land use land cover (LULC) change on the ecosystem, awareness of past and present land cover dynamics is vital. However, information on the consequences of land cover change for ecosystem services and human well-being at local as well as wider scales is largely deficient (Reyers *et al.* (2009). Thus, the objective of this review is to analyze LULCC and its adverse ecological and gender impact in southern Ethiopia since there is lack of comprehensive data on the issue for the region.

Method

Different study results on the LULCC and its ecological impact in areas constituting southern Ethiopia were reviewed to understand general patterns of land use change and its adverse ecological impacts. There are no comprehensive studies covering all southern part of the country, rather research results are available at catchment or small scale at woreda levels. Area coverage of land in these studies were presented in either in hectare or square kilometer to indicate the land cover and land use changes over time though some studies use additional form of analysis. The types of land cover, naming land cover, and unit of measurement also differ according to respective researchers; these characteristics make it difficult to compile data in tables. Therefore, about eight research results of remotely sensed data analysis of LULCC from agricultural suitable areas and three from range land studies were organized in two categories and information was accessed from journal articles. Regarding ecological impacts of LULCC, additional 68 materials including journal articles, reports and documents were reviewed. Based on these sources ecological impacts of LULCC particularly impact on soil, soil elements, biodiversity, gender and ecosystem service were assessed and are presented.

LULC dynamics in southern Ethiopia. Data availability and scientific study regarding the causes of LULC and resultant land quality indicator information in the northern and southern part of the country are different in terms of time and spatial extent. During the 16th-century European travelers observed from the narration of the physical geography of the country such as the watersheds, topography, the seasonal rainfall and vegetation or the description of forest and the wildlife during their short stay in the country (Ambrosetti *et al.,* 2016). As mentioned by different sources, information about land cover and environment in southern Ethiopia in scholarly writing present data of few decades indicating that environment was intact. In the Southern part of Ethiopia it is believed that land degradation which resulted from land use land cover change (LULCC) is a relatively recent phenomena (Tigabu *et al.,* 2014). During the 19th century, most parts of the southern Ethiopia and Central Rift Valley were covered by high forests. But from late 19th century, the continuous change of economic, socio-political and cultural conditions has affected the natural indigenous forest cover of southern Ethiopia (McCann, 1999; Muluneh, 2010). Rahamato (2001) indicated that as a result of environmental damage in the Rift Valley area of southern Ethiopia "thousands of hectares" of forest were deliberately set on fire by peasants and pastoralists who wanted to convert the land into farmland and pasture.

LULC dynamics in agricultural suitable areas. In this section LULCC in agriculture practice dominated areas are presented. In such situation about eight journal articles were accessed for study results from different scholars in southern Ethiopia and LULC change rates were reviewed. In these areas common land use/cover types include seasonal or perennial crop cultivation, agroforestry, and forest; while shrub/bush land, grass and wood lands are common in range lands.

As indicated in the Table 1, different studies in southern Ethiopia show that agricultural land cover increased with larger number of hectares and agro-forestry also increased next to crop land use. For example, analysis of land remotely sensed data of 1987, 2001 and 2015 identified that in Addiyo woreda, Kaffa Zone, different land use has shown a remarkable change between 1987 and 2015, however, with conversion from forest to other land uses taking the largest share. Forest cover accounted for 8146 ha (65%) and 3709 ha (29.47%) of the total area in the year 1987

Table 1. Land Use and Land Cover Change in agricultural suitable areas in Ethiopia

Reference year	Forest	Crop lands	Agroforestry	Settlement	Grass land	Shrublands	Bare land	Reference
		Ameleke Watershed, area by hectare						
1986	-	1626	433	-	1807	2112	-	Worku et al., 2014
2000	-	2052	492	-	1601	1596	-	
2006	-	2156	529	-	1043	1690	-	
Change in ha 1986-2006	-	+530	+96	-	-764	-422	-	
		Elemo Micro-Watershed, Gedeo, area by hectare						
1987	-	426	34	-	773	171	147	Legesse et al., 2018
1995	-	391	167	-	748	106	139	
2011	-	359	207	-	469	456	60	
2015	-	303	252	-	473	517	6	
Change in ha from 1987-2011	-	-67	+173	-	-304	+285	-87	
		Abaya-Chamo Basin (ACB), area by km						
1985	531.6	4454.0	2226.3	7.5	3205.7	4 477.9	-	Yohannes et al., 2018
1995	530.9	6043.4	2144.6	10.6	2264.6	4 076.5	-	
2010	522.5	7088.6	2216.8	25.0	2143.8	3188.2	-	
Change in % km^2 from 1985-2010	-9.1	+2634.6	-9.5	17.5	1061.9	-1289.7	-	
		Bilate Alaba subwatershed, area by hectare						
1972	3777.48	9402.48	-	318.0	-	22303.5	4467.97	Godebo et al., 2018
1986	3961.44	13335.20	-	1318.0	-	20340.0	1314.36	
2008	1686.40	15648.00	-	1262.34	-	19221.6	2478.15	
2017	1270.93	15738.30	-	2011.10	-	18208.3	3968	
Change in ha from 1972-2017	-2506.55	+6335.82	-	+1693.1	-	-4095.2	-499.97	
		Yeki and Decha woredas, area by hectare						
1973	40981	11012	-	-	-	-	-	Tadesse et al., 2014 (Yeki woreda)
2010	19973	18531	-	-	-	-	-	
Change in ha 1973-2010	-21008	+7519	-	-	-	-	-	
1973	76491	62668	-	-	-	-	-	Tadesse et al., 2014 (Dech woreda)

