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Impacts of Climate Change on Food Security: A Literature Review in Sub Saharan Africa

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Abstract

Background: In Sub Saharan African countries, fast GDP growth has created a great opportunity to improve developmental indicators including food security but showed only limited improvements. There is scientific consensus on the climate change and expected to have substantial impact on food security significantly. Therefore, it is recommended new advocacy and public health movement to reduce the effect of climate change on food security and malnutrition. So this literature review is used to assess the impacts of climate change on food security in Sub-Saharan Africa.

Methods: A literature review was conducted from different sources using a Google scholar searching strategy that are written within 10 years period in English language.

Result: Documents related to impacts of climate change on food security were reviewed. Literatures indicate climate components like temperature, precipitation, CO_2 concentration and extreme climate events have an effect on food security components. Sub Saharan Africa is one of the most severely affected regions to climate change where most of the population is dependent on climate sensitive economic activities. The most direct effect and well researched component of climate change on food security is food availability by reducing net crop production. It is also found that climate change has an impact on food accessibility and utilization but not well studied due to its complexity. Projections indicate that this problem will be more severe in the future than today unless climate change mitigation and adaptation strategies are done.

Conclusion: This review concludes that climatic conditions are changing in SSA countries and is affecting food availability, food accessibility and utilization. The problem will be severe in the future unless the current adaptation and mitigation efforts do not improve. Therefore to reduce the problem, the region should use its potential to adopt climate change.

Keywords: Climate change; Food security; Nutrition security; Sub Saharan Africa

Introduction

There is no internationally agreed definition of the term climate change, which has resulted in differences of opinion on the issue. Climate change can refer to long term changes in average weather conditions covering all changes in the climate system, including the drivers of change, the changes themselves and their effects [1]. According to World Food Summit of 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 [2].

The United Nations development program regional Bureau for Africa in 2012 report shows a faster Gross Domestic Product (GDP) growth in Sub Saharan African countries from 1990 to 2010. Although this condition creates a great opportunity to improve living standards of the population including food security and malnutrition showed only limited improvements [3]. Different studies indicated this problem will increase in the future [4-6] due to climate change with population growth which are contributing the great share of the problem in addition to the pre-existing traditional determinants [6]. There is scientific consensus global climate is changing and expected to have substantial impacts on food security significantly but in uncertain ways [7].

Africa is commonly identified as a region highly vulnerable to climate change [8] and projections indicate warming will be greater than global annual mean, with an average increase of 3–4°C over the next century [9]. This climate change will reduce crop yields and in turn will increase the price of food that force people to change production and consumption patterns and directly will reduce calorie intake [10]. So climate change is undermining current efforts to address food security and malnutrition problems, one of the world's most serious but least addressed socioeconomic and health problem [11].

So new advocacy and public health movement is needed urgently to bring together governments, international agencies, Non-Governmental Organizations (NGOs), communities, and academics from all disciplines to adapt to the effects of climate change on public health including food security and malnutrition [12] through research particularly in developing countries, where they are highly sensitive to climate change, to predict the anticipated impacts and inform effective interventions accurately [13]. Estimating the impacts of climate change on food security have importance to policy of providing a

fuller picture of the consequences of climate change on food and nutrition security that helps them to develop interventions and allocate resources to adapt and mitigate to climate change [14].

Different literatures indicate the impact of climate change on food security and malnutrition is highest among Sub Saharan African Countries where most of the population depends on climate sensitive Agro economic activities. However, adequate amount of research is not done on the problem to provide evidence to key actors. Therefore, this paper reviews literatures on impacts of climate change and food security specifically in Sub-Saharan Africa, to characterize and synthesize our current understanding of the problem, and identify priorities for future research.

Search strategy

A narrative/ traditional/ literature review was conducted from peer-reviewed literatures, working papers, conference papers and reports from known organizations related to climate change, food security and malnutrition. To include only up-to-date information, a maximum time frame of 10 years is usually placed on the age of the works to be included in the review.

Manual searching and Google scholar search strategies were performed in this literature review from different databases. Finally, the full text documents were assessed to evaluate the relevance of the paper particularly for this review. Papers both published and unpublished in English language were included in this review.

Results

In this review, most of the studies have tried to classify the effect of climate change on food security in four ways. First, changes in temperatures and precipitation have a potential to alter the distribution of agro ecological zones which affects irrigation availability and demand. Second CO_2 effects are expected to have a positive impact due to greater water use efficiency and higher rate of photosynthesis. Third water availability which is highly sensitive to climate change can affect the food availability. Fourth agricultural loses can result from climate variability and the increased frequency of extreme events such as droughts and floods or changes in precipitation and temperature [15,16].

