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Impact of Climate Change on Crop Yield and Food Accessibility in Sub-Saharan Africa -A Review

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ABSTRACT

Agriculture is of special concern as it is the primary source of food and is dependent on weather. The impact of climate change on agriculture is estimated to be large, even in the face of large doubts. It is one of the drivers of globalization, is a growing concern not only in the global scale but also in Sub Saharan Africa (SSA). This paper reviews numerous studies in the influence of climatic change on crop production and food accessibility in SSA. Reports have predicted that SSA is one of the regions that would have the most severe impacts of climatic change. The increasing climatic variability brought about by the increase in extreme weather events, global warming, seawater rise and deficit in rainfall would obviously have serious effects for food production and availability in the region. Thus, climate change has threatened the food security in SSA. The climatic change would significantly shake the livelihood patterns, the ability to access food and the socio-economic lives of the majority of the people in the region. Prediction models that we reviewed, in relation to impacts of climatic change on the food systems, showed consistent predictions of decrease in crop productivity, increase in land degradation, high food prices, and negative impacts on livelihoods, and increase malnourishment. Therefore, there is an urgent need to avert the trend which climatic change is reducing the entire SSA into through the adoption of robust adaptation strategies as a means of mitigating severe food insecurity across the entire region. This can help to mitigate the impacts of climate change on crop production and food security and thus, increase the capacity of the people to adapt. The feasible adaptation programs that could be adopted include improvement in agricultural land areas, crop productivity, cropping intensity, consumption and strengthening of all aspects of agriculture.

Keywords: climate change; extreme weather events; food security; food accessibility; Sub- Saharan Africa.

INTRODUCTION

Agriculture constitutes the backbone of most African economies and is a major contributor to the gross domestic product (GDP) of the region. Africa has been identified as one of the parts of the world most vulnerable to the impacts of climate change (IPCC, 2014; Niang *et al*. 2014).

Here we present an overview of the effects of climate change projected for the Sub-Saharan region of the continent. The agriculture sector employs 65 % of Africa's labour force and the sector have output have increased since 2000, mainly due to an expansion of agricultural area (World Bank, 2013). Yield potential remains higher than actually achieved, with inadequate water and nutrients being the major limiting factors (Mueller *et al*. 2012). Agricultural production in Sub-Saharan Africa is particularly susceptible to the effects of climate change, with rain fed agriculture accounting for approximately 96 % of overall crop production (World Bank, 2015a).

In Sub-Saharan Africa (SSA), about 60 percent of the economically active population works in the agricultural sector (WDI, 2006). Any improvement in this sector would amount to an increase in the rural incomes and the purchasing power of a large number of the population in the region and, this wold reduce poverty and hunger and, ensures sustainable development (Irz *et al*., 2001). Therefore, to ensure that the region is food secure, actions geared toward higher agricultural production and increasing access to food should vigorously pursue.

However, climate change considered as posing the greatest challenge to agriculture and food security in SSA. This is because the region is vulnerable to climatic change and its coping capacity is perceived to be very low (Shah *et al*., 2008 and Nellemann *et al*., 2009). Reports indicate that food production, including access to food, in many African countries projected to be severely cooperated by climate variability and change (IPCC, 2007). This means that areas suitable for agriculture negatively affected by climatic change and the yield potentials of many high profile crops produced in the region, particularly along the margins of semiarid, arid and coastal areas are expected to decrease. Moreover, it would further adversely affect food security and exacerbate malnutrition in the region. FAO (2008) estimates indicate that the number of hungry and malnourished people due to insufficient food availability and lack of access to food, have increased from about 90 million in 1970 to 225 million in 2008, and was projected to add another 100 million by 2015.

Climate change is an important environmental, social and economic issue. It threatens the achievement of Millennium Development Goals aimed at poverty and hunger reduction, health improvement and environmental sustainability (UNDP, 2010). National poverty rates have been declining in most Sub-Saharan African countries, with the exception of Mozambique, Cote d Ivoire and Guinea, although Sub-Saharan still has the largest proportion of people living below the poverty line of all world regions (World Bank, 2015b). Levels of stunting among children under 5 years of age as a result of chronic hunger are slowly declining but remain high at 39.6 % in 2011 (United Nations Children's Fund, World Health Organization and The World Bank2012). Around one in four people in Sub-Saharan Africa is undernourished, amounting to a quarter of the world's undernourished people (FAO, IFAD and WFP2014).

Climate change affects the type of policy measures that governments take and the adaptation strategies that the potential victims adopt. Existing policies and institutions also influence the severity of climate change in a country or region. Moreover, climate change affects crop yield and the livelihood patterns of households depending on the adaptation strategies put in place. According to Smit and Pilifosova (2001), adaptive capacity is defined as "the potential or ability of a system, region, or community to adapt to the effects or impacts of climate change". The adaptation strategies determine the productivity of the ecosystem and the food security status of that household. A lower agricultural production and productivity due to climate change has implications for food prices, which in turn affect the livelihood and food security status of households in a country. In the absence of proper social security programs and where markets are not functioning well, which is the case in most of the countries in SSA, high prices will have severe short and long- term impacts on households.

1.2. Food Security

As defined in the Rome Declaration on World Food Security 1996 food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996, p. 4). Food security depends on availability of food, access to food, and utilization of food (FAO,2000). Food availability refers to the existence of sufficient quantities of food in appropriate quality, and supplied through domestic production or import. As indicated in Figure 1, food availability is a result of domestic production, distribution, storage, import and export. The comparison of available food to the estimated domestic consumption requirement gives estimation to the deficit or surplus of food availability in a certain country (FAO, 2008a). Food availability is probably most frequently used as a measurement of food security. It is also the channel which climate change directly affects food security (Thompson *et al*., 2010).

