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ECONOMIC IMPACTS OF CLIMATE CHANGE IN ETHIOPIA

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ABSTRACT

This study depicted to identify the economic impacts of climate change to have adverse economic, ecological and social impacts. Continuous stable and suitable climate condition of the last 10,000 years of the world for the whole of human development strategies had been changed on a variation from 1degree Celsius to a sudden changes of temperature between 2°C and 6°Cduring 1960 and 2006. It was changed by 1.3°C in Ethiopia, at an average rate of 0.28°C per decade. This change had been most rapid from July to September .Climate change exacerbates the problem for the majority of the world's rural poor who are prone to climate risk. Ethiopia which is reliant on agriculture extremely vulnerable to frequent drought and other natural disasters like flood, heavy rain fall, frost and heat waves. These shocks are a major cause of transient poverty and households had been unable to smooth consumption.

Keywords: Climate change, Economic impacts and Vulnerability

INTRODUCTION

The world has been living in a remarkably stable climate condition suitable to perform the whole of human development strategies for the past 10,000 years. In all that time, there was only a variation of 1°C. This balance has been seriously disturbed by various types of human activity which are rapidly degrading the atmosphere's capacity to absorb greenhouse gasses without disastrous climate effects (Somali Region Administration, 2011). Now days the potential sudden changes of temperature is between 2°C and 6°C between 1960 and 2006. We don't know what the world will look like and we are climbing rapidly out of safe zone into new territory, and we have no idea if we can live in it (Robert Corel and The Guardian, 2007). Climate change exacerbates the problem for the majority of the world's rural poor who live in areas that have meager natural resources and are prone to climate risk (Hobbs *et al*. 2007). As Neupane*et al*. 2001, stated traditional agriculture practices coupled with intensive farming has led to soil degradation, elevated erosion rates and declines in agricultural productivity. Recent scientific research has concluded that the increased atmospheric concentration of Green House Gases (GHG) have significant impacts on the Earth's climate in the coming decades.

Ethiopia is extremely vulnerable to drought and other natural disasters of floods, heavy rain fall, frost and heat waves. These events caused loss of lives, property and disrupt livelihoods. Ethiopia's people are heavily dependent on rain-fed agriculture, which is affected by the impacts of climate change. Global circulation models predict a change range of 1.7-2.1ºC rise of Ethiopia's mean temperature by 2050. This could cause food insecurity, malnutrition, land

Vol. 3, No. 02; 2018

ISSN: 2456-8643

degradation, disease outbreak and damage to infrastructure (IPCC and NMA, 2007, Muna, 2006).

Majority of the Ethiopian population is involved in traditional forms of farming (i.e., rainfall dependent). In addition, its economic development is heavily reliant on agriculture and natural resources with 80% employment and about 40% of Gross Domestic Product (GDP). Extreme climate change-related events affected livelihoods and national economic growth of poverty alleviation and development agendas negatively related to the increasingly pivotal role of agriculture as an engine for Ethiopian development (BirhanuAdenew, 2010).

The number of climate change initiatives in Ethiopia is growing and climate change impacts are increasingly being recognized as well as vulnerability and the need for social protection programs. Given the range of negative impacts of climate related hazards on economic development and livelihoods, the implications of climate change must be taken into account to ensure longer-term survival and sustainability of the livelihoods. This requires an appreciation of how the climate has already changed in recent decades and what is projected to change in the decades to come. Ethiopia recognize and share the concerns of climate change; the government embarked the development of a Climate-Resilient Green Economy (CRGE) strategy to address both climate change adaptation and mitigation strategies. The objective of the paper was to evaluate the impacts of climate change on agriculture and other natural dependent economic sectors. This study further focused to identify the main consequences of climate change on agricultural productivity.

