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Ethiopia's Response to Climate Change and Variability: A Review

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Abstract

This review paper was initiated to review the Ethiopia's response to the existing climate variability and change. Climate variability and change have been occurring in Ethiopia. Evidences showed that there is an increase in temperature and spatial and temporal rainfall variability has been increasing. The changing climate has led to recurrent droughts and famines, flooding, expansion of desertification, loss of wetlands, loss of biodiversity, decline in agricultural production and productivity. Ethiopia had shown many efforts to combat climate change in the different parts of the country. Promoting conservation agriculture, home gardens and traditional agroforestry systems, harvesting non-timber forest products, protected area systems, afforestation and reforestation programs, renewable energy sources, livestock selling and production are among the mechanisms for mitigating and adapting climate change in Ethiopia as a response.

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Keywords

Climate change, Variability, Renewable energy sources.

Introduction

There is a rapid change and variability in the earth's climate as a result of increases in the concentrations of greenhouse gases in the atmosphere mainly caused by human activities, particularly burning of fossil fuels, agriculture and deforestation (Wigley, 1999; Stern, 2006; IPCC, 2007; Zegeye, 2013; Hailab, 2018).

According to the Intergovernmental Panel on Climate Change (IPCC) prediction, the global surface temperature will increase by 1.4 - 5.8°C by 2100 years due to increasing concentration of GHGs specifically carbon dioxide. The Least Developed Countries (LDCs) like Ethiopia are highly vulnerable to climate change and variability since they are dependent on agriculture and climate sensitive economic sectors (Bruckner, 2012).

Climate, as a natural resource, is probably the most important single factor in agriculture and food production. Agriculture remains highly sensitive to climate variations, which are the dominant source of the overall inter-annual variability in production in many regions and a continuing source of disruption to ecosystem services (Howden *et al.*, 2007). Adverse climate change impacts are particularly high in countries located in tropical Africa that depend on agriculture as their main source of livelihood (IAC, 2004; Dixon, Gulliver and Gibbon, 2001; IPCC, 2001).

Rural communities, who depend on agriculture for sustenance and livelihood, are often vulnerable to the direct impacts of adverse impacts of climate variability and change (Molnar, 2010; Melese, 2019). Negussie and Ashebir, 2016 reported that the smallholder, low-input

and rain-fed agriculture, and the pastoral livelihood system in the arid and semiarid lowlands are more vulnerable to the adverse effects of climate variability and change because of dependence on climate sensitive natural resource based economic activities.

Ethiopia is mainly at risk to climate change and variability because of its greater reliance on climate sensitive economic sectors like subsistence crop cultivation and livestock production. In addition, a large part of the country is arid and semiarid and is highly prone to desertification and drought (NMA, 2001 and Melese, 2019). Thus, this review paper was initiated to review the country's response to the existing climate variability and change.

Climate variability and change in Ethiopia

Even if the climate of Ethiopia is changing in recent years, it is naturally diverse and variable (Umer, 2010; Eshetu, 2011; Mokria *et al.,* 2017). The temperature (maximum, minimum, mean) is increasing, but the rainfall does not show any definite trend, it shows high variability (NMSA, 2007; Bewket and Conway, 2007; McSweeney *et al.,* 2008; Addisu *et al.,* 2015). Since 1950, the annual average maximum and minimum temperatures of the country have been increasing every decade by about 1 and 0.25°C, respectively (NMSA, 2001). In Ethiopia, climate variability and change is mainly manifested through the variability and decreasing trend in rainfall and increasing trend in temperature. Besides, rainfall and temperature patterns show large regional differences (Zerga and Gebeyehu, 2016).

According to Addisu *et al.,* (2015), the annual total rainfall data from 109 representative ground based meteorological stations in Ethiopia indicated a coefficient of variation ranging from 20 to 89%, and 17 stations had above 42% coefficient of variation highlighting the extreme variability of rainfall over the country. They also noted that the maximum, minimum and mean temperatures had increasing trend; whereas rainfall amount showed a general decreasing trend in Lake Tana Sub-Basin.The amount of rainfall has been decreasing in many parts of the country. But some areas in the western part of the country have experienced irregularities, unpredictability and a pattern of shortened rains, temperature increase, heavy rains, frost and hail (Troeger, 2010).