In the 2015 deadline set for achieving the Millennium Development Goal targets, Sub-Saharan Africa (SSA) made some progress towards halving the proportion of its population suffering from hunger (MDG 1.C target). Overall, the prevalence of hunger in the region declined by31percent between the base period (1990-92) and 2015, according to the latest estimates of the State of Food Insecurity in the World (SOFI 2015 report). In other words, approximately one person out of four in SSA is estimated to be undernourished today compared to a ratio of one out of three in1990-92.

Access to food is determined by physical and financial resources as well as social and political factors (Ericksen *et al*., 2011). Food access consists of affordability, allocation and preferences. Physical availability of food is not sufficient for an individual to have access to food. There may be food available in the market but some households may not access it for many reasons such as poverty, poor infrastructure, high prices, transaction cost, etc. The food available in the market may also be not the type that the households prefer. Thus, insufficient access to food could be a result of either high prices or lack of capacity to acquire food. The concept of access to food has been specially given emphasis since Amartya Sen's seminal book "Poverty and Famines" that shows famine can occur in spite of availability of food but due to failure of entitlement by a group of people to food (Sen, 1982).

Utilization of food depends on how food is used, whether food has sufficient nutrients and whether a balanced diet can be maintained. "Food utilization refers to the individual or household capacity to consume and benefit from food" (FAO, 2011, p.8). Although food availability and access to food are necessary for food utilization, they are not sufficient conditions. A household who has physical as well as economic access to food could be food insecure if it cannot get a balanced and nutritious diet. Food utilization has implications for healthy and productive population in a country. Food utilization is determined, among other things, by food preparation, nutrition knowledge, health care, access to clean drinking water, women and child care and women's role (Negin et al., 2009). These are specially limited if not absent in most of the SSA countries where disease and malnutrition is widespread as a result.

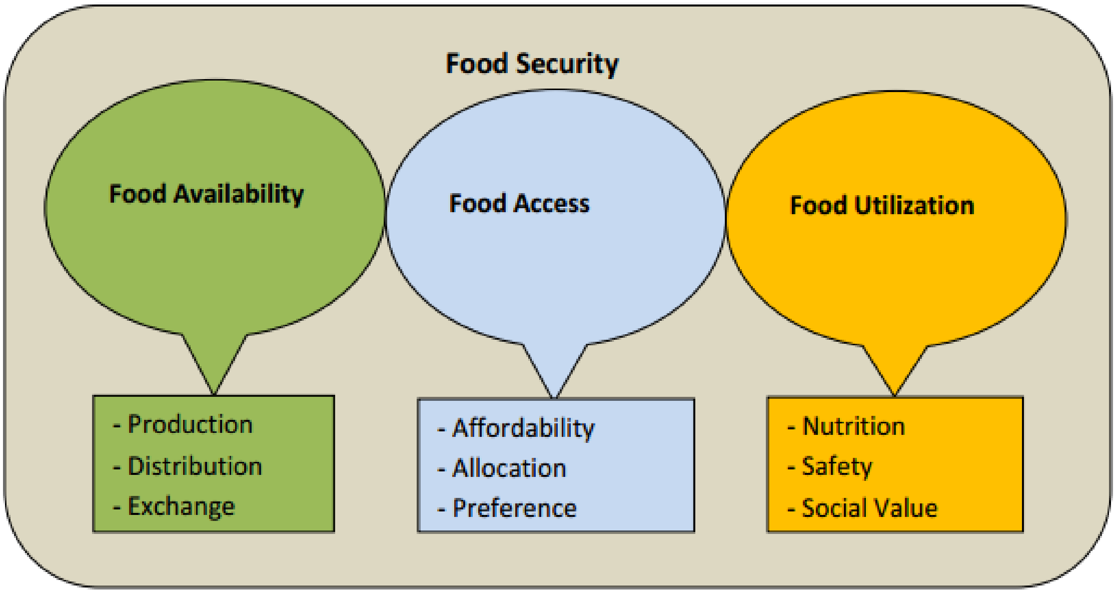
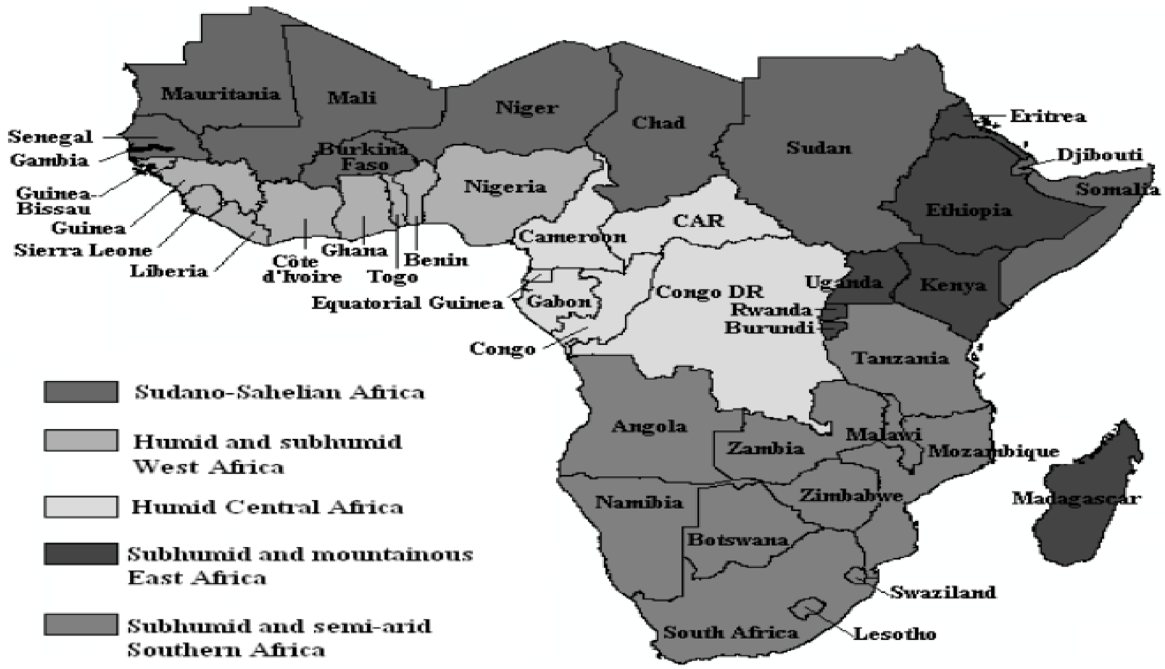


Figure 1. Basic components of food security



Source: constructed from FAO (1997).
Notes: CAR denotes Central African Republic, Congo DR denotes Democratic Republic of Congo and Tanzania denotes United Republic of Tanzania.