OVERVIEW OF CLIMATE CHANGE IN ETHIOPIA

The Overall Climate Change Views in Ethiopia

Earth has more people than ever before new and technologies have improved the quality of life for many of them. But our quest for a better life is also changing the face of the planet to unsafe and putting our health at risk(Jonathan,2007).According to the United Nations Development Program (UNDP) Climate Change Profile for Ethiopia, the mean annual temperature has increased by 1.3°C, at an average rate of 0.28°C per decade. The temperature increase has been most rapid from July to September. The average number of hot days per year has increased by 73 (an additional 20% of days) and the number of hot nights has increased by 137 (an additional 37.5% of nights) between 1960 and 2006. The rate of increase is seen most strongly from June to August. On the contrary the average number of cold days cold nights were decreased by 21 (5.8% of days) and41 (11.2% of nights), mainly in the months of September to November (M., Sweeney, *et al*., 2008).

A recent mapping on vulnerability and poverty in Africa Yosuf, *et al.,* (2008) put Ethiopia as one of the most vulnerable countries to climate change with the least capacity to respond for the events. Indeed, Ethiopia has experienced at least five major national droughts since 1980, along with literally dozens of local droughts. Cycles of drought create poverty traps for many households, constantly preventing the efforts to build up assets and increase income.

Vol. 3, No. 02; 2018

ISSN: 2456-8643

Empirical Review of Climate Change and Economic Impacts

Survey data between 1999 and 2004 showed that more than half of all households in the country experienced at least one major drought shock. These shocks are a major cause of transient poverty and had households been able to smooth consumption, then poverty in 2004 would have been at least 14% lower, and country was one of the biggest food aid receipt countries in Africa that accounts to 20-30% of all food aid to sub- Saharan Africa (Bezu and Holden, 2008).Some of the studies employed different models to evaluate the climate change effects and opportunities like, Nhemachena and Hassan (2007) used multivariate probit model to analyze factors influencing the choice of climate change adaptation options in Southern Africa. Kurukulasuriya and Mendelsohn (2006) employed the multinomial logit model to see if crop choice by farmers is climate sensitive. Similarly Seo and Mendelsohn (2006) used the multinomial logit model to analyze how livestock species choice is climate sensitive. Glwadys (2009) employed the Heckman probit and multinomial logitmodels were applied to examine the determinants of adaptation to climate change and variability in the Limpopo Basin, South Africa. By the same token, Maddison (2006) argued that adaptation to climate change is a two-step process which involves perceiving that climate is changing in the first step and then responding to changes through adaptation in the second step. Thus, the studies in Ethiopia adopt the Heckman's two-step procedure (Heckman 1976) to analyze the perception and adaptation to climate change.

Deressa*et al.,* (2008) used the multinomial logit model (MNLM) to analyze factors that determine adaptation techniques and used for analyzing unordered qualitative variables. Multinomial logit and probit were used to examine the factors that influence farmers' decisions to adopt various adaptation options in Ethiopia. The extensions of these models, most often referred to as multivariate models, are employed when the number of choices available is more than two.

Kader (2012) used ordered logit regression and multinomial logit regression to analyze determinants of perceptions and adaptation strategies to climate change among pastoral households in Somali regional state of Ethiopia. Similarly, Aemro (2012) employed ordered logit model and multinomial logistic regression to analyze the factors influencing household's choice of adaptation and perception of climate change in Babilie district of Oromia regional state of Ethiopia. The most commonly cited multivariate choice models in unordered choices are multinomial logit (MNL) and multinomial Probit (MNP) models. Multivariate choice models are advantages over their counterparts of binomial logit and Probit models in two aspects (Wu and Babcock, 1998). First, they allow exploring both factors conditioning specific choices or combination of choices and second, they take care of self- selection and interactions between alternatives. Gene J., Y., You and Claudia Ringler, 2010. Were used Hydro-Economic Modeling Projections to evaluate Climate Change Impacts in Ethiopia. And Roberto, Roson, 2003. Identified Modeling for Economic Impact of Climate Change.

ECONOMIC IMPACTS OF CLIMATE CHANGE IN ETHIOPIA

Vol. 3, No. 02; 2018

ISSN: 2456-8643

Impact on Production and Productivity of Agriculture

Climate change is expected to have adverse ecological, social and economic impacts. Quantitative climate change impact assessments made so far on various socio-economic sectors are limited in the country. However, effort was made to compile information on climate change impacts from various sources such as the Initial National Communications of Ethiopia to the UNFCCC, the IPCC reports and other sources. Impact and vulnerability assessments in priority sectors were undertaken as part of the process of developing the Initial National Communications of Ethiopia to the UNFCCC (Abebe, 2009).

