International Journal of Environmental Sciences & Natural Resources
ISSN: 2572-1119

Juniper Publishers
key to the Researchers

Research Article
Volume 26 Issue 2 - October 2020
DOI: 10.19080/IJESNR.2020.26.556183

Int J Environ Sci Nat Res

Greenhouse Gas Emissions/Removals Due to Agriculture and Related Land Use Activities in Ethiopia

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Submission: September 25, 2020; **Published:** October 09, 2020

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Abstract

Agriculture and related land-use sector is a significant contributor to climate change due to its generation of a high amount of greenhouse gas emissions. The sector is also unique among the sectors since the mitigation potential is derived from both an enhancement of removals of the emissions, as well as reduction of emissions. There is a high demand for quantitative information on emissions of greenhouse gases and sources of emissions especially on the agriculture sector which greatly influences the economic performance in Ethiopia. This paper aims to show the emissions trend and sources of the emissions focusing on emissions from key agriculture and land use processes in the country using the regularly updated data available from FAO via its FAOSTAT database. The analysis indicated that the country's emissions from the sector kept increasing in all decades over the analysis period. This increase in emissions also continues in the future years to come. Agricultural processes related to the livestock sub-sector, enteric fermentation, and manure left on pasture, is the major contributor for the total emissions. Besides, burning-savanna, cultivation of organic soils, crop residues, and use of synthetic fertilizers are also identified as contributors to the country's emissions from the sector. Even though a significant amount of GHG emissions are generated from the land uses, there is a relatively decreasing amount of emissions calculated in the 2010s relative to the 1900s. Burning of biomass, forest land and cropland is the major land-use type contributor to the country's emissions. Since there is a high emission from the livestock sub-sector among the other in the agricultural processes, climate change mitigation technologies/practices, and policies need to be implemented to reduce the emissions in managing manure left/applied on pasture and introducing or shifting to livestock which could emit lesser GHGs due to enteric fermentation processes. Enhancement of removals of emissions needs to be enhanced by reducing the burning of biomass and planting more trees. Specific mitigation strategies particularly through the management of land and livestock are needed to enhance removals as well as reduce emissions without compromising risks, sustain farming, and food security.

Keywords: Agriculture; GHGs; Land use; Climate change mitigation; Ethiopia

Abbreviations: AFOLU: Agriculture, Forestry, and Other Land Use; CO2eq: CO2 equivalent; GHGs: Greenhouse Gases; GWP: Global Warming Potential; IPCC: Intergovernmental Panel on Climate Change

Introduction

According to the Intergovernmental Panel on Climate Change (IPCC), Agriculture, Forestry, and Other Land Use (AFOLU) is unique among the sectors, since the mitigation potential is derived from both an enhancement of removals of Greenhouse gas (GHG) emissions, as well as reduction of emissions through management of land and livestock [1]. Agriculture is frequently central to the livelihoods of many social groups, especially in developing countries where it often accounts for a significant share of production [1,2]. The land provides food that feeds the Earth's human population of ca. 7 billion, fiber for a variety of purposes, livelihoods for billions of people worldwide, and is a critical resource for sustainable development in many regions. In addition to food and fiber, the land provides a multitude of ecosystem services; climate change mitigation is just one of many that are vital to human well-being. Mitigation options in the AFOLU sector, therefore, need to be assessed, as far as possible, for their potential impact on all other services provided by land [1,3].

Ethiopia, with a total area of 1.1 million km^2, lies in the northeastern part of the Horn of Africa. The country is landlocked. The Great East African Rift Valley divides the country. It is estimated that 16 million ha is cultivated and 20 million ha are permanent pastures. Water bodies cover around 744 400ha, forest and woodland about 4 million ha and 29 million ha respectively, while over 26 million ha are protected [4]. The Ethiopian economy is mostly based on agriculture. Agriculture accounts for 42% of GDP in 2014 and about 85% of exports earnings in 2010. It also employs

83% of the active population [5]. Agriculture is primarily rainfed and thus highly dependent on rainfall. Smallholders dominate the sector and the land holding is increasingly fragmented. In 2015, there were 15.6 million agricultural households with an average farm size of 0.95ha [6]. The Ethiopian livestock is also significant with over 50 million cattle, 50 million poultry, 20 million sheep and 20 million goats in 2015 [4,6].