Figure 2.Major Climatic Regions of SSA

OBJECTIVES

General Objective

To review knowledge about the relationships among climate change, food production and food accessibility in Sub-Saharan Africa

Specific Objectives

To review the impact of multiple effects that climate change on crop yield and food accessibility in Sub-Saharan Africa

To review how does climate change affect crop yield and food accessibility in Sub-Saharan Africa?

METHODOLOGY

Area of Reviewing

The area of reviewing focuses on SSA, which can be separated into five major climatic regions (FAO, 1986a; cited in FAO (1997)): Sudano-Sahelian Africa, humid and sub-humid West Africa, humid Central Africa, sub-humid and mountainous East Africa and sub-humid and semiarid South Africa. These regions are refers to as Sudano -Sahel, West, Central, East and South. The five climatic regions are displayed in Figure 2.

The Methods Followed for Reviewing

Revising of Journal Research Papers, Project Reports, Thesis and Dissertation Researches, Reference Books and Text Book Chapters

LITERATURE REVIEW

Overview of Climate Change, Crop Production and Food Accessibility

Crop production and food accessibility are key elements for determining whether an individual a household or even a given region is food secured. These elements are affected climatic change. Thus, climate change is a critical element for assessing the household or regional food security. FAO (2008) stated that climate change will affect food security through its impacts on all components of global, national and local food systems. There is an overwhelming report that climate change will bring both impacts and opportunities with respect to crop production.

Crop production is one aspect of the food systems affected by climate change. It is very pertinent to look at how climatic change would affect crop production in SSA. This is because crop production does not only look at how the crops we consume are produced, but it is also an employer of labour especially in SSA where over 70 percent of the people depend on farming for their livelihoods. Thus, if the people are no longer able to make their living producing food crops, their ability to have the capital to access food may also be affected. Therefore, any change affecting the crop production in SSA will have significant ripple effects that results not only in the reduction of the available food but also increases market prices in the region. In this chapter, we will look at the interactions of climatic change with crop production and food accessibility in SSA.

Impact of Climate Change on Outcomes for Sub-Saharan Africa

While climate change impacts in the form of yield declines are less severe in Sub-Saharan Africa than in Asia, for example in ADB and IFPRI (2009), Sub-Saharan Africa is much more vulnerable to climate change. This is because Africa's adaptive capacity is extremely low, which is linked to acute poverty levels and poor infrastructure, as reflected in a high dependence on rain fed agriculture (see, for example, Brooks, Adger, and Kelly 2005; Ikeme 2003; Tschakert 2007). As we have shown, Sub-Saharan Africa faces increased net food imports even under the historic climate scenario because of growing populations; faster economic growth than in the past; and growing urbanization, coupled with insufficient improvement in agricultural productivity.

Impacts of Climate Change on Crop Production

Climate change affects crop production through direct impacts on the biophysical factors such as plant and animal growth and the physical infrastructure associated with food processing and distribution (Schmidhuber and Tubiello, 2007). In this section, we will be exploring on how climate change will affect crop production in SSA directly. Recent research has suggested that some impacts of climate change are occurring more rapidly than previously anticipated (Parry et al., 2007). Climate change will affect crop area, yield, and production.

In SSA, climate models predict increased evapotranspiration and lower soil moisture levels (Rosenzweig *et al*., 2002).This would result in drought, some agricultural lands becoming unsuitable for cropping, and some tropical grassland becoming increasingly arid. Lobell *et al*. (2011) exploited historical data from over 20,000 field trials of maize conducted in Africa over the past decade. In addition, they found out that each 'degree day' that the crop spends above °C (a unit that reflects both the amount and duration of heat experienced by the plant) depresses yields by 1percent if the plants are receiving sufficient water. They also revealed that water accessibility has an important effect on the crops sensitivity; with yields decreasing by 1.7 percent for each degree day spent over 30°C under drought conditions. Thus, they indicated that under no drought conditions 65 percent of the land area in Africa that is under maize cultivation at present would experience yield losses from a uniform 1 °C warming. Under drought conditions, 100 percent of the present cultivated area would experience yield losses, with 75 percent of this area suffering yield losses of at least 20 percent. Temperature rise will also expand the range of many agricultural pests and diseases by increasing the ability of pest populations to survive and attack crops thereby causing yield reduction. The climate change will exacerbate drought and land degradation, with estimations of 5 to 8 percent increase (60 to 90 million ha) of arid and semiarid land in Africa (Parry et al., 2007). This means that about two thirds of arable land in Africa is expected to be lost by 2025, land degradation currently leads to the loss of an average of more than 3 percent annually of agriculture GDP in SSA (UNESC, 2007). In addition, decreased rainfall would impact negatively on the yields from rain fed agriculture, with estimations of up to 50 percent in some countries by 2020. Maize, for example, could be discontinued in some areas in the region.

Table 1. Gives changes in crop yields for major crops grown in Sub-Saharan Africa by agro ecological zone. Interestingly, yield impacts are quite heterogeneous across crops and zones, and no crop or zone has consistently positive or negative results. Among the crops, the Sudano-Sahelian and Eastern zones show projected yield increases for four out of the five crops. Rice is particularly important in the Sudano-Sahelian zone, and maize is the key staple crop in Eastern Africa. The Central zone, on the other hand, shows yield declines for four out of five crops, but declines are minor. The Gulf of Guinea shows the largest yield declines for cassava and sweet potato, and the Southern zone has projected declines for maize, rice, and cassava.