Literatures indicate climate change is one of the growing concerns not only in the global scale, but highly in Sub Saharan African countries. Different reports have predicted Sub Saharan Africa is one of the regions that would have the most severe impacts of climate change. Climate change is affecting all three dimensions of food security, i.e. Food availability, Food accessibility and Food utilization [15]. SubSaharan Africa is more vulnerable to the effects of Climate Change and variability than many developing regions. This is due to the heavy dependence on rainfed agriculture, high variability of production, poor and small producers, recurrent food shortages and net importers, low institutional capacity to adapt, lack of insurance and safety nets and fragile environments (low resilience) [17].

Impact of climate change on food availability

Food availability refers to the existence of sufficient quantities of food with appropriate quality, and supplied through domestic production or import. Food availability is probably most frequently used as a measure of food security and it has a channel with climate change which directly affects food security [18]. The major direct impact of climate change is expected to have on food security is through food availability component due to changes in agricultural productivity [16]. Food availability in Sub Saharan Africa is directly affected by many aspects of climate change like temperature increase, change in rainfall amount and patterns, rising atmospheric concentrations of CO_2, change in climatic variability and extreme events and sea water rise [15].

Literatures indicate there is a debate on the impacts of climate change on food security based on evidences from sub Saharan Africa [19,20]. Climate change has a potential to shift land suitability which leads to increases in suitable cropland in higher latitudes and declines of potential cropland in lower latitudes [19]. Also another study indicates moderate increase in temperature (1°C-3°C mean temperature) is expected to benefit crop yields in temperate regions but have a negative impact in tropical and seasonally dry regions particularly for cereal crops. However, warming of the climate more than 3°C is expected to have a negative effect in all regions [20].

An assessment of the impact of climate change on food production of a 2020 perspective indicates about two thirds of arable land in Africa is expected to be lost by 2025 due to decreased rainfall and reduce yields with an estimations of up to 50 percent in some Sub Saharan countries [21] where 96% of the cultivated land depends on rain feed agriculture [21,22]. The most significant impacts of climate change on food production is in tropical regions between 30° North and 60° South of the equator due to less water availability and increased temperature and in temperate regions between 300 North and 600 South due to changes in precipitation [21].

The International Food Policy Research Institute (IFPRI) tries to compare calorie availability in 2050 with and without climate change and predicted it will decline resulting in an additional 24 million undernourished children (0-5 years), 21% more relative to a world with no climate change, almost half of which would be living in sub-Saharan African countries [23]. The impact of climate change on food availability in Sub-Saharan Africa is generally expected to be severe. This is primarily due to the vulnerability of subsistence farmers, who are believed to have a low capacity to cope with environmental stresses [24].

According to Intergovernmental Panel on Climate Change's (IPCC) Assessment Report [25] in developing countries including Sub Saharan Africa, agricultural productivity will decrease from 9-21% by 2080 due to climate change and in some Sub Saharan African countries, the effect will be felt much sooner even by 2020. This report also indicates rising in temperature and variability in precipitation are likely to reduce the production of stable foods by up to 50% [23].

A study in Tanzania in 2011 indicates by 2050, projected seasonal temperature increases by 2°C reduce average maize, Sorghum and rice yields by 13%, 8.8% and 7.6% respectively. Also 20% increase in intra seasonal precipitation variability reduces agricultural yields by 4.2%, 7.2% and 7.6% respectively for maize, sorghum and rice [26]. A time series study in the Northern Showa zone in Ethiopia (2012) indicates food production faces severe challenges due to climate change. The annual production losses to climate variability significantly increase from year to year [27]. A study conducted in Ethiopia to predict food requirement and consumption by 2050 based on three scenarios. The first scenario is based on with no climate change and high population growth; there will be 2322 and 2160 kcal per capita per day food requirement and consumption, respectively. The second scenario is based on with climate change and high population growth which will

lead to 2296 and 1788 kcal per capita per day food requirement and consumption, respectively. And the third scenario is based on with climate change and low population growth which will lead to 2322 and 2192 kcal per capita per day food requirement and consumption, respectively [28].

Impact of climate change on food accessibility

Access to food refers to the ability of individuals, communities and countries to purchase food in sufficient quantities and quality [19]. In Sub Saharan countries, households fail to access food for many reasons like high food price, access to markets, the level of poverty, employment condition, educational status and property rights [15]. This will affect Sub Saharan Africa population that relies primarily upon subsistence agriculture, markets has long been important as a secondary source of food. In general, there has often been a hungry seasonal from June to August, when crop yields do not meet demands, and food must largely be bought from markets [29]. Falling real prices for food and rising real incomes over the last 30 years have led to substantial improvements in access to food in many developing countries. Possible food price increases and declining rates of income growth resulting from climate change may reverse this trend [19].

