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REVIEW ON CLIMATE CHANGE ADAPTATION AND MITIGATION PRACTICES IN ETHIOPIAN AGRICULTURE SECTOR

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Abstract

Climate change is widely considered to be one of the greatest challenges to modern human civilization that has profound socioeconomic and environmental impacts. The main objective of this is paper is to review climate change adaptation and mitigation measures or practice in agricultural sector (crop farming, agroforestry, fishing and aquaculture). Ethiopia has been identified as one of the most vulnerable countries to climate variability and change, and is frequently faced with climate-related hazards, commonly drought and floods. So there are so many climate change adaptation measures from those building defenses to protect coastal areas from rising seas, switching to drought or flood resistant crop varieties, and improving systems to warn of heat-waves, disease outbreaks, droughts and floods and also the migration measures are efforts to switch from fossil fuels to renewable energy sources such as wind and solar, or to improve energy efficiency. It also includes efforts to plant trees and protect forests, or to farm land in ways that prevent greenhouse gases from entering the atmosphere. Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases (GHGs) Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g., through reforestation. Impacts of climate change to crop sector include decreasing in both productivity/yield and cultivable land (in some crops like maize shifted from lowland areas to highland areas; while, barley since it is a highland crop, due to climate change its cultivable land diminished and productivity decreased) due to high temperature and water deficit. In addition, the water sector of the country gets impacted negatively by climate change by decreasing soil water, ground water and stream flow due to high evaporation in some areas. To alleviate these negative impacts of climate change, different climate change adaptation and mitigation strategies practiced in different areas of the country. Extreme weather events, combined with a low capacity to adapt to the adverse impacts of climate change, aggravate food security risks, due to shortage of rainwater/changes in rainfall patterns, exposed to flooding /erosion, declining soil fertility, decline in productivity, reduced yield, food insecurity.

Keywords: Climate change, Adaptation, Mitigation, Agricultural production

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1. Introduction

Climate change is widely considered to be one of the greatest challenges to modern human civilization that has profound socioeconomic and environmental impacts. Rapidly raising greenhouse gases, enhanced land and sea temperatures and increased frequency and magnitude of extreme events pose enormous risks to various economic activities and freshwater availability and affect the sustainability of agriculture and food security of billions of people around the world, especially in most developing countries where agriculture is the dominant sector of the economy (Sivakumar and Stefanski, 2018). Ethiopia is one of the developing counties in which agriculture is the main source of the economy (Kide, 2014).

According to IPCC (2007a) and Gashaw et al. (2014), developing countries like Ethiopia will be more vulnerable to climate change since its economy is depend on agriculture. Similarly, Kide (2014) states that Ethiopia is highly vulnerable to climate change and low capacity to adopt and perceived. High levels of poverty, rapid population growth, high level of reliance on rain-fed agriculture, high levels of environmental degradation, chronic food insecurity and frequent natural drought cycles increase climate change vulnerability in the country; and the most vulnerable sectors are agriculture, water and human health (Aklilu et al., 2009).

Ethiopia has been identified as one of the most vulnerable countries to climate variability and change, and is frequently faced with climate-related hazards, commonly drought and floods. The variability of rainfall and the increasing temperature were a cause for frequent drought and famine, and putting disastrous impact on the livelihood of the peoples (Nathnael and Gustavsson, 2017; Gashaw et al., 2014).

Ethiopian agriculture sector is negatively affected by climatic related disasters with drought and flood being the major one. Increasing temperature and rainfall variability in different parts of the country adversely affect the agricultural production of farmers. The country is highly depending on agriculture which had failed to meet the growing food demand because of the negative effect of climate changes on agricultural production (World Bank and Deressa Kebede, 2007).

To cope up and reduce the impact of climate change and enhance food security, mitigation and adaptation measures are meaningful strategies in Ethiopia where the impact of climate change on agriculture is high. Mitigation refers to any activities that reduce the overall concentration of greenhouse gases in the atmosphere. While, adaptation refers to activities that make people, ecosystems and infrastructure less vulnerable to the impacts of climate change (Gashaw et al., 2014; IPCC, 2007b).

Different studies have been carried out on the adaptation and mitigation practices in agriculture sector around the world in general (Sivakumar and Stefanski, 2018) in Ethiopia in particular (Gashaw et al, 2014) and different adaptation and mitigation measures to climate change in agriculture are identified (Nathnael and Gustafson, 2017). And in Ethiopia in particular; and different adaptation and mitigation measures to climate change in agriculture are identified. Thus, the main objective of this review paper is to review the climate change adaptation and mitigation practices in Ethiopian agriculture sector.