Table 1. Yield changes, selected crops, under climate change, by agro ecological zone, Sub-Saharan Africa, 2050, (in percent)

	Maize	Rice	Sweet potato and yam	Cassava	Sugarcane
Gulf of Guinea	0.24	1.38	(15.09)	(11.94)	(0.50)
Sudano-Sahelian	3.30	(0.80)	1.98	1.22	0.34
Southern	(0.91)	(2.32)	1.14	(0.75)	1.09
Eastern	(1.92)	0.24	1.06	0.42	0.31
Central	(0.79)	(0.63)	(0.11)	(0.14)	0.93

Source: c.ringler@cgiar.org

Crop production in SSA directly affected by many aspects of climatic change, stemming primarily from:

- Average temperature increase
- Change in rainfall amount and patterns
- Rising atmospheric concentrations of CO2
- Change in climatic variability and extreme events
- Sea Water Rise
-

Average Temperature Increase

Increases in mean, maximum and minimum temperatures are forecasted for most regions of the world as a result of climate change. It is expected that countries in the low latitude (tropical and sub-tropical) regions, where water availability is low, would generally be at risk of decreased crop yield at even 1 to 2°C of warming (Parry et al., 2007; FAO, 2008b). This is because of increased evapotranspiration and lower soil moisture levels (Bals *et al*., 2008). Thus, the phenomenon would result in some of the agricultural lands in the SSA, which is located in the tropics, becoming unsuitable for cropping and some grassland becoming unsuitable for pasture (Bals et al., 2008). This would result in crop yield reduction in the region. The extent of these declines in yields is still unknown, but some analysts suggest they could be severe (Bals *et al*., 2008).

Change in Rainfall Amount and Patterns

It is expected that as a result of climate change, the temperate regions (wet areas) could become wetter and the dry areas in the tropics could become drier (FAO, 2008b).The intensity of rainstorms could increase (in some areas) and precipitation could become more variable and unpredictable. The change in rainfall can affect soil erosion rates and soil moisture, both of which are important for crop yields. SSA would experience decreased precipitation, which according to Parry *et al*. (2007) is about 20 percent. Thus, increase in temperature along with reduced precipitation will likely result in the loss of arable land in the region due to decreased soil moisture, increased aridity, increased salinity and groundwater depletion (Bals et al., 2008). Water shortages could lead to water rationing and higher water costs and will limit opportunities to maintain or extend these cultivated agricultural lands through the use of irrigation. FAO (2008) opined that reduction in available good quality water for crop at certain times of the year will negatively affect food supplies. SSA depends on rain- fed agriculture and, the distortion of the rainfall pattern would limit crop production and this would bring untold physical and socioeconomic hardship to the rural farmers in the region.

Rising Atmospheric Concentrations of CO2

The atmospheric CO2 concentrations are estimated to be approximately 379 ppm at past but are potentially rise to 550 ppm by 2100 under the IPCC Scenario under the lowest future emissions scenario and greater than 800 ppm under the business as usual scenario (Schmidhuber and Tubiello, 2007). Increasing atmospheric CO2 levels is beneficial to plant: it acts as a fertilizer by enhancing the growth and development of crops. Increase in the atmospheric CO2 levels would stimulate photosynthesis and improves water use efficiency (Eamus, 1991, Bazzaz and Sombroek, 1996).Thus resulting in an increase in the crop biomass and yield. However, the increasing atmospheric CO2 level does not only contribute to increased crop yields, but is also a major cause of the greenhouse effect.

Change in Climatic Variability and Extreme Events

Extreme events are not new phenomena in agriculture, but they are increase in frequency and the areas subject to extreme events are likely to expand (Schmidhuber and Tubiello, 2007). Easterling *et al*.(2007) cited several studies that projected increased frequency of extreme weather events in SSA, which will have more serious consequences for food production and food security. This is becoming worrisome due to the high dependence of the region on rained agriculture. Climate variability, particularly severe flooding and droughts, have been directly linked to declines in economic activity (Brown *et al*. 2008). Reports of Wassmann and Dobermann (2007) showed that the SSA region has experienced a series of extreme precipitation events that seem to be linked to changing climate. According to the report, the 2000 Mozambique flood had apart from huge human losses a devastating effect on the agriculture of Mozambique with approximately 90 percent of the country's functioning irrigation infrastructure damaged and a significant loss in agricultural land that resulted many households without food.

Rise in Sea Water Level

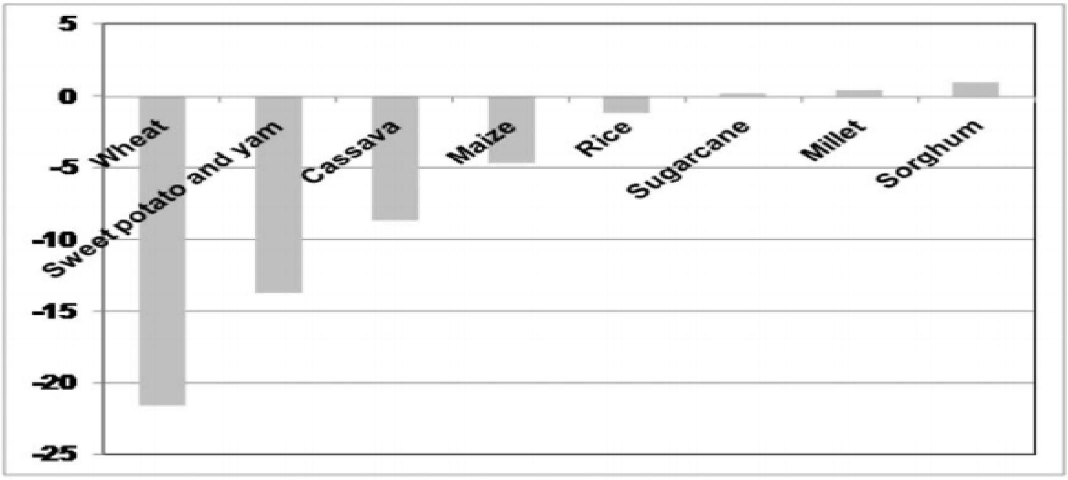
Sea level is set to rise as a consequence of increasing global temperatures. Both will increase the vulnerability of coastal and low-lying agricultural lands factoring in impacts such as coastal inundation, soil salinization and intense rainfall. Sea level has already risen by 15 to 20 cm due to the melting of glaciers and polar ice, as well as rising temperatures in the oceans (Douglas, 1997). There is significant uncertainty with regard to how much sea level could rise, but current projections suggest a sea level rise of about half a meter by 2100 can be expected and that it could possibly be significantly higher (Ibid). The countries that would be vulnerable to seawater rise in SSA include Gambia, Gulf of Guinea, Senegal, Southern Mediterranean and Mozambique. Coastal inundation and soil salinization, will lead to a loss in agricultural land in the region. This would significantly affect crop production in the coastal regions, leading to regional loss in famers'income and food supply systems. Contamination of arable land through greater exposure to wastewater is also a possibility (ESCAP, 2009).