2010	54834	77775	-	-	-	-	-	
Change in ha 1973-2010	-21657	+15107	-	-	-	-	-	
Somodo watershed, Didessa catchment in Upper Blue Nile river, area by hectare								
1985	474	472	663	-	239	-	-	Alemayehu etal., 2019
1995	377	519	839	-	112	-	-	
1999	362	587	856	-	63	-	-	
2005	401	396	721	-	330	-	-	
2017	414	466	713	-	255	-	-	
1985-2017								
Change in ha	-60.57	-5.22	49.77		16.02	-	-	
Wallecha Watershed, North West of Lake Abaya, area by hectare								
1984	2153.34	3779.91	-	-	-	-	487.89	Babiso et al., 2016.
2000	1405.26	4271.85	-	-	-	-	326.61	
2010	1262.16	4493.79	-	-	-	-	289.53	
Change in ha 1984-2010	-891.18	+713.88	-	-	-	-	-198.36	
Addiyo woreda, Kaffa Zone, Changes of forest to other forms of Land Use by hectare								
	Forest to agriculture			Forest to shrub		Forest to grazing		Danano et al., 2018
1987-2001	426			488		906		
2001-2015	2612			23		0		
1987-2015 conversion in ha	3028			511		229		

and 2015, respectively (Danano *et al.,* 2018). Agro-forestry expansion with respecct to forest-based ecosystem services has been towards forest-coffee mosaics as forest loss continues in southwestern as well as other parts of the Region (Tadesse *et al.,* 2014), Across studies, forest cover and shrub lands showed continuous decline. Bare land also showed decreasing trends and this may be contribution of the measures taken to rehabilitate degraded lands.

LULCC dynamics in rangelands. This section covers LULCC studies in range lands of southern Ethiopia, particularly Borena range lands and and Nech Sar National park areas. According to Liao *et al.* (2018) rangelands in southern Ethiopia have been undergoing a rapid regime shift from herbaceous to woody plant dominance in the past decades, reducing indigenous plant biodiversity, altering ecosystem function, and threatening subsistence pastoralism; moreover, the study in Borena range land identified that spatial locations of bush encroachment occurred rapidly (Liao *et al.,* 2018). Other three research results reviewed from journal articles are presented in Table 1.

In Borena range land there is decrease in bushland vegetation cover whereas grassland, crop land, bare land covers increased. According to Mgalula (2016), bushland decreased as a result of the government clearing it to encourage grassland coverage and settlement increased because of immigration and natural increase (Mgalula, 2016). The study in Yabello woreda found that grassland and shrubby grassland covers were in a declining trend between 1987 and 2003. On the other hand, the size of woodland, bushland, settlement, and

Table 2. Land Use and Land Cover Change in rangeland areas in Ethiopia

Reference year	Crop land	Settlement	Bushland	Woodland	Grassland	Bare land	Reference
Samaro, Borena range land, Area by hectare							
1985	1665	68	8451	1047	2991	1270	Mgalula, 2016
2011	1639	79	4315	1254	6924	1729	
change in ha from 1985-2011	-26	+11	-4136	+207	+3933	+459	
Haralo, Borena range land, area by hectare							
1985	1231	-	5813	1	1340	576	Mgalula, 2016
2011	1601	-	2320	80	3146	2044	
change in hectare from 1985-2011	+370	-	-3493	+79	+1806	+1468	
Land cover in Did mega, Borena range land, area by hectare							
1985	851	-	4041	472	341	919	Mgalula, 2016
2011	912	-	1860	274	1908	1069	
Change in hectare from 1985-2011	+61	-	-2181	-198	+1567	+150	
Yabelo woreda, Borena range land, area by km^2							
1987	16.6	7.9	1197.1	1209.5	2172.1	110.1	Abate and Angassa, 2016
1995	28.1	18.7	1161.2	1478.9	1925.2	109.1	
2003	59.3	72.0	1444.0	1369.5	1994.4	108.2	
change in by km^2 from 1987-2003	+42.7	+64.1	+247.1	+160	-177.7	-1.9	
Nech Sar National Park, area by hectare							
1985	Forest 3197.70	-	4862.34	5972.04	8740.71	-	Fetene et al., 2019
1995	2497.23	-	5409.18	5599.80	6915.06	-	
2005	2381.49	-	6763.95	4873.68	4973.40	-	
2013	2087.91	-	c7975.98	4872.51	2278.62	-	
Change in ha from 1985 – 2013	-1109.79	-	+2566.8	-727.29	-4636.44	-	