Agriculture is a significant contributor to climate change. GHGs from crop and livestock activities contribute some 5 billion metric tonnes of CO_2eq, or CO_2 equivalent (CO_2eq) to the atmosphere each year [5]. The three main GHG relevant for agriculture emissions are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). CO_2 is released largely from microbial decay or burning of plant litter and soil organic matter. CH_4 is produced when organic materials decompose in oxygen-deprived conditions, notably from fermentative digestion by ruminant livestock, from stored manures, and from rice grown under flooded conditions. N_2O is generated by the microbial transformation of nitrogen in soils and manures and is often enhanced where available nitrogen exceeds plant requirements, especially under wet conditions [2]. CO_2eq is a measurement unit that expresses a unit weight of a given greenhouse gas to the equivalent weight of CO_2, in terms of relative climate forcing of the gas compared to CO_2. The conversion factor is the global warming potential (GWP). The scientific community provides regular updates of GWP values for different gases, mainly through IPCC reports [5].

Land use and land use change activities connected to agriculture release a similar amount annually. Taken together, agriculture and associated land use activities generate about one-quarter of total GHG emissions worldwide. Contribution is much larger in developing countries, where the combined emissions from agriculture and related land use activities can be more than half of total emissions [5].

Emissions from agriculture are computed for nearly 200 countries for the reference period 1961-2011 and are built in FAOSTAT for automatic updating of emissions as soon as new activity data from member countries are uploaded [3]. Emissions for Ethiopia are available for the period 1993-2017. This paper focuses on emissions from key agriculture and land use processes in Ethiopia. These emissions are well-quantified in the paper, with regularly updated statistics available, mostly from FAO via its FAOSTAT database [7]. Building on the analysis of the most recent FAOSTAT statistics, this paper also analyzes trends in GHG emissions from the agriculture and land use sectors.

Materials and Methods

The data for the analysis was obtained from the most recent online FAO country GHGs emissions which is available on FAOSTAT database after importing the data, excel worksheet used for the descriptive analysis.

Results and Discussion

Country level GHGs emissions from agriculture nearly doubled from 1993 to 2017, specifically from 47984 to 102933Gg CO_2eq yr^{-1} (Figure 1). While the country's emissions kept increasing in all decades over the analysis period, specifically 51483, 69793, 95357 Gg CO_2eq yr^{-1} in the 1900s, 2000s and 2010s respectively (Figure 2).

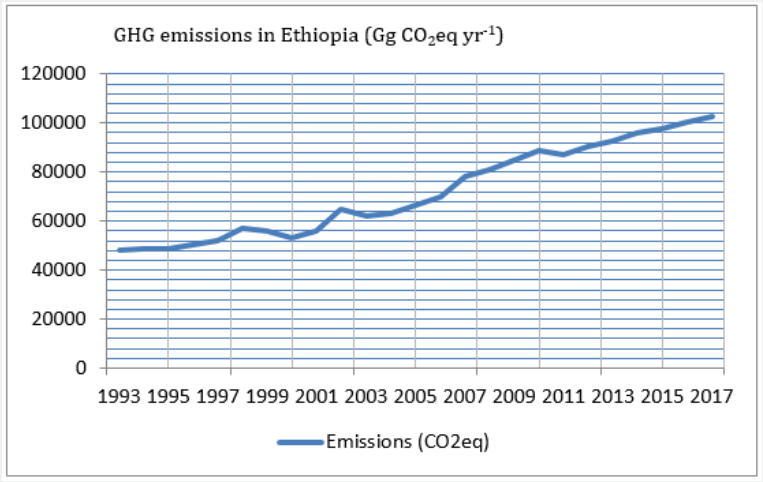

Figure 1: Annual average, over the period 1993-2017, of total GHG emissions from agriculture (Gg CO2eq yr-1) for Ethiopia. Source: FAOSTAT database [7], domain: Emissions-Agriculture.