3.4. Projected Impacts on Crop Yield

The projected change in yields as a result of climate change in 2050 for selected crops grown in SSA is shown in Figure 3. IFPRI (2007) reported that negative yield impacts are projected to be largest for wheat, followed by sweet potato, whereas overall yields for millet and sorghum are projected to be slightly higher under climate change. Although negative impacts are largest for wheat, the region grows very little of it (about 4.3 million ha in 2000)

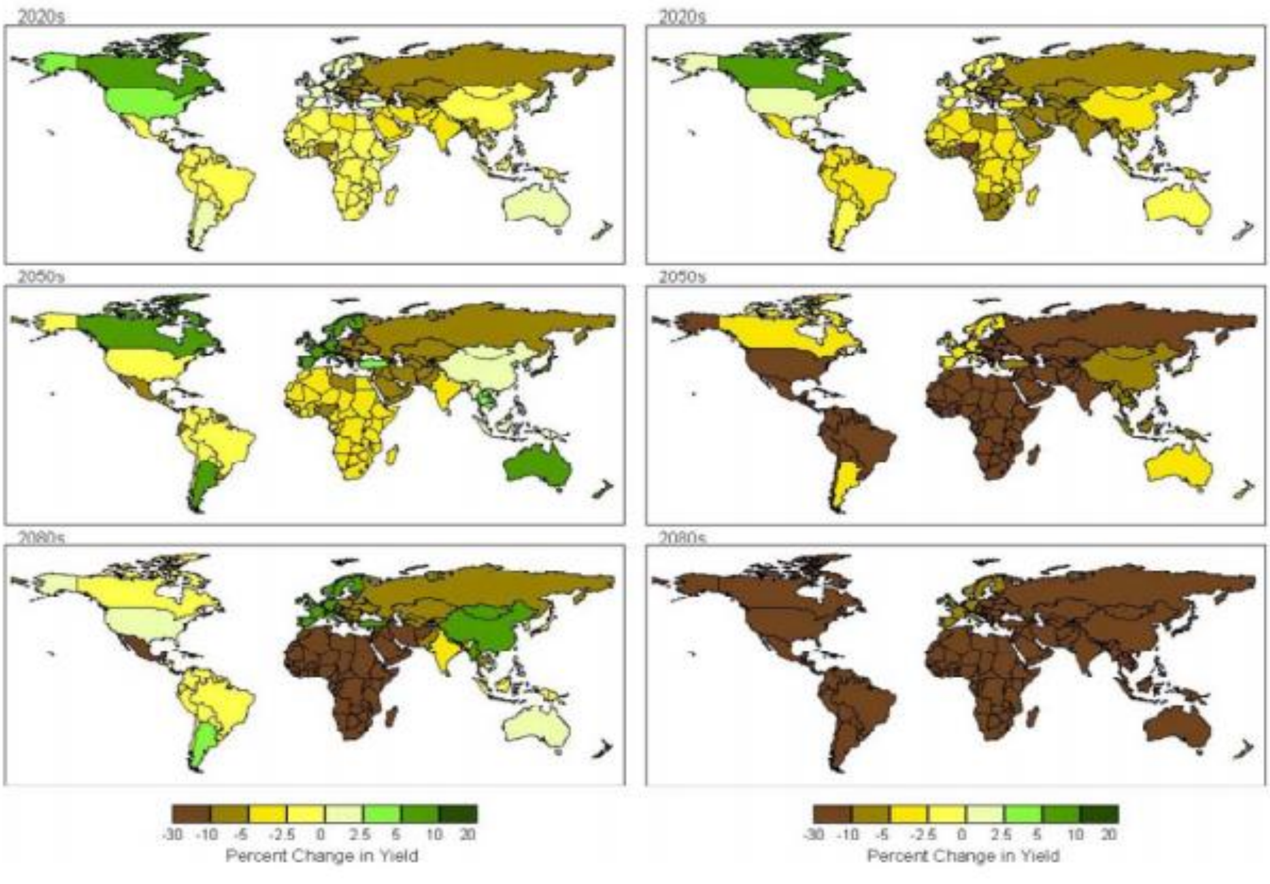
Table 2.Significances of Climate Change on Food Systems in SSA