cultivated land covers increased (Abate and Angassa, 2016). The LULCC in Nech Sar National Park showed that anthropogenic disturbances in the park has led to change in size, number, distance, spatial distribution and configuration of fragmentation in the habitat between 1985 and 2013. The most probably highest impacts were reduction of forest and grassland habitats through fuel wood and construction wood collection, settlement and overgrazing (Fetene *et al.,* 2019). In southern Ethiopia, major causes of LULCC include absences of land use planning and practice and rapid population growth and these are the two primary causes for continuous land use/cover change in Ethiopia. Development activities have happened without clear strategic analysis of optimal allocations of land in the regions for industry, forestry, crop agriculture, fisheries, tourism and wildlife (Keeley *et al.,* 2014). Land-use changes during the past couple of decades in rural Ethiopia are mostly linked to agricultural developments, land tenure issue, unwise use of its natural resources, agricultural development policies and government-sponsored resettlement programs which are majorly responsible factors for LULCC (Bielli *et al.,* 2001; Tadesse *et al.,* 2014; Alemu, 2015; Zewdu *et al.,* 2016; Getahun *et al.,* 2017).

Ecological impacts of land use land cover change. Ecological impact of land use land cover change (LULCC) can be two dimensional, i.e., desirable or adverse effects. If land use type changed from bare or agricultural land to vegetation cover the impact would be desirable as this would sustain ecological functions while when the LULCC is reverse it poses negative impacts on ecosystem. In most developing world the situation happing is the latter case since land cover commonly changed from vegetation cover to agricultural land. Thus, in this paper negative ecological and gender impact of LULCC was reviewed.

The concept of ecology is the study of interactions among organisms and their environment that is biotic or abiotic. Ecology includes many aspects: biological diversity, production and biomass, distribution of population, as well as competition between them within and among ecosystems. On the other hand an ecosystem is a community of living organisms comprising plant, animal and microbes in conjunction with the non living components including air, water and mineral soil, and interacting as a system that produce life-supporting functions through the regulation of climate, biogeochemical cycles, soil formation, water filtration (Ricard, 2014; Ricard, 2014; Buraka *et al.,* 2019). Thus, ecological or ecosystem function are linked to general environmental systems in multiple complex pathways. LULCC affect not only land surface/subsurface but also general components and interactions of biosphere and other spheres (environmental systems) on which biosphere depends (Girma and Hassan, 2014; Tadesse *et al.,* 2014). LULCC has contributed to land and/or ecosystem degradation which is the common environmental problem in Ethiopia (Gashaw *et al.,* 2014) because LULCC and land degradation are associated with deforestation, biodiversity loss and land degradation (Tsegaye, 2019).

Further, land degradation directly affects the type of plants grown in a given area, reduces availability of potable water, depletion of aquifers, soil erosion and soil quality, biodiversity loss and lessenes volumes of surface water. It is one of the major causes of low and declining agricultural productivity and continuing food insecurity and rural poverty in Ethiopia and other paert of the world (Gashaw *et al.,* 2014; Alemu, 2015). Detail impacts on soil, biodiversity and ecosystem service, soil organic carbon and climate are discussed in the sections below.

Impact on Soil. Many researches in southern Ethiopia show that LULCC has been transforming

from vegetation cover to agricultural fields, where more soil erosion takes place, and this has led to land degradation. The resultant ecological impacts of land degradation include loss in the chemical, physical and/or biological properties of soil which directly affects the type of plants that are grown in an area (Gashaw *et al.,* 2014). The overall qualities of the soils in Geshy Sub catchment of Omo-Gibe basin, under the cultivated land were inferior in soil quality indicators such as volumetric soil water content, total porosity, and water infiltration rates. There was higher density of soil in grazing land and top surface and this might be attributed to excessive livestock trampling and its tendency to increase with depth soil. On higher slopes under cultivation decrease in available phosphorous, extractable boron, exchangeable calcium, copper, zinc and iron are common with an increase in slope positions (Laekemariam *et al.,* 2016; Dagnachew *et al.,* 2019). Cultivation of hilly marginal lands in Chencha and Arba Minch, three subwatersheds near Lake Hawassa, Wolaita zone led to sever soil erosion and areas of fragile ecosystems. Such soil erosion resulted in a decline in soil fertility (Assefa, 2012; Gebretsadik, 2014). Frequent irrigation in Sego farm near Lake Chamo led to around 6 ha of the area to get moderately to strongly salinized per year (Zewdu *et al.,* 2017). Therefore, these studies enlighten that change in land cover and use, continuous cultivation, unsustainable agricultural practices affected physical, biological and chemical properties of soil.