Impact of climate change on food utilization

Food utilization depends on how food is used, whether food has sufficient nutrients and whether diet can be maintained. Food utilization refers to the individual or household capacity to consume and benefit from the food [30]. Although food availability and access are necessary conditions for food utilization, they are not sufficient conditions to reduce malnutrition. A household which has physical as well as economic access to food could be food insecure if it cannot get a balanced and nutritious diet [31].

The most significant component of food security in a changing climate, but least studied, is food utilization. Even when the availability and accessibility are not infringed upon, if food sources are not able to contribute to a balanced, nutritious diet, then the implications for health and productivity of the population could be significant [32]. The utilization component of food security is generally related to nutritional aspects of food consumption. Most poor households receive what micronutrients they do get through the consumption of plants. There are the main ways by which climate change could directly affect micronutrient consumption by changing the yields of important crop sources of micronutrients, by altering the nutritional content of a specific crop, or by influencing decisions to grow crops of different nutritional value [20]. According to World Bank poverty net report [33], Climate change affects food utilization capacity through different mechanisms. Climate change affects the production rate and pattern of different food items and this can affect the nutritional requirements of the population.

Climate change can affect the income and capacity of the household to purchase a diversity of food items to get a balanced diet [33]. A study in Sub Saharan Africa indicates the price of food has increased since 2006 and almost by 50% from June 2010 to February 2011. For this, climate change (extreme weather events) is one of the root causes of the recent high and volatile food prices. Most of the Sub Saharan Africa countries are negatively affected by the rise of price where they are net food importers and more vulnerable to climate change than developed countries. Due to this high food price, households may be forced to reduce both quality and/or quantity of food they consume, consume less preferred food and allocate food only to certain household members [15].

Climate change limits access to clean water and sanitation infrastructure, diarrheal disease is a leading killer (highly sensitive to climate change), and contributes directly to child morbidity and poor food utilization by limiting the absorption of nutrients [20]. Also climate change will cause new patterns of pests and diseases to emerge, affecting human health like increased incidence of vector borne diseases in flood prone areas, changes in vectors for climate responsive pests and diseases, and emergence of new diseases could affect both the food chain and people's physiological capacity to obtain necessary nutrients from the foods consumed [33]. Climate change may initiate a vicious circle where infectious diseases, including waterborne diseases, cause or compound hunger, which, in turn, makes the affected population more susceptible to those diseases. Results may include declines in labor productivity and an increase in poverty, morbidity and finally mortality [19].

Conclusion

This review summarizes the multiple effects of climate change on food security. All the documents emphasized the negative net effect of climate change on the food system. Most of the papers have indicated Sub Saharan African is one of the regions which are sensitive to climate change where most of the populations are dependent on the climate sensitive agricultural system. Climate change has a potential effect on the three components of food security but only food production (avail) component was well studied. However, food availability alone will not grant food security and nutrition without capacity of people to access and proper utilization of nutrients.

Projections for different time points indicate, amount of rainfall is decreasing and will decrease in the future with some uncertainties in its amount. This will affect the food production (availability) especially to vulnerable subsistence farmers in Sub Saharan African countries where there is no well-established adaptation strategies. Although, moderate increase in temperature (1°C- 3°C) can have a benefit to food production in temperate regions, it has a negative impact in tropical and seasonally dry regions. When the temperature is more than 3°C, it has a negative effect on food production (availability) in all regions.

The second effect of climate change on food accessibility is not well investigated due to its factors complex interaction. Climate change has a potential to affect food price, access to markets, the level of poverty, employment condition and educational status and these can affect people food accessing capacity and will lead to food insecurity and malnutrition.

The third component of food security and least studied in relation to climate change is food utilization. Climate change can affect people food utilization capacity through different ways. The direct effect of climate change is through decreasing productivity of plants that are rich in micronutrients or it alters the micronutrient contents of specific crops through flooding of the cropland. Also climate change can influence decisions of farmers on whether to cultivate or not crops with high nutritious value. Climate change has an effect on food prices and in addition to its effect on food access, high food price can also influence people to consume less preferred quality of food items and allocate food only to certain household members.

Climate change limits safe water and sanitation facility services which may lead to diarrheal disease that can affect absorption of nutrients. In addition, climate change can increase different vector borne diseases which can hinder people's physiological capacity to obtain necessary nutrients from the foods consumed and reduce labor productivity due to morbidity.

From the above facts, climate changes may be seen as a main challenge to the development of Sub Saharan Africa in reducing food insecurity and achieving the first MDG (reduction of hunger). But the region has adaptation potentials to reduce the current food insecurity. Among these adaptation strategies, diversifying the income generating mechanisms like off farm employment, safe water supply and sanitation facility that can resist climate change stresses, awareness creation to the community, establishment of early warning systems and establishing weather based crop insurance systems. Finally there should be commitment of various stakeholders to reduce the problem.