2. Climate Change Adaptation and Mitigation Practices in Ethiopian Agriculture Sector

2.1. Basic Definitions and Concepts

2.1.1. Climate change

Climate change refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer (IPCC, 2007c).

Similarly, FAO (2009) defines climate change as a change of climate which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere and which are in addition to natural climate variability observed over comparable time period.

2.1.2. Climate change adaptation

Adaptation refers to activities that make people, ecosystems and infrastructure less vulnerable to the impacts of climate change. This includes things like building defenses to protect coastal areas from rising seas, switching to drought or flood resistant crop varieties, and improving systems to warn of heat-waves, disease outbreaks, droughts and floods (Gashaw et al., 2014).

Climate change adaptation is a response to global warming and climate change, that seeks to reduce the vulnerability of social and biological systems to relatively sudden change and thus offset the effects of global warming. According to (IPCC, 2007d) Adaptive capacity is closely linked to social and economic development The economic costs of adaptation to climate change are likely to cost billions of dollars annually for the next several decades, though the amount of money needed is unknown. Donor countries promised an annual $100 billion by 2020 through the Green Climate Fund for developing countries to adapt to climate change.

2.1.3. Climate change mitigation

According to Gashaw et al. (2014), mitigation refers to any activities that reduce the overall concentration of greenhouse gases in the atmosphere. This includes efforts to switch from fossil fuels to renewable energy sources such as wind and solar, or to improve energy efficiency. It also includes efforts to plant trees and protect forests, or to farm land in ways that prevent greenhouse gases from entering the atmosphere.

IPCC (2007d) defines Mitigation as the technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change,

mitigation means implementing policies to reduce GHG emissions and enhance sinks.

Climate change mitigation consists of actions to limit the magnitude or rate of long-term climate change. Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases (GHGs) Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g., through reforestation. Examples of mitigation include phasing out fossil fuels by switching to low-carbon energy sources, such as renewable and nuclear energy, and expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere Energy efficiency may also play a role for example, through improving the insulation of buildings. Another approach to climate change mitigation is climate engineering (IPPC, 2007).

2.2. Impact of Climate Change on Agriculture in Ethiopia

According to Bezu and Holden (2008) as cited in Kide (2014), agriculture is the back bone of the Ethiopian economy. In line with this climate is the key determinant factor for economic growth and development. This is due to the fact that most of population in Ethiopia is the dependence of rain-fed agriculture sector. Ethiopia is one of the countries that most vulnerable to climate change with the least capacity to respond. Food shortage and famine associated with rainfall variability cause a situation of high dependency on international food aid, and Ethiopia is one of the biggest food aid receipt countries in Africa. This is because of that agricultural production in

Ethiopia is adversely affected by climate change and weather variability's, which is decreasing crop yield, decrease in livestock feed availability, affecting animal health, expansion of tropical dry and expansion of desertification.

Nathnael and Gustavsson (2017) found that there are direct impacts of climate change to crops, livestock, and water as compared to other economic sectors in Ethiopia. Impacts of climate change to crop sector include decreasing in both productivity/yield and cultivable land (in some crops like maize shifted from lowland areas to highland areas; while, barley since it is a highland crop, due to climate change its cultivable land diminished and productivity decreased) due to high temperature and water deficit. In addition, the water sector of the country gets impacted negatively by climate change by decreasing soil water, ground water and stream flow due to high evapotranspiration in some areas. To alleviate these negative impacts of climate change, different climate change adaptation and mitigation strategies practiced in different areas of the country as reviewed below. Extreme weather events, combined with a low capacity to adapt to the adverse impacts of climate change, aggravate food security risks, due to shortage of rainwater/changes in rainfall patterns, exposed to flooding /erosion, declining soil fertility, decline in productivity, reduced yield, food insecurity (Aster, 2010).

2.3. Climate Change Adaptation and Mitigation Practices in Ethiopian Agriculture Sector

2.3.1. Climate change adaptation practices

Climate changes in response to rising temperatures, adaptation will be vital to reduce the impact of climate change (Aster, 2010). Climate change adaptation is a response to global warming and climate change, that seeks to reduce the vulnerability of social and biological systems to relatively sudden change and thus offset the effects of global warming promotion of alternative crops; developing new drought and heat-resistant varieties; more use of intercropping; using sustainable fertilizer and tillage practices; improved crop residue and weed management, use of water harvesting techniques; better pest and disease control for crops; implementing new or improving existing irrigation systems; improved livestock management; and more use of agroforestry practices are the adaptation measures that the agricultural sector can undertake to cope with future climate change (Sivakumar and Stefanski, 2018).