Impact on biodiversity and ecosystem service. Under LULCC, major ways of biodiversity degradation and loss are fragmentation and loss of habitats, over-exploitation of natural resources; homogenization of species in agriculture, pollution of air and water (Gashaw *et al.,* 2014; Gebretsadik, 2016). Studies in Wallecha Watershed, Munessa-Shashamane forest and surroundings, Gojera and Upper Web Valley, Borena range lands and south central Rift Valley found remarkable impacts of LULCC on biodiversity, habitat fragmentation, losses of habitat through LULCC and increased number livestock in range lands and National Parks (Nech Sar and Bale) which caused a decline in wildlife species, such as loss of Swayne's heartbeest from Nech Sar park over the last three decades. In Borena range lands decline in grass cover in Yabello woreda and threat to native plant diversity has contributed to the reduced ecosystem and livelihood resilience. In south central Rift Valley land transformation from vegetation cover to agricultural lands caused substantial damage to biodiversity and watershed services (Stephens *et al.,* 2001; Dessie and Kleman, 2007; Girma and Hassan, 2014; Abate and Angassa, 2016; Babiso *et al.,* 2016; Fetene *et al.,* 2019). Loss of vegetation cover even led to deterioration of soil seed banks (Lemenih, 2004). A study in Bilate Alaba Sub-watershed showed that Ecosystem Service Value decreased by 26.6% from 1972 to 2017 and this was attributed to LULCC (Godebo *et al.,* 2018). Further, the pressure of LULCC led to rangeland fragmentation, homogenization of species in agriculture, decline ecosystem Service Value, and loss of plant and animal biodiversity including deterioration in the soil seed banks.

Impact on soil organic carbon and other elements. Study in Munessa-Shashamane forest and surroundings indicate that soil organic carbon (SOC) and total N declined exponentially in the 0-10 cm layer of the soil. Soil pore space decreased progressively and bulk density increased in the 0-10 and 10-20 cm soil layers with increasing cultivation period after deforestation. Available P and K, exchangeable K, Ca and Mg, BS and CEC also changed significantly (Lemenih, 2004). Geshy Subcatchment of Omo-Gibe basin SOC showed decline in total nitrogen and SOC content in cultivation lands that could be caused by the burning and removal of the biomass and insufficient replenishment (Dagnachew *et al.,* 2019). Similarly, the effect of land use change

on SOC stock in three land use types, i.e., enclosures, communal grazing and cultivated lands in Yabello woreda, Borena rangeland indicated that there were significant interactions between land use types and depths for soil organic carbon stock. Communal grazing and crop cultivation resulted in significant decrease in soil organic carbon stock with mean losses of 60% and 69% in SOC stock from the surface layer (0-10 cm) of communal and cultivated lands, respectively, as compared to enclosure land use type (Shiferaw, *et al.,* 2019).

Impact on climate. Land is both a source and a sink of GHGs and plays a key role in the exchange of energy, water and aerosols between the land surface and atmosphere, and LULCC deviates the rate of interaction of these matters. Changes in forest cover for example directly affect regional surface temperature through exchanges of water and energy (IPCC, 2019). LULC change influences hydrological process in a catchment through surface runoff and evapo-transpiration where area affected by reduction of vegetation coverage increases wet river flow and decreases dry river flow (Tesfaye, 2017). Burning and/or decaying biomass from deforestation of vegetation releases CO_2, CH_4, N_2O, ozone-precursors and aerosols including black carbon to the atmosphere (Smith *et al.,* 2014) and increase in their concentration in the atmosphere can cause climate change. LULCC particularly conversion of forest lands to agriculture, for example, contributes a lot to climate change in Ethiopia since in most cases land use change is conversion to the agricultural land (Hailemariam *et al.,* 2016). According to Ethiopia's 2015 report, agriculture, forestry, and other land use accounted for 79% from total 146 Mt CO_2e of GHG country's emissions by the year 2013 (FDRE-MFE, 2015). Whereas at world scale, global models estimate that net CO_2 emissions of 5.2 ± 2.6 $GtCO_2$ /yr from land use and land cover change occurred between 2007-2016, mostly due to deforestation (IPCC, 2019). This requires that there must be careful planning in the area to mitigate climate change; design wise ways of meeting food security and stabilize population growth since rapid population increase necessitates additional agricultural land, which is the main cause of deforestation.

Agricultural expansion into forest lands and its implication to rural women. Ethiopia is an agricultural-based economy, with more than 85% of its population largely depending on the agricultural sector for its livelihood and this agricultural expansion has contributed to higher rate, 85,000 ha per year, of deforestation though other factors also have a role. Land use conversion for smallholder agricultural expansion, promotion of large-scale commercial agriculture and government-led human resettlement in forest areas led to deforestation and forest degradation thus threatening Ethiopian forest biodiversity and ecosystem services (Cherinet and Mulugeta, 2003; FDRE-MEFCC, 2017). Besides environmental service, forests provide many products and services that contribute to socio-economic development for world's poorest rural people as base of income and livelihood for those living in close proximity to forests, and those who make use of trees outside forests (FAO, 2016; FAO, 2018).