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References

1. Institute for security studies (2010) The impact of climate change in Africa.
2. FAO (1996) World Food Summit, Corporate Document Repository. Rome, Italy.
3. Viridian G (2012) Children Malnutrition and Horizontal Inequalities in Sub-Saharan Africa: A Focus on Contrasting Domestic Trajectories. United Nations Development Program, Africa.
4. Akram AK, Nazil B, Abdus S (2006) Child malnutrition: An overview of trends, issues and policy prescriptions. VIKALPA 31: 81–90.
5. Save the Children (2007) Everybody's Business, Nobody's Responsibility: How the UK government and the European commission are failing to tackle malnutrition, UK.
6. Lloyd SJ, Kovats RS, Chalabi Z (2011) Climate change, crop yields, and undernutrition: development of a model to quantify the impact of climate scenarios on child undernutrition. Environ Health Perspect 119: 1817–23.
7. Howard F, Jeremy H, George L, Josephine M, Michael M (2008) Climate Change: The Public Health Response. Am J Public Health 98: 435-445.
8. FAO (2005) Impact of Climate Change, Pests and Diseases on Food Security and Poverty Reduction: In Proceedings of the Committee on World Food Security, Rome, Italy.
9. Boko M, Niang I, Nyong A, Vogel C, Githeko A, et al. (2007) Impacts, Adaptation and Vulnerability: In Proceedings of the Working Group II Report. Cambridge University Press, Cambridge, UK.
10. European Commission DG ENV (2009) Climate change to reduce crop yields and increase child malnutrition. Bristol.
11. United Nations System Standing Committee on Nutrition (2010) Climate change and nutrition security. Switzerland.
12. Costello A, Abbas M, Allen A, Ball S, Bell S, et al. (2009) Managing the health effects of climate change. Lancet Univ Coll Lond Inst Glob Heal Comm 373: 1693–733.
13. Bush KF, Luber G, Kotha SR, Dhaliwal RS, Kapil V, et al. (2011) Impacts of climate change on public health in india: future research directions. Environ Health Perspect 119: 765–70.
14. Campbell-Lendrum D, Woodruff R (2007) Climate change: quantifying the health impact at national and local levels. Environmental burden of disease series, WHO, Geneva.
15. Oyiga B, Mekibib H, Christine W (2011) Implications of climate change on crop yield and food accessibility in Sub Saharan Africa. Bonn University, Germany.
16. Wlokas HL (2008) The impacts of climate change on food security and health in Southern Africa. J Energy South Afr 19:12–20.
17. Bekele S, Mathew R, Jonathan H, Jill C, Kai S, et al. (2011) Climate change and food security in Africa: Vulnerabilities and role of maize and wheat research for adaptation and impact mitigation. Kigali, Rwanda.
18. Thompson HF, Berrange-Ford L, Ford J (2010) Climate change and food security in Sub Saharan Africa: A systematic literature review. Sustainability 2: 2719–33.
19. Ludi E (2009) Climate change, water and food security. Overseas development institute, UK.
20. Badolo F, Kinda Somlanare R (2012) Rainfall Shocks, Food Prices Vulnerability and Food Security: Evidence for Sub-Saharan African Countries.
21. Liliana H (2005) The Food Gaps: The impacts of climate change on food production: A 2020 perspective.
22. FAO (2007) The State of Food Insecurity in World, 2010. Rome, Italy.
23. Nelson GC (2009) Climate change: Impact on agriculture and costs of adaptation. Intl Food Policy Research Inst. Washington DC, USA.
24. Gregory PJ, Ingram JSI, Brklacich M (2005) Climate change and food security. Philos Trans R Soc B 360: 2139–48.
25. IPCC (2007) Impacts, Adaptation and Vulnerability. Asia Climate Change 2007. Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE (edn). Cambridge University Press, Cambridge, UK 469-506.
26. Pedram R, David BL, Navin R (2011) Climate variability and crop production in Tanzania. Agricult Forest Meteorol 151: 449–60.
27. Gutu T, Bezabih E, Mengistu K (2012) A time series analysis of climate variability and its impacts on food production in north shewa zone in Ethiopia. African Crop Sci J 20: 261-274.
28. Moreland S, Smith E (2012) Modeling Climate Change, Food Security, and Population. USA.
29. Brown ME (2009) Markets, climate change, and food security in West Africa. Environ Sci Technol 43: 8016–8020.
30. FAO (2011) The state of food insecurity in the world: How does international price volatility affect domestic economies and food security? Rome, Italy.
31. Negin J, Rome R, Karuti S, Kanzo JC (2009) Integrating a broader notion of food security and gender improvement in to African Green Revolution. Food Sec 1: 351-360.
32. FAO (2009) Declaration of the World Summit on Food Security. In Proceedings of World Summit on Food Security 18–9.
33. http://www.povertynet.org/