According to Kide (2014), changing crop variety, changing planting dates, mixed cropping, decrease number livestock, moving animals/temporary migration, change livestock feeds, soil and water management, planting trees, change animal breeds, seek off-farm employment, planting short season crop, and irrigation/water harvesting are some of climate change adaptation strategies that the farmers used to reduce the impact of climate change on agriculture.

Nathnael and Gustavsson (2017) found that changing planting dates, planting trees, adoption of drought tolerant and early maturing crops/varieties, increased use of soil and water conservation techniques and/or soil erosion prevention programs, diversification into non-farming activities, increased use of irrigation and/or use of irrigation techniques, the herd composition, applying different feed techniques, temporary or permanent migration, home-garden agriculture are the micro-level (farm level) climate change adaptation strategies to the agriculture sector in Ethiopia.

Similarly Gashaw et.al. (2014) found that mobility, adoption of drought-tolerant livestock species, and fodder production saving, diversification, wood sell, mobility, social interconnectedness and credits are the local coping mechanisms that are used to reduce the impacts of climate change in Ethiopia particularly in West Arsi Zone.

According to MoA (2008) of Ethiopia, livestock mobility; developed and improved water sources such as ponds, protect and manage dry season rangelands through customary institutions; promoting flood and rain water harvesting to address chronic water shortages; small scale irrigation schemes for fodder production and livestock watering; and rotation grazing and changing of the traditional feeding practices (cut and carry system) are the climate change adaptation mechanisms in water stress and feed shortage pastoralists areas in Ethiopia. Similarly, Kide (2014) found that crop diversification and the use of soil and water conservation practices,

integrated crop and livestock diversification, engaging in off-farm income activities and rain water harvesting are the climate variability and climate change adaptation strategies in Doba district, western Hararghe, Ethiopia.

2.3.2. Climate change mitigation practices

Climate change mitigation practices consist of actions to limit the magnitude or rate of long-term climate change. Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases (GHGs). Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g. through reforestation (Sivakumar and Stefanski, 2018).

According to Sivakumar and Stefanski (2018), improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management to reduce CH4 emissions; improved nitrogen fertilizer application techniques to reduce N2Oemissions; and improved energy efficiency are the key mitigation technologies in agriculture.

Nathnael and Gustavsson (2017) found that reducing expansion of cultivated land through agricultural intensification (increasing productivity by reducing Green House Gas (GHG) emission: conservation agriculture, compost, wise use of inorganic fertilizers, proper crop management); improving animal productivity through breeding; feedlots practice by smallholder farmers; improving feed and feeding management; diversification toward lower emitting animal species (small ruminants); manure management; and agroforestry are climate change mitigation strategies in Ethiopia.

3. Conclusion

Ethiopia is one of the most vulnerable countries to climate variability and change since its economy is depending on rain-fed agriculture (the most vulnerable sector). Increasing temperature and rainfall variability in different parts of the country adversely affect the agricultural production of farmers. To alleviate the negative impacts of climate change, different climate change adaptation and mitigation strategies are practiced in different areas of the country. Thus, the main aim of this article was to review the climate change adaptation and mitigation practices in Ethiopian agriculture sector; and reviewed that changing planting dates; adoption of drought tolerant and early maturing crops/varieties; increased use of soil and water conservation techniques and/or soil erosion prevention programs; diversification into non-farming activities; increased use of irrigation and/or use of irrigation techniques for crop production, fodder production and livestock watering; herd composition; applying different feed techniques (rotation grazing and changing of the traditional feeding practices); temporary or permanent migration and livestock mobility; flood and rain water harvesting to address chronic water shortages; developed and improved water sources such as ponds; and home-garden agriculture are the climate change adaptation strategies in Ethiopian agriculture sector. On the other hand, conservation agriculture, composting, wise use of inorganic fertilizers, proper crop management; improving animal productivity through breeding; feedlots practice by smallholder farmers; improving feed and feeding management; diversification toward lower emitting animal species (small ruminants); manure management; and agroforestry were reviewed as the major climate change mitigation practices in Ethiopian agriculture sector.

Conflict of interest

The author declared that there is no conflict of interest.

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