There are wide ranges of community in Ethiopia who are dependent on forest product for their livelihoods in which women are involved to greater extent. Small scale studies in different parts of the country indicated remarkable contributions of forest products to household income. For example, income from forest products in Hammer woreda, south west Ethiopia, contributes 21.4% of the total annual household income (Fikir *et al.,* 2016). A study in Bale Highlands indicated that forest products contributed to 34% per capita income and forest income and also reduces income inequality with Gini coefficient by 15.5%; and income from forest served as safety nets in times of income crisis (Yemiru *et al., 2*010). In localities of Bench maji, Sheka, Masha and Andracha,

south western part of the county NTFPs including forest coffee and honey represents almost 50% of total household cash income (Chilalo and Wiersum, 2011). Assessment of forest role in areas of Chilimo Forest (Dendi Woreda) indicated that forest income contributed 39% of the average household income (59% for poorest and 34% for wealthiest), roughly equal to agriculture, which contributed 40% (Mamo *et al.,* 2007). Concerning country wide contribution, a study conducted by UN-REDD (UNEP and UNDP) Programme and Ministry of Forest, Environment and Climate Change of Ethiopia to assess the socio-economic value of forest products and services for rural communities indicated that about 11.6 million rural households in Ethiopia rely on some aspect of timber and non-timber forest products for their livelihood. Based on this survey, forestry sector was estimated to have contributed 11.2% of national GDP in 2014/15 (MFECC and UN-REDD, 2017). Further, forest products have great role in gender equality in income since NTFPs contributed to total annual income for women and reduced income inequality in Gimbo woreda, south west Ethiopia. Comparing the Gini index with and without NTFPs production (income), the income disparity lowered from 0.40 to 0.27 with the inclusion of NTFPs (Kassa and Yigezu, 2015).

In developing world, rural women have less access to information, productive resources, markets, are excluded from decision-making and have less secure land tenure rights than men particularly in agricultural society (World Bank, 2017). This is due to discriminatory customary and statutory laws and practices that favor men over women access to land and other productive resources (UN *et al.,* 2011). However, the constitution of Ethiopia propagates gender equality but the cultural practice still favor men. To this effect, usually women have limited bargaining power due to social norms, lack of control over the means of production and/or relatively lower shares of income in agricultural production as compared to men (Tirivayi *et al.,* 2013). In Ethiopia, gender disparity and resource entitlements (land, capital, and material) inequality even result in increased deforestation. Women in rural Ethiopia are disadvantaged and resources ownership is entirely in the male domain. Thus, women tend to rely on free access resources such as forests for their income (FDRE-MoEFCC, 2017) since forests provide many products and services, and hence, women's enhanced access to these have strong potential to improve gender equality across the developing world (FAO, 2018). Rural women in Ethiopia are the main group of society affected more by deforestation and forest degradation. Because deforestation reduces access to forest products that are required on daily basis, it adds to the drudgery of women who are forced to cover long distances and spend more time in fetching fuel wood and other forest products (Gebrehiwot, 2007). However, Ethiopian poor women have traditionally played a significant role in managing, using and protecting forest resources and for household consumption as well as to generate income to secure their livelihood (Gebrehiwot, 2007, FAO, 2016). Reviewed literature showed that forest resource based livelihood and income support greater gender equality than agricultural dominant one.

Conclusion

Land cover land use dynamics studies showed remarkable changes in land cover-transformation from other land cover particularily from forest to agricultural lands especially in agro-suitable climate and soils. In rangeland, effect of land cover change from bush to grasslands assisted by human action as it used for grazing is unclear. Land cover change has been identified as one of the main drivers of change in ecosystems and their services. Ecological impacts of LULCC in southern Ethiopia includes change in the chemical, physical and/or biological properties of soil

like increased salinity, disruption of soil organic matter and nutrient cycles and erosion which directly affects the type of plants that are grown on the area, and this contributed to climate change through changing land surface cover. Agriculture is continously expanding type of land use in expense of forests, and especially decline of forests and this affects women who depend on it for their income and livelihood. Therefore, LULCC influence general environmental quality through complex pathways and to minimize its adverse impact careful planning and management of land cover and land use is important, especially since agriculture, which is key to livelihood in Ethiopia is also the primary cause of land cover change.

Reference

Abate, T. and Angassa, A. 2016. Conversion of savanna rangelands to bush dominated landscape in Borana, Southern Ethiopia. *Ecological Processes* 5 (1):1-18.

Alemayehu, F., Tolera, M. and Tesfaye, G. 2019. Land use land cover change trend and its drivers in Somodo watershed South Western, Ethiopia. *African Journal of Agricultural Research* 4 (2): 102-117.

Alemu, B. 2015. The effect of land use land cover change on land degradation in the highlands of Ethiopia. *Journal of Environment and Earth Science* 5 (1): 1-12.

Ambrosetti, D, Boisserie, J R., Ayenachew, D. and Guindeuil, T. 2016. Climatic and environmental challenges: Learning from the Horn of Africa. Open Edition Books, DOI: 10.4000/books.cfee.101

Ango, T.G. 2018. Medium-scale forestland grabbing in the Southwestern highlands of Ethiopia: Impacts on local livelihoods and forest conservation. Land 2018, 7, 24; www.mdpi.com/journal/land; doi:10.3390/land7010024

Assefa, E. 2012. Landscape dynamics and sustainable land management in southern Ethiopia. Doctoral dissertation, Christian-Albrechts Universität Kiel. 144pp.

Ayele, G. T., Demessie, S. S., Mengistu, K. T., Tilahun, S. A. and Melesse, A. M. 2016. Multitemporal land use/land cover change detection for the Batena Watershed, rift valley lakes basin, Ethiopia. Springer International Publishing Switzerland.