Nowadays climate change is a key concern to Ethiopia and needs to be tackled in a state of emergency. It has brought an escalating burden to already existing environmental concerns of the country including deforestation (Ayana *et al.,* 2011) and agriculture sector (UNDP Ethiopia, 2011). Climate change and its impacts have also been perceived by local people, who express climate variability and change in that generally the temperature is increasing and the rainfall is decreasing (Kassa, 2013; Addisu *et al.,* 2016; Belay *et al.,* 2017; Mekonnen *et al.,* 2017; Tilahun *et al.,* 2017). The frequency of droughts in Ethiopia, particularly in the recent decades, is an indication of the prevalence of the variation in climate. There were 19 drought events which occurred in Ethiopia in the period 1900-2002, which is almost once in 6 years in the period 1900-1987 (14 drought events) and roughly in 3 years in the period 1988-2002 (5 drought events) (NMSA, 1987; World Bank, 2005). Since 1876, about 22 droughts with an average cycle of every 6 years are occurring in Ethiopia (Eshetu *et al.,* 2010).

According to study of Deressa (2006) for Ethiopia, by using Heckman sample selection model both increasing temperature and decreasing precipitation are damaging Ethiopian agriculture. Climate change has strong impact on the agricultural sectors and forestry by modifying or degrading productive capacities and by directly and indirectly increasing the risks associated with production (FAO, 2011).

Climate change adaptation mechanisms in Ethiopia

Adaptation to climate change refers to adjustments in environmental, social and economic systems in response to the actual and expected impacts of climate change. Adaptation to climate change has to be localized, given that adaptation to climate change is inevitably and unavoidably local (Blaikie *et al.,* 1994; Ribot, 1995).Adaptation to climate change requires combining scientific knowledge with indigenous knowledge and practices. Moreover, adaptation to climate change needs to be a continuous endeavor.

Conservation agriculture and climate smart agriculture, has a high potential for both climate change mitigation and adaptation in Africa including Ethiopia (Ching *et al.,* 2011). Conservation agricultural practices include terracing, crop rotation, intercropping, retention of crop residues and use of animal dung, composting, mulching, crop diversification (including farmers' varieties), water harvesting and storage, home gardening and traditional agroforestry, management of grazing areas, etc. The agricultural system of the Konso people in southern

Ethiopia is famous for its perfect adaptation to a harsh environment of steep, stony hills and little rainfalls. Traditional technologies are used for soil and water conservation, water harvesting and many more (Kebede *et al.,* 2010). According to Ching *et al.,* (2011) report, conservation agriculture in Tigray has showed positive results, both in terms of rehabilitation of degraded lands and improvement of livelihoods of local communities, and is being scaled up to many areas within the region and other regions of the country.

Pastoralists and agro-pastoralists in the drylands such as Afar in northeastern, Somali in eastern and Borana in Southern Ethiopia use different strategies like decreasing the number of cattle and sheep and increasing the number of camels and goats (because of their remarkable capacity to adapt severe drought) in their herds as a strategy to improve their livelihoods and adapt to climate change to cope with the impacts of climate variability and change (Aklilu and Catley, 2010; Tadesse *et al.,* 2013).Those pastoral communities in Afar, Somali and Borana are living with climate change and are able to adapt to the changing climate with their own short and long term strategies (Riché *et al.,* 2010; Tilahun *et al.,* 2017).

According to Temesgen *et al.,* (2006), sale of agricultural tools and other assets are identified as a coping mechanism to climate variability and extremes in Ethiopia. Farmers may sell some of their resources in market, and this can be an important extra income, and can also function as a safety net and a coping mechanism. Material assets within the household can be seen as a buffer against difficult periods, in the same way as for example livestock. According to Amsalu and Adem (2009), about 78% of the households in Borena, 40% in Guji, and 33% in South Omo Ethiopia reported an increasing trend of livestock selling.

Homegardens and agroforestry systems are other sort of mechanisms in climate change adaptation in Ethiopia (Asfaw, 2010).Homegardens and agroforestry systems have a range of environmental, social, economic and cultural benefits. They help to sustain the environment and improve livelihoods of people, and as such hold considerable potential for human and livestock adaptation to climate change (FAO, 2000; Asfaw, 2010; Zegeye, 2013). They control soil erosion, improve soil fertility, sequester carbon, moderate microclimate, provide various products; fuel wood, charcoal, construction material, timber, poles, posts, farm implements, food, medicines, fodder, spices, bee forage, etc.), increase income, and provide shade and amenity. They supplement food supplies and also serve as a buffer during periods of droughts and crop failures. Moreover, they are well placed for adding new plants to the existing flora.

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