IPPC (2007) warned that global warming could lead to large scale flood in the one side and water shortages in the other sides. Considering the last 10 years alone the number of people affected by natural disasters in the world is close to 2 billion, and this has tripled when compared to the preceding decade. Climate affects the productivity of critical development resources, such as crops and livestock, forests, fisheries, water, tourisms, mining and corporations by reducing market access due to aggravate poverty and. And climatic impacts on populations inadequately or inappropriately prepared for climate change can have knock-on effects on all forms of development. As events such as weather events can cause significant damage to the economic foundations of a country or region. Results from various assessments of impacts of climate change show that Sub-Saharan Africa is one of the regions likely to emerge as the most vulnerable, with likely losses between 2 and 7 percent of GDP (Mendelsohn, *et. al* 2000).

Climate Change is well known to have negative impact on agriculture outcome on limiting the expected potential in three different ways. Firstly, increases in temperatures are known to be detrimental to a number of crop and livestock and natural resources varieties and genotypes, especially those in sensitive to long matured varieties, feed resources, habitats such as coral reefs and rainforests. Secondly, the pressures posed by a changing climate may lead to sets of responses in areas as variedas phenology, range and physiology of maturity, often leading to changes in life cycles (especially but not only in reproduction) and losses in productivity. On occasions, the very survival of some very sensitive species may be endangered. Thirdly, the impacts of climate change to agriculture are estimated to be felt in the short term in respect of some varieties, species and ecosystems, but also in the medium and long term in many biomes. Indeed, if left unattended, some of these impacts may be irreversible.

A key research finding depicted that climate change is being felt and reacted to everywhere in Ethiopia. Yet it is only one of many challenges with which people are confronted in their daily lives. Ethiopia's mainly rural societies are rendered vulnerable by several factors, including its fast-growing population, deforestation, soil degradation, overstocking and large-scale agro-investment(GIZ, 2011).According to UNEP (2006) estimate, due to climate linked factors, cereal yields in Ethiopia, Eritrea, Gambia, Ghana and Zambia will decline up to 5% by the 2080s.

Vol. 3, No. 02; 2018

ISSN: 2456-8643

The wheat maturity period will decrease by 10.6% to 18.5% in central Ethiopia. Such shortening of crop development stages due to increased temperature is reported to decrease yields. As Thornton,*et al*, (2006) stated that the combination of increased temperatures and rainfall changes may lead to an extension of the growing season in few highland areas.According to Zenebe, *et al*(2011), over the last 50-years the projected reduction in agricultural productivity may lead to 30% less average income, compared with the possible outcome in the absence of climate change.

The reflection of farmers on the effects of climate change on the production of crops and livestock were also identified. As FAO (2009), farmers in Ethiopia observed that marked increases in temperature and reduction of rainfall distribution for the past five years. The same observation was made by Bryan *et al*. (2009) in Ethiopia. Agriculture will continue to suffer the negative consequences of climate change is already being felt and its effects are expected to increase. The rural communities are increasingly vulnerable to climate induced hazards (Gurung and Bhandari 2008).Because of its close links to adaptation of climate variables change, agriculture is particularly the most vulnerable area where policy reforms with sound macroeconomic intentions can spill over into its impacts that need to be addressed (Muthukumara and Anil,2007).

There is a general consensus that poor people in developing countries like Ethiopia will suffer most from climate change (Sperling 2003).The warming is definitely hazardous for agricultural activities in the continent as many of the crops are grown close to the thermal tolerance limits (Collier *et al*., 2008).According to the World Bank (2007) Climate change is projected to reduce yields of wheat by 33% in Ethiopia .This amounts to a serious threat to food security and to the achievement of major developmental goals. Adverse effects of climate change continue to be a major threat to rural livelihoods (IPCC, 2007a, 2007b; Nhemachena, 2009). In the same way analysis of climate change impacts on agriculture subsector that are important for smallholder subsistence farmers and pastoralists showed that an increase in climate change variability increases poverty, even with increased irrigation development (You *et al.*, 2010).