Ayenew, B. and Tesfay, Y. 2015. Economic valuation of forest ecosystems service's role in maintaining and improving water quality. *Economics* 4 (5): 71-80. doi: 10.11648/j.eco.20150405.11

Babiso, B., Toma, S. and Bajigo, A. 2016. Land use/land cover dynamics and its implication on sustainable land management in Wallecha Watershed, Southern Ethiopia. *Global Journal of Science Frontier Research*: *H Environment and Earth Science* 16 (4): 9-53.

Beavor, A. and Augustinus, C. 2018. Women's Economic Empowerment Linked to Land Programming: A Review of evidence for DFID Ethiopia. WOW Helpdesk Query No. 14. London, UK: WOW Helpdesk.

Berihun, M.L., Tsunekawa, A., Haregeweyn, N., Meshesha, D.T., Adgo, E., Tsubo, M., Masunaga, T., Fenta, A. A., Sultan, D., Yibeltal, M. and Ebabu, K. 2019. Hydrological responses to land use/land cover change and climate variability in contrasting agro-ecological environments of the Upper Blue Nile basin, Ethiopia. *Science of the Total Environmen*t 689: 347–365.

Bielli, C., Berhanu, G., Isaias, A. and Oras, A. 2001. Population growth and environment in Ethiopia: In-Depth Studies from the 1994 Population and Housing Census in Ethiopia. CSA -Addis Ababa, Institute for Population Research Roma.

Buraka, T., Assen, M. and Elias, E. 2019. Review of land use and land cover change and its causes, consequences and environmental implications in highlands of Ethiopia. *International Journal*

for Research in Applied and Natural Science 5 (5): 1-26.
Commission of the European Communities. 2008. Addressing the challenges of deforestation and forest degradation to tackle climate change and biodiversity loss. Commission Staff Working Document, Commission of the European Communities, SEC(2008) 2619/2. Brussels.
Cherinet, H. and Mulugeta, E. 2003. Towards gender equality in Ethiopia: A profile on gender relations. Sida
Chilalo, M. and Wiersum, K. F 2011. The role of non-timber forest products for livelihood diversification in Southwest Ethiopia. *Ee-JRIF– Agriculture and Forestry* 3 (1): 44-59.
Dagnachew, M., Moges, A. and Kassa, A K 2019. Effects of land uses on soil quality indicators: The case of Geshy Subcatchment, Gojeb River Catchment, Ethiopia. *Applied and Environmental Soil Science* 26: 1-11.
Daley, B. 2015. Environmental issues in Ethiopia and links to the Ethiopian Economy. DFID report, UK
Danano, K. A., Legesse, A. and Likisa, D. 2018. Monitoring deforestation in South Western Ethiopia using Geospatial Technologies. *J Remote Sensing and GIS* 7: 229. doi:10.4172/2469-4134.1000229
Debebe, D. 2010. The impact of deforestation on soil erosion and climate change: structural equations modeling. Msc Thesis, Addis Ababa University, Ethiopia.
Dessie, G, and Kleman, J. 2007. Pattern and magnitude of deforestation in the South Central Rift Valley Region of Ethiopia. *Mountain Research and Development* 27 (2): 162–168. https://doi.org/10.1659/mrd.0730
Fetene, A., Yeshitela, K. and Gebremariam, E. 2019. The effects of anthropogenic landscape change on the abundance and habitat use of terrestrial large mammals of Nech Sar National Park. *Environ Syst Res* 8 (1):1-16.
Fikir, D., Tadesse, W. and Gure, A. 2016. Economic contribution to local livelihoods and households dependency on dry land forest products in Hammer District, Southeastern Ethiopia. *International Journal of Forestry Research*, Hindawi Publishing Corporation, Volume 2016, Article ID 5474680, 11 pages; URL: http://dx.doi.org/10.1155/2016/5474680
Food and Agriculture Organisation (FAO). 2003. Role of planted forests and trees outside forests in sustainable forest management in the Republic of Ethiopia. Thomas, I. and Bekele, M. (Eds.). Planted forests and trees Working Papers, Working Paper 29. Forest Resources Development Service, Forest Resources Division. FAO, Rome (unpublished).
Food and Agriculture Organisation (FAO). 2016. State of the World's Forests. Forests and agriculture: land-use challenges and opportunities. FAO, Rome.
Food and Agriculture Organisation (FAO). 2018. The State of the World's Forests 2018 - Forest pathways to sustainable development. FAO, Rome, Italy.
FDRE-MFE, Federal Democratic Republic of Ethiopia-Ministry of Environment and Forest. 2015. Ethiopia's Second National Communication to the UNFCCC. FDRE-MEF, Addis Ababa, Ethiopia.
FDRE-MEFCC, The Federal Democratic Republic of Ethiopia Ministry of Environment, Forest and Climate Change. 2017. Strategic Environmental and Social Assessment (SESA): For the implementation of REDD+ in Ethiopia. FDRE-MEF Report, Addis Ababa, Ethiopia.
Gashaw, T., Bantider, A. and G/Silassie, H. 2014. Land degradation in Ethiopia: Causes, impacts and rehabilitation techniques. *Journal of Environment and Earth Science* 4 (9): 98-104.
Gebrehiwot, M. 2007. Gender Mainstreaming in Forestry in Africa: Ethiopia. FAO, Rome, Italy.
Gebreslassie, H. 2014. Land use-land cover dynamics of Huluka watershed, Central Rift Valley,