Climate change impact	Region/Country	Direct consequences for food systems
Average temperature increase **Hot days & nights** **Warm spells/heat waves over most land areas**	Countries of SSA	- Increased evapo-transpiration, resulting in reduced soil moisture - Greater destruction of crops and trees by pests - Greater threats to human that reduce the productivity and availability of agricultural labour - Reduced quantity and reliability of agricultural yields - Greater need for cooling/refrigeration to maintain food quality and safety - Greater threat of wildfires
Extreme events - **Droughts** - **Floods**	Semi-arid and sub-humid Africa (particularly the Sahel, Horn of Africa and Southern Africa),	- Crop failure or reduced yields - Damage to forests - Destruction of agricultural inputs - Increased land degradation and desertification - Damage to crops & food stores - Soil erosion, inability to cultivate land due to water logging
Change in rainfall amount and patterns	SSA	- Reduced quantity and quality of agricultural yields and forest products - Shortage of water and heavy reliance on irrigation
Sea-level rise	West Africa (Gambia, Gulf of Guinea, Senegal), Southern Mediterranean (Egypt) and East Africa (Mozambique) East Africa (Mozambique)	Loss of cropland and nursery areas for fisheries through salt water intrusion Salinisation of irrigation water, estuaries & freshwater systems which will threaten - irrigated crops - aquaculture in low-lying areas - coral fisheries dependent on spawning grounds in mangrove swamps



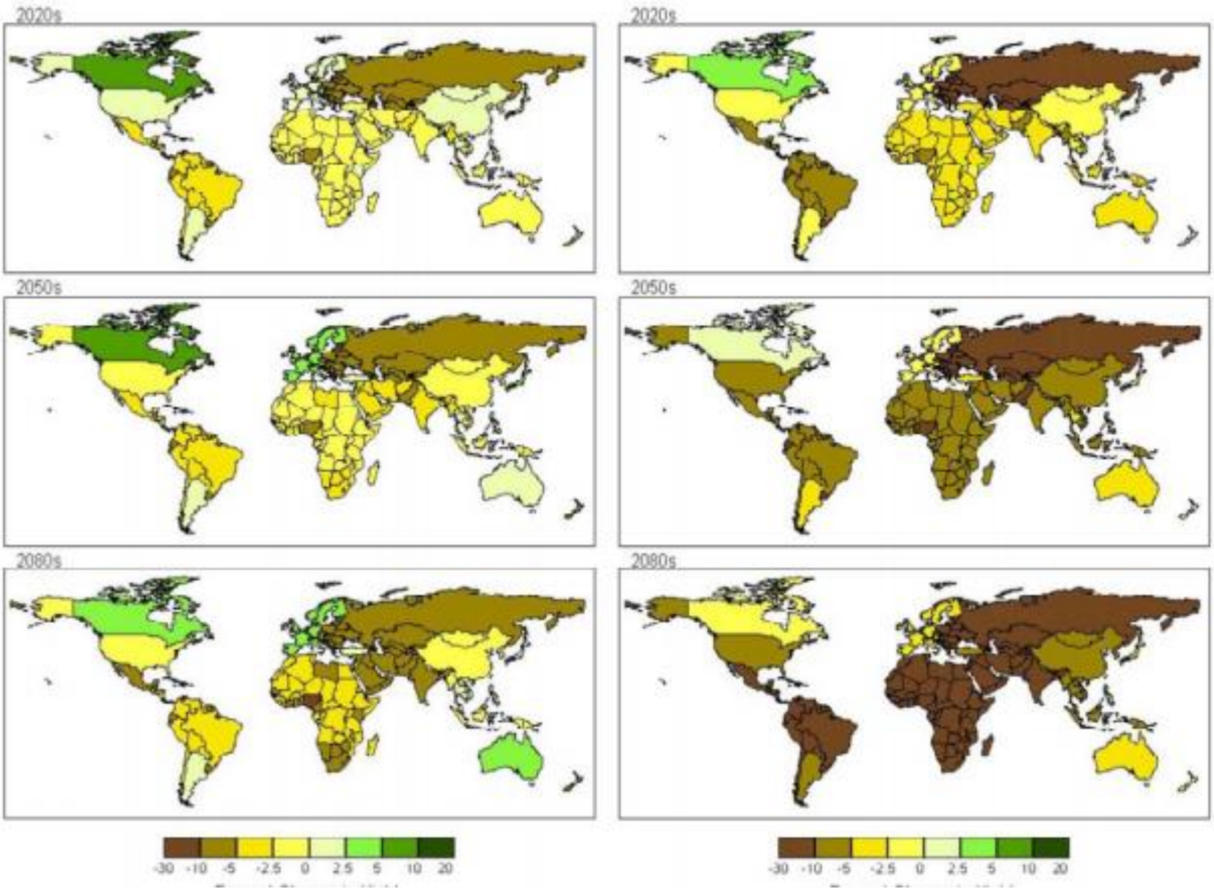
Source: IFPRI, 2007

Figure 3.Yield Changes by Crop because of Climate Change, 2050, SSA (percentage change)



Source: Parry et al., 2004

Figure 4.Potential Changes (%) in National Cereal Yields for the 2020s, 2050s and 2080s (compared with 1990) under the HadCM3 SRES A1 Scenario with and without CO2 Effects)



Source: Parry *et al*., 2004

Figure 5.Potential Changes (%) in National Cereal Yields for the 2020s, 2050s and 2080s (compared with 1990) under the HadCM3 SRES B1 Scenario with and without CO2 Effects)

Changes in temperature and precipitation associated with continued emissions of CO2 gases will bring changes inland suitability and crop yields. The IPCC Special Report on Emissions Scenarios (SRES, 2000) grouped the socio- economic development and associated emissions into four scenarios, namely; A2, B2, A1 and B1. The A1 scenario (the “business- as-usual scenario”) is the scenario of the highest CO2 emissions, while the B1 category corresponds to the lowest CO2 emission. The A2 and B2 scenarios are intermediate between the A1 and B1 scenarios. Depending on the SRES emission scenario and climate models considered, global mean surface temperature is projected to rise in a range from 1.8°C (with a range from 1.1°C to 2.9°C for SRES B1) to 4.0°C (with a range from 2.4°C to 6.4°C for A1) by 2100 (IPCC, 2007). Changes in the regional crop yields under each of the IPCC (2000) SRES scenario are the result of the interactions among temperature and precipitation effects, direct physiological effects of increased CO2, and effectiveness and availability of adaptations. Figures 4 and 5 show the potential changes in world and regional wheat, rice, maize, and soybean production for the 2020s, 2050s and 2080s (compared with 1990) under SRES scenarios with and without elevated atmospheric CO2 concentrations. The model predicted that by 2020, small changes in cereal yield will be evident in all scenarios (FAO, 2002), and the differences in the mean impacts of the SRES scenarios will depend on the range of the spatial variability. Generally, the SRES scenarios result in grain yield decrease in SSA. The A1 scenario, as expected with its large increase in global temperatures, exhibits the greatest decreases in the grain yields, especially by the 2080s. Decreases are significant in SSA with expected losses up to 30 percent (Figure 4). This is an indication that effects of temperature and precipitation changes on the yields are beyond the inflection point of the beneficial direct effects of CO2. However, the B1 scenario will result in smaller cereal yield decreases that never exceed 10 percent (Figure 5).