On average for the 1993 to 2017 period, the two largest contributors to agricultural emissions in Ethiopia were generated mostly by livestock-related processes such as enteric fermentation (51.3%) and manure left on pasture (36.0%) (Figure 3). Adding the other livestock-related processes, manure management (2.1%) and manure applied to soils (0.7%), it follows that 90.1% of agricultural emissions in the mentioned period were related to livestock. The other four major contributors to Ethiopia's

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agricultural emissions are burning-savanna (6.1%), cultivation of organic soils (1.3%), crop residues (1.1%) and use of synthetic fertilizers (1.0%). Other relevant emissions sources of agricultural processes include burning of crop residues (0.3%) and rice cultivation (0.1%).

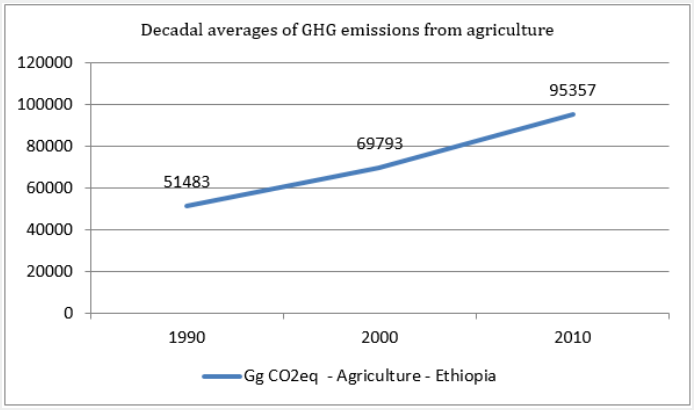

Figure 2: Decadal averages of total GHG emissions from agriculture in Ethiopia (Gg CO2eq yr-1). FAOSTAT database [7], domain: Emissions-Agriculture.

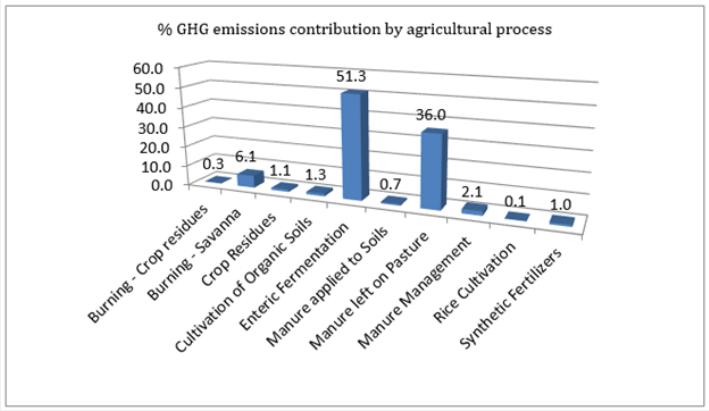

Figure 3: Average, with reference to the period 1993-2017, of the percent (%) contributions of sub-sectoral emissions to the total GHG emissions from agriculture over Ethiopia. Source: FAOSTAT database [7], domain: Emissions-Agriculture.

Future emissions of GHG from agriculture in Ethiopia are expected to be 79819.5 and 87874.0Gg CO_2eq yr^{-1} in the year 2030 and 2050 respectively (Figure 4).

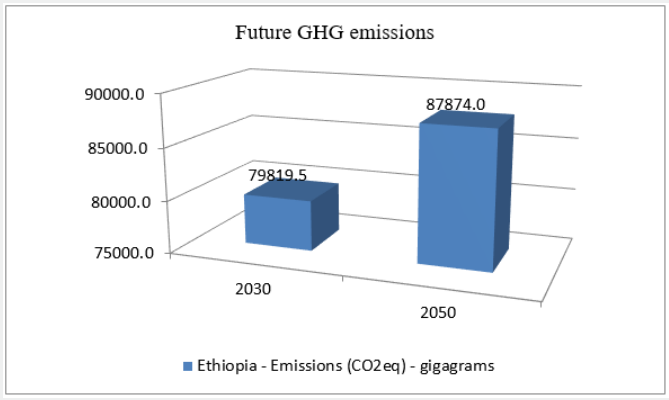

Figure 4: Future (2030 and 2050) total GHG emissions from agriculture (Gg CO2eq yr-1) over Ethiopia. Source: FAOSTAT database [7], domain: Emissions-Agriculture.