The Ministry of Finance and Economic Development (MoFED, 2006) five year plan for the agricultural led economy of Ethiopia; as agriculture is very sensitive to climate change, it has failed to capture the impact of climate change on the achievement of the plan. On the other hand, Block,*et al*. (2006) witnessed that the analysis of the Gross Domestic Product (GDP) of Ethiopia would significantly overestimate future welfares if modeled by the mean climate parameters, in comparison to the variable climate ensemble. The increased temperature and reduced rainfall trends in most part of Ethiopia will have a considerable impact on the performance of agriculture.

Most of the studies clarify the strong relationship between climate variability and Ethiopia's GDP have been based on historical data. As the economic development in Ethiopia is heavily reliant on agriculture and natural resources and more than 80% of the population is directly employed in agricultural sector; thus, with climate change-related extreme events, vulnerable

Vol. 3, No. 02; 2018

ISSN: 2456-8643

livelihoods and its effects on national economic growth have negative impacts on poverty reduction and development interventions. This is related to the increasingly pivotal role of agriculture as an engine for Ethiopian development within the last six years (Birhanu, 2010).

As (Bewket, 2003), in the past decades the growth rate of agriculture sector in Ethiopia has lingered behind the rate of population growth; and as consequence, the country has, become one of the net importers of agricultural products to support the demand of the population, and lined along with the major food aid recipients in Africa. According to (Goldstone, 2007) and (Fraser, 2007) owing the above facts, and the high sensitivity of Ethiopian agro-ecosystem to rainfall and low adaptive capacity to respond to damages and a slight change in climate will have a large impact on the socio-economic activity of the country.

Impacts on Economic Resources

Labour force: the supply of labour is affected by human health which is influenced by climate change. The human health is the most vulnerable to climate variability and change due to its different outcomes. In terms of the livelihoods approach, farmers and pastoralists are found to be the most vulnerable. The arid, semi-arid and the dry sub humid parts of the country are affected most by drought which leads to scarcity of available water both for food and sanitation purposes (NAPA 2007). Climate change is expected to affect the health status of millions of people through increases in malnutrition, mortality, diseases, and injuries due to adverse weather events. These adverse weather events could increase incidence of infectious diseases like malaria, cerebrospinal meningitis, cholera, and waterborne diseases in developing countries the consequences of these adverse effects will contributing for morbidity and mortality which affect the labour force productive capacity on agriculture and bring additional costs to survive from the outcomes.

Warming during 1970-2000 was estimated to have caused at least 160,000 deaths annually (from just four outcomes of malaria, diarrhea, malnutrition, and flooding) WHO, 2004. According to this data Ethiopia was categorized among those having high death rate of estimate about 70-120 per annum. The impacts on health due to climate change will be felt most by the poor who often have reduced resistance to those diseases which are likely to increase due to climate change. Diseases like cholera, diarrhea and malaria often hit the poor the hardest. In addition to reduced resistance, the poor also have much more limited access to healthcare. Due to climate change new diseases will be introduced into health rural areas previously not affected and communities depend on traditional medicines for these diseases (Fulco, 2007).

Water Resource: As everyone knows water is a very essential resource for any society irrespective of its sources either surface or ground it may be. According to Fulco, 2007, climate change affects this important resource in different parts of Africa including Ethiopia in frequent droughts, low water storage in reservoirs and lakes, reduced or increased run-off, frequent floods, increased water stress due to climate change resulted increased demand and scarcity of water could trigger more conflicts. Ethiopia is rich in water resources that have local and

Vol. 3, No. 02; 2018

ISSN: 2456-8643

international significance. However, only a handful of studies have attempted to assess the likely impact of climate change on their use potential, flow characteristics, volume etc.Zeray*et al.* (2006) have addressed the ZiwayLake water volume is declined.