Ethiopia. *International Soil and Water Conservation Research* 2 (4): 25-33.
Gebretsadik, T. 2016. Causes for biodiversity loss in Ethiopia: A review from conservation perspective. *Journal of Natural Sciences Research* 6 (11): 2224-3186.
Gebretsadik, Z. M. 2014. Watershed degradation and the growing risk of erosion in Hawassa-Zuria District, Southern Ethiopia. *J Flood Risk Management* 7: 118–127. DOI: 10.1111/jfr3.12033
Getahun, K., Poesen, J. and Rompaey, A. V. 2017. Impacts of resettlement programs on deforestation of moist evergreen Afromontane forests in Southwest Ethiopia. *Mountain Research and Development* 37 (4): 474-486.
Girma, H. M. and Hassan, R. M. 2014. Drivers of land-use change in the Southern Nations, Nationalities and People's Region of Ethiopia. *African Journal of Agriculture and Resource Economics* 9: 148-164.
Godebo, M. M., Ulsido, M. D., Jijo, T. E. and Geleto, G. M. 2018. Influence of land use and land cover changes on ecosystem services in the Bilate Alaba Sub-watershed, Southern Ethiopia. *Journal of Ecology and The Natural Environment* 10 (9): 228-238. DOI: 10.5897/JENE2018.0709
Hailemariam, S.N., Soromessa, T. and Teketay, D. 2016. Land use and land cover change in the Bale Mountain Eco-Region of Ethiopia during 1985 to 2015. *Land* 5 (4): 41-
IPCC. 2019. Climate change and land: Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Summary for Policy makers. WGI, II and III Approved Draft. WMO and UNEP.
Kassa, G. and Yigezu, E. 2015. Women economic empowerment through non timber forest products in Gimbo District, South West Ethiopia. *American Journal of Agriculture and Forestry* 3 (3): 99-104. doi: 10.11648/j.ajaf.20150303.16
Keeley, J., Seide, W. M., Eid, A. and Kidewa, A. L. 2014. Large-scale land deals in Ethiopia: Scale, trends, features and outcomes to date. London: IIED
Laekemariam, F., Kibret, K., Mamo, T., Karltun, E. and Gebrekidan, H. 2016. Physiographic characteristics of agricultural lands and farmers' soil fertility management practices in Wolaita zone, Southern Ethiopia. *Environmental Systems Research* 5(1):1-15. DOI 10.1186/s40068-016-0076-z
Legesse, A., Bogale, M. and Likisa, D. 2018. Impacts of community based watershed management on land use/cover change at Elemo micro-watershed, Southern Ethiopia. *American Journal of Environmental Protection* 6 (3): 59-67. doi: 10.12691/env-6-3-2.
Lemenih, M. 2004. Effects of land use changes on soil quality and native flora degradation and restoration in the highlands of Ethiopia: Implications for sustainable land management. Doctoral Thesis, Swedish University of Agricultural Sciences, Uppsala.
Liao, C., Clark, P.E. and DeGloria, S.D. 2018. Bush encroachment dynamics and rangeland management implications in southern Ethiopia. *Ecol Evol.* 8:11694–11703. https://doi.org/10.1002/ece3.4621
Mamo, G., Sjaastad, E. and Vedeld, P. 2007. Economic dependence on forest resources: A case from Dendi Woreda, Ethiopia. *Forest Policy and Economics* 9: 916–927.
Mengistu, D. A. 2008. Remote sensing and GIS-based land use and land cover change detection in the Upper Dijo River Catchment, Silte Zone, Southern Ethiopia. Working papers on population and land use change in Central Ethiopia. Addis Ababa University
Mogues, T., Cohen, M.J., Birner, R., Lemma, M., Randriamamonjy, J., Tadesse, F. and Paulos, Z. 2009. Agricultural extension in Ethiopia through a gender and governance lens. Development Strategy and Governance Division, International Food Policy Research Institute– Ethiopia