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Country level GHGs net emissions/removals from land use were changed from 34966 to 22358Gg CO_2eq yr^{-1} in 1993 to 2017 recording years (Figure 5). Which indicates that a total of 12608Gg CO_2eq yr^{-1} of GHGs were removal/sequestration in the year 2017 compared to 1993. While the country's net emissions/removals vary from year to year over the analysis period. Average decadal net emissions/removals also showed a varying trend of 32185, 34133 and 22220Gg CO_2eq in the 1900s, 2000s and 2010s respectively (Figure 6).

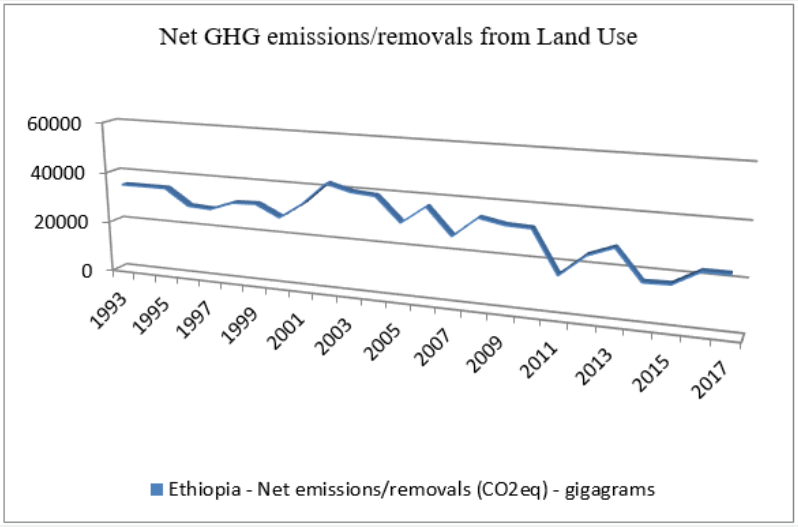

Figure 5: Annual averages, over the period 1993-2017, of total GHG emissions/removals from land use (Gg CO2eq yr-1) over Ethiopia. Source: FAOSTAT database [7], domain: Emissions-Land use.

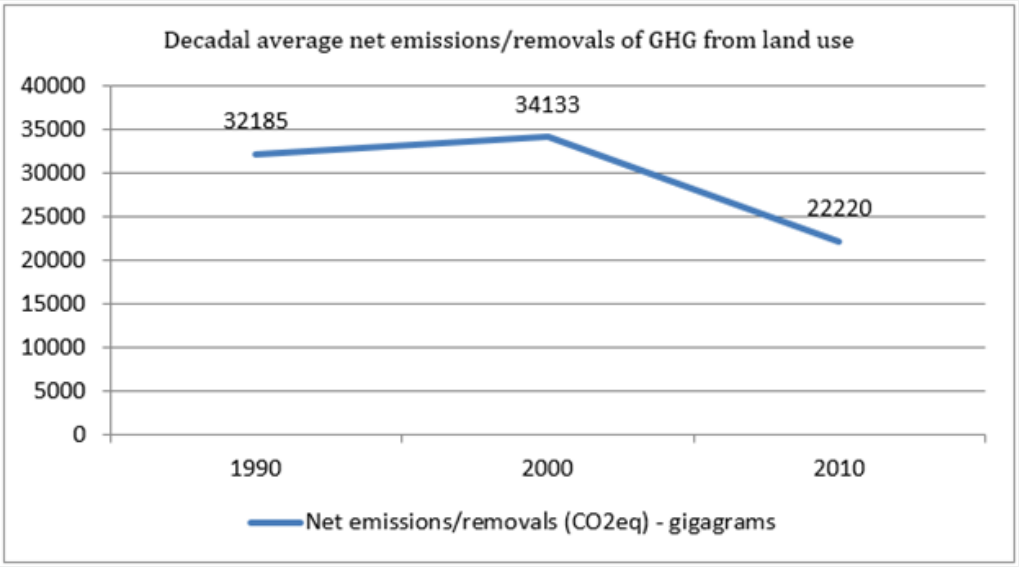

Figure 6: Decadal averages of total GHG emissions from agriculture in Ethiopia (Gg CO2eq yr-1). Source: FAOSTAT database [7], domain: Emissions-Land use.