Ecosystems and biodiversity: Biodiversity is the source of essential inputs for agricultural development and provides a multitude of choices and means for dealing with natural and man-made environmental disturbances. Though Ethiopia is endowed with rich biodiversity resources, their degradation has become a threat. The major environmental impact of climate change were changes in rainfall patterns, increased frequency and severity of floods, droughts and storms, changes in growing seasons and regions, changes in water quality and quantity, sea level rise, glacial melt and coastal management. The temperature increase could have bigger implications, especially in the low-lying areas of the country. Coupled with declining rainfall amounts, increasing temperatures will exacerbate the existing water stress level, leading to the deletion of grazing lands and desertification.

Focul*etal.*,(2007)identified the overall climate change effects on ecosystem and biodiversity. Biodiversity in the highlands of East Africa is severely threatened, 25-40% of large mammal species in National Parks will become endangered, Wildlife Tourism at risk in this area due to lower density of large mammals. Desertification likely to increase due to combined threats of climate change.

According to World Bank (2006) "urgent action is needed to climate-proof development because, as with energy investments, decisions taken today about infrastructure, production systems and institutions determine the vulnerability of those systems for many decades to come" (Stern, 2006) also suggested the same opinion on the decisions to be considered to combat the adverse situations. The Stern Review (2007) pays considerable attention to the implications of climate change for development stated that "climate change poses a real threat to the developing world". In addition more quantitative information on the costs and benefits of economy-wide adaptation is required.

SUMMARY

Climate change will become more harmful unless it will be reversed or ceased its progress. In order to control the consequences of climate change events copping strategies should be established and implemented. The most cost effective and possible copping strategies for developing countries are adaptation and mitigation. The copping strategies can be implemented by different actors at different levels in different economic sectors.Hence, climate change is by know the cross-cutting issues of our country and the existing government planned to come up the diverse effects of its consequence by implementing different affirmative action with great attentions for soil and water conservation strategies both biological and physical, water shade management practices, irrigation dam facilities and green economy strategies.

Vol. 3, No. 02; 2018

ISSN: 2456-8643

According to this review the main effects of climate change in the Ethiopian economy resulted in the reduction of agricultural productivity of both crop and livestock through recurrent drought and reducing the maturity period of crops due to moisture deficits and reduction of pasture products of livestock forage. The overall future consequences and effects of climate change in agriculture will have severe impact on food production and security, unsustainable agriculture in several marginal semi-arid regions, increased poverty of small scale farmers, small increases in productivity in regions with mild climate change where rainfall is increasing. Changing season will make agriculture more difficult like planting dates due to late or early start of wet season and less predictable water availability will make agriculture sector more difficult.

Climate change in Ethiopia will also affects the human health in one or the other ways of increased malaria risks due to warmer temperatures, increase of water borne diseases due to more frequent floods and droughts, higher temperatures and reduced water availability increase risks of cholera, water borne diseases due to flooding malnutrition, malaria, and other diseases related to poor sanitation and the risk of drinking water contamination.

The most frequent and least cost copping strategy for climate change hazards include adaptation of the upcoming conditions and mitigation against climate change consequences, like irrigation facility establishment, establishment of environmentally friendly green economy strategies and proper soil and water conservation techniques. The major determinant factors affecting climate change coping strategies in Ethiopia includes information flow, farmer to farmer communications, extension communication system, livestock ownership, education level of the household heads, and sex of the household heads being male. Regarding land management options also farm size, farming system and landownership option being owned affect it the adoption and implementation of climate change coping strategies positively, whereas poverty, household size and land fragmentation affects it negatively.

CONCLUSION

Given the looming threat of climate change in Ethiopia, where the economy is very weak to take up the challenge, this review suggests the following options. The potential adverse effects of climate change on Ethiopia's agricultural sector are a major concern, particularly given the country's dependence on agricultural production. Securing Ethiopia's economic and social well-being in the face of climate change requires that policymakers and stakeholders work together to integrate climate change adaptation into the country's development process. Drought conditions, flooding, and pest outbreaks are some of the stress factors due to climate change that affect agriculture and food production systems. As climate change is the most terrible trend in developing countries like Ethiopia which are highly dependent on agriculture, policy and strategic measures should be taken asapproaches to adapt climate change stress factors in the agriculture and food production sector.

Vol. 3, No. 02; 2018

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