Factors Affecting Access to Food

Households in SSA countries fail to access food for many reasons. Figure 6 shows the most common drivers of food insecurity for households in developing countries.

The factors in figure 6 are not entirely independent. As discussed in the previous section, the impact of climatic change could result in failure of farmers' crops which would give rise to a greater reliance on purchased commodities. For a farmer with small asset base such a loss in production would, obviously increase his/her poverty status, lead to rise in the prices of crops and high rate of unemployment. Lack of education may result in suboptimal decision making by households about investments, credit, sale of outputs, etc. High food prices and unemployment deteriorate the purchasing power of the households which may potentially lead them to food insecurity. Poor access to infrastructure and markets may result in an exclusion of rural households from markets where they can earn better prices for their surplus produce. Thin markets and high transaction costs force farmers to gain less for their produce but to spend more for purchased commodities. Property rights and climate change have an indirect effect on food accessibility via their effect on food availability. The following sections go more into detail about these drivers of accessibility to food.

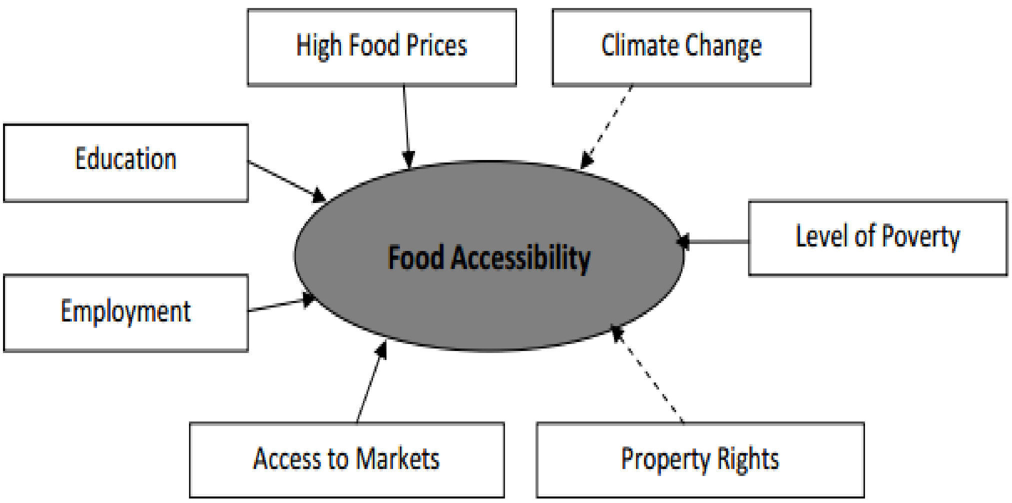
3.6. Consequences of climate change in SSA

Climate change will also slow the improvement in caloric consumption in SSA. The figure shows the improvements in caloric consumption in SSA with and without climate change (Figure 7).

Figure 7. Shows that climate change will reduce the daily food calorie intake of households in SSA by about 60 kilo calories. The caloric consumption varies across different agro ecological zones in SSA.

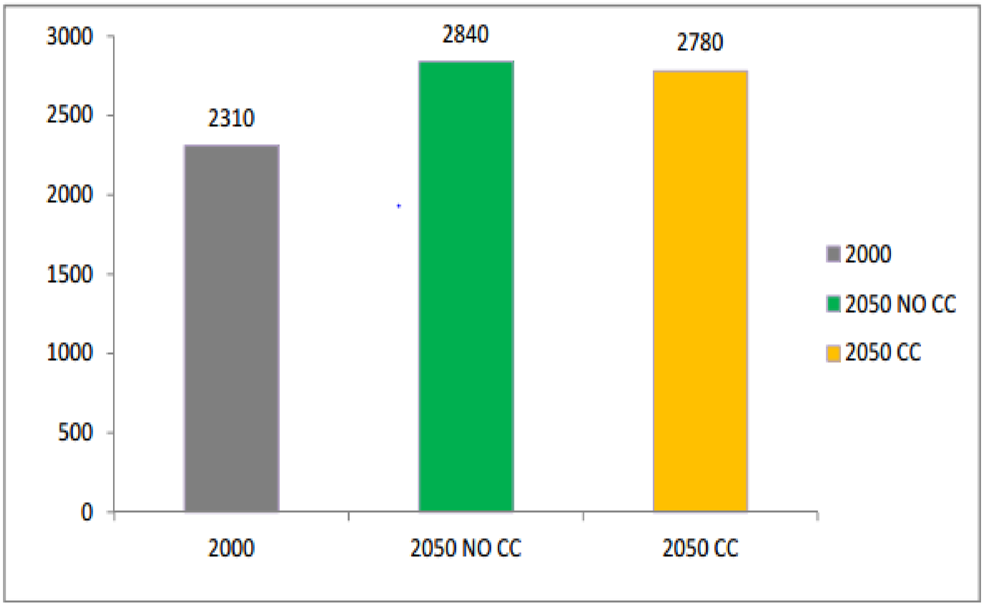
Climate change offsets some of the benefits of economic growth in the SSA region. For instance, simulation models by IFPRI's IMPACT model show that climate change increases the size of malnourished children by 11 percent in low income developing countries (in comparison to no climate change or perfect mitigation scenario) in 2050. The number of malnourished children in SSA has also worsened due to global climate change. Figure 10 shows that the number of malnourished children in SSA is projected to be about 1 million more in 2030 and 600,000 more in 2050 due to climate change relative to no climate change scenario.