Emissions of GHG from land uses in Ethiopia generated mostly from burning of biomass (48%), forest land (28.5%) and cropland (21.4). Grassland is the least source of emission in contributing only 2% of the total emissions (Figure 7) [8].

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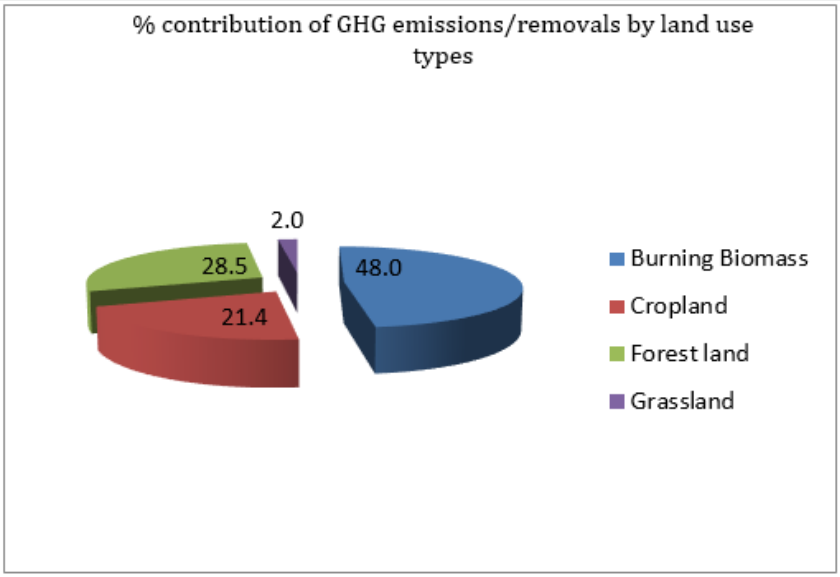

Figure 7: Average, with reference to the period 1993-2017, of the percent (%) contributions of land use type emissions/removals to the total GHG emissions from land use, over Ethiopia. Source: FAOSTAT database [7], domain: Emissions-Land use.

Conclusion

Agriculture is a significant contributor to climate change due to its generation of high amount of greenhouse gas emissions. The country's emissions from the sector kept increasing in all decades over the analysis period. This increasing of emissions also continues in the future years to come. Agricultural processes related to the livestock sub-sector, enteric fermentation and manure left on pasture, is the major contributor for the total emissions. In addition to these sources, burning-savanna, cultivation of organic soils, crop residues and use of synthetic fertilizers are also identified as the rest contributors for the country's emissions from the sector. Even though a significant amount of GHG emissions from the land use activities, there is a relatively decreasing amount of emissions calculated in the 2010s relative to the 1900s. Burning of biomass, forest land and cropland are the major land use types contributor to the country's emissions.

References

1. Smith P et al. (2014) Agriculture, Forestry and Other Land Use (AFOLU). In: [Edenhofer O, Madruga RP, Sokona Y, Farahani E, Kadner S (Eds.), 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.
2. Smith P, et al. (2007) Agriculture in Climate Change 2007: Mitigation. In: Metz B, Davidson OR, Bosch PR, Dave R, Meyer LA (Eds.), Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
3. FAO (2014) Food and Agricultural Organization of the United Nations. Agriculture, Forestry and Other Land Use Emissions by Sources and Removals by Sinks.
4. FAO (2016) Food and Agricultural Organization of the United Nations. Aqua stat report. Country Profile-Ethiopia.
5. Francesco N (2019) Greenhouse Gas Emissions Due to Agriculture. Statistical Division, Food and Agricultural Organization of the United Nations, Rome, Italy.
6. CSA (2015) Central Statistical Agency of Ethiopia. Key findings of the 2014/2015 (2007 E.C.) Agricultural sample surveys. Addis Ababa, Ethiopia.
7. FAO (2020) Food and Agricultural Organization of the United Nations. FAOSTAT Database.
8. MoA (2011) Ministry of Agriculture. Small-scale irrigation situation analysis and capacity needs assessment. Ministry of Agriculture, Addis Ababa, Ethiopia.

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