Strategy Support Program 2, Ethiopia.
Mustard, J. F., Defries, R. S., Fisher, T. and Moran, E. 2004. Land use and land cover change pathways and impacts. Kluwier, Netherlands
Muluneh, A. 2010. Synthesis of research on land use and land cover dynamics in the Ethiopian highlands. Iceland
McCann, J. C. 1999. Green land, brown land, black land: An environmental history of Africa, 1800–1990. Oxford: James Currey.
Mgalula, M. E. 2016. Assessing trends in land use change in the Borana rangeland Ethiopia as one cause of greenhouse gas emissions and carbon sequestration variations. PhD project. German Institute for Tropical and Subtropical Agriculture, DITSL Witzenhausen, Germany.
Ministry of Environment, Forest and Climate Change (MEFCC). 2017. National Forest Sector Development Program, Ethiopia. Volume II: Program Pillars, Action Areas and Targets
Ministry of Environment, Forest and Climate Change (MEFCC) and UN-REDD Programme 2017. Assessment of Socio-economic value of forest products for rural communities in Ethiopia. UNDP Ethiopia.
Palo, M. and Mery, G. (Eds.). 1996. Man and forest in African history. Sustainable forestry challenges/or developing countries. pp. 311-326. Kluwer Academic Publishers.
Nigussie, A. M. 2016. Land use/land cover changes and associated driving forces in Bale eco-Region, Ethiopia. MSc. Thesis, Haramaya University.
Rahmato, D. 2001. Environmental change and State policy in Ethiopia: Lessons from past experience. FSS Monograph Series 2; Forum for Social Studies, Addis Ababa.
Reyers, B., O'Farrell P. J., Cowling R. M., Egoh, B. N., Le Maitre, D. C. and Vlok J. H. J. 2009. Ecosystem services, land-cover change, and stakeholders: finding a sustainable foothold for a semiarid biodiversity hotspot. *Ecology and Society* 14 (1): 38. [online] URL: http://www.ecologyandsociety.org/vol14/iss1/art38/.
Ricard, M. 2014. Ecological principles and function of natural ecosystems: Intensive Programme on Education for sustainable development in Protected Areas. UNESCO.
Shiferaw, A., Yimer, F. and Tuffa, S. 2019. Changes in soil organic carbon stock under different land use types in semi-arid Borana rangelands: Implications for CO_2 emission mitigation in the rangelands. *J Agri Sci Food Res* 10 (245):1-5.
Smith, P., Bustamante, M., Ahammad, H., Clark, H., Dong, H., Elsiddig, E.A., Haberl, H., Harper, R., House, J., Jafari, M. and Masera, O. 2014. Agriculture, forestry and other land use (AFOLU). pp. 811-922. In: Climate change 2014: mitigation of climate change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
Stephens, P.A., Candy, A d'Sa., Zubiri, C.S. and Williams, N. L. 2001. Impact of livestock and settlement on the large mammalian wildlife of Bale Mountains National Park, Southern Ethiopia. *Biological Conservation* 100: 307-322.
Tadesse, G., Zavaleta, E., Shennan, C. and FitzSimmons, M. 2014. Policy and demographic factors shape deforestation patterns and socio-ecological processes in southwest Ethiopian coffee agroecosystems. *Applied Geography* 54:149-159.
Tesfaye, G. 2017. Land use pattern and its implication on hydrology, climate and degradation in Ethiopia: A review. *IJAER* 3 (4): 418 – 426.
Tigabu, M., Lemenih, M., Negash, M., Yirdaw, E. and Teketay, D. 2014. Rehabilitation of degraded forest and woodland ecosystems in Ethiopia for sustenance of livelihoods and ecosystem services. Part II: Case studies. *IUFRO World Series* 32: 299-313.

Tirivayi, N., Knowles, M. and Davis, B. 2013. The interaction between social protection and agriculture: A review of evidence. FAO, Rome, Italy.

Tsegaye, B. 2019. Effect of land use and land cover changes on soil erosion in Ethiopia. *Int J Agric Sc Food Technol* 5 (1): 026-034. DOI: http://doi.org/10.17352/2455-815X.000038

Wilson, C. J. 2003. Land-use/ land-cover change analysis for Ghibe valley - Ethiopia: 1993-2003. Environmental Monitoring and Management Component-Project Number : 7.ACP.RP.R. 578

Williams, M. 2016. Deforestation: past and present. Pennsylvania State University http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.846.4116&rep=rep1&type=pdf visited on 11/2/2019.

Worku, G., Bantider, A. and Temesgen, H., 2014. Land use and land cover change in Ameleke Watershed, South Ethiopia. *Journal of Natural Sciences Research* 4 (14): 42-47.

World Bank. 2017. Gender-focused portfolio review of forest projects for the environment and natural resources. Program on Forests (PROFOR) of the World Bank.

UN, FAO, IFAD and WFP. 2011. Enabling rural women's economic empowerment: institutions, opportunities and participation. Expert Group Meeting, Accra, Ghana.

Yemiru, T., Roos, A., Campbell, B.M. and Bohlin, F. 2010. Forest incomes and poverty alleviation under participatory forest management in the Bale Highlands, Southern Ethiopia. *International Forestry Review* 12 (1): 66-77.

Yohannes, A.W., Cotter, M., Kelboro, G. and Dessalegn, W. 2018. Land use and land cover changes and their effects on the landscape of Abaya-Chamo Basin, Southern Ethiopia. *Land* 7 (1): 1-17.

Zewdu, S., Suryabhagavan, K.V. and Balakrishnan, M. 2016. Land-use/land-cover dynamics in Sego irrigation farm, southern Ethiopia: A comparison of temporal soil salinization using geospatial tools. *Journal of the Saudi Society of Agricultural Sciences* 15: 91–97.

Zewdu, S., Suryabhagavan, K.V. and Balakrishnan, M. 2017. Geo-spatial approach for soil salinity mapping in Sego Irrigation Farm, South Ethiopia. *Journal of the Saudi Society of Agricultural Sciences* 16:16–24.