In general, the following process shows how the effect of climate change is channelled to food accessibility problems, which could in turn lead to food insecurity.



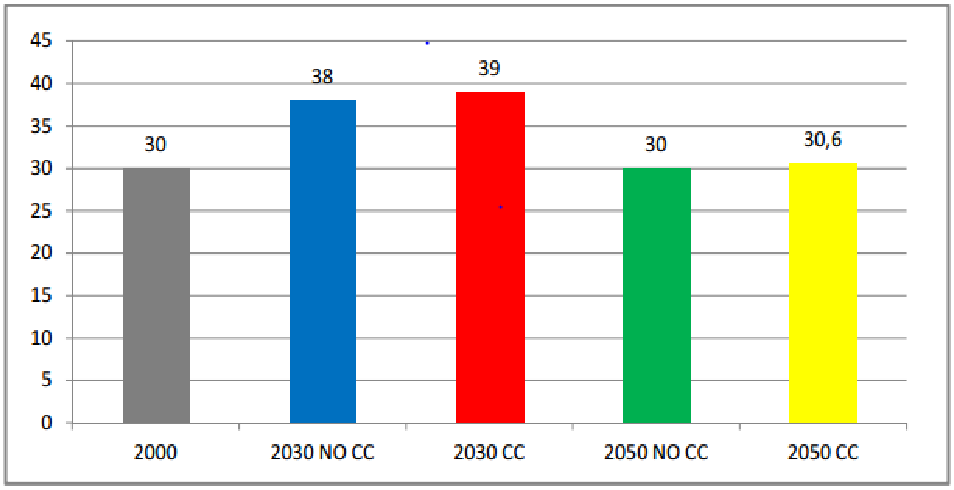
Source: Gregory, 2005. The arrows in dotted lines are for factors that primarily affect food availability whereas the others primarily influence food accessibility.

Figure 6.Determinants of Food Accessibility



Source: Own calculations from Ringler et al., 2010

Figure 7. Food Calorie Availability under Climate Change and no Climate Change Scenarios (kilocalorie per capita per day)



Source: own calculations from Ringler et al., 2010

Figure 8.Impact of Climate Change on Child Malnutrition in SSA (Million children)

Mitigation and sequestration strategies of climate change for field crop agriculture

Although agriculture contributes to excess greenhouse gases in the atmosphere, it is possible to reduce emissions and even remove carbon dioxide from the atmosphere through specific land management practices. There are three main concepts central to interactions between climate change and agriculture

1) Mitigation: intervention to reduce the sources or enhance the sinks of greenhouse gases1

2) Sequestration: the removal of carbon dioxide from the atmosphere and subsequent storage in carbon sinks (such as oceans, forests, or soils) through physical or biological processes, most notably through photosynthesis Pirog R and Rasmussen R (2009).

3) Adaptation: Initiatives and measures to reduce the vulnerability of natural and human systems gains actual or expected climate change effects IPCC (2007).

Table 3.Mitigation and sequestration strategies for field crop agriculture

Mitigation and sequestration strategies for field crop agriculture

Goal	Practice	Additional benefit to farmers
Reduce fossil fuel consumption	Renewable energy sources, improved efficiency equipment, biofuel crop substitution	Saves money, potential new biofuel crops and markets.
Restore (sequester) soil carbon: increase carbon inputs to soil	Crop diversity through cover crops and rotations; increase crop residue quantity in no-till; manure and compost additions	Improves soil and water quality. Reduces erosion.
Restore (sequester) soil carbon: reduce carbon loss from soil	Permanent no-till, retain crop residue, perennial crops	Improves soil, water, and air quality. Reduces soil erosion and fuel use.
Reduce nitrous oxide emissions	Better manage nitrogen fertilizer use	Improves water quality. Saves expenses, time, and labor.

SUMMARY

This term paper summarizes that, climatic change has significant negative effects on the crop yields and this will pose a huge challenge to the livelihoods and food accessibility of most people living in SSA. This will not only result in food imports but also, the number of households who will not be able to have access to adequate food to meet their nutritional requirements would increase. The paper also describes how the lack of food accessibility affects malnutrition, human capital and productivity. Climate change may be seen as a challenge in the way of SSA reaching its potential but the respective governments and relevant stakeholders should vigorously pursue, adopt and push for adaptation strategies that will not only mitigate further food insecurity, but could also diminish that which had already set in. This is especially necessary since poor farmers often lack the ability to adapt and are therefore more sensitive to climate change (Thompson 2010). One possible adaption strategy for farmers is to diversify livelihoods since not all sources of income are affected as much by climate change (e.g. off farm employment).There is no doubt that action and investment of governments is needed for effective adaption strategies. To directly improve the physical access to food. With respect to production, governments may support the breeding of crops for biotic and abiotic stresses with a high tolerance to drought, heat stress, salinity or flooding. Enhancing the agricultural management skills as well as making relevant information available to relevant stakeholders could go a long way in helping farmers improving and developing their own mitigation or adaption strategies. The respective SSA governments should also strive to implement a good social safety net, e.g. Through weather based crop insurance systems. Moreover, water control measures can be improved, IT systems upgraded and extended and their services extended to the poor resource famers in rural areas. An open trade regime, which is a way to share climate risk across countries and mitigate adverse effects of climate change, should be adopted. Finally, there should be a greater commitment of the various stakeholders and significant investments and expenditures in the agricultural sector to reduce the adverse impacts of climate change in SSA.

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Conflict of Interest

The author declares that there is no conflict of interest.

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