

## Effects of Climate Change on Crop Productions and Its Adaption Mechanism

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### ABSTRACT

This seminar paper performed review on effects of climate change on crop production and its adaptation mechanisms. Climate change refers to a statistically significant variation in either the mean of the climate or in its variability which may be due to natural processes or external forcing or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Adaptation generally refers to actions taken to adjust to the consequences of climate change either before or after impacts is experienced. An adaptation to climate change takes place through adjustments to reduce vulnerability in response to observed or expected change in climate and associated extreme weather events of people who rely on climate dependent resources for their livelihoods. Climate change has various effects on crop production. For instance; food availability reduction scarcity of water and crop yield reduction are observable effects of climate change. Even though Crop production affected by climate change we can reverse its impacts through adaptation mechanisms; such as, using participatory approaches, promoting insurance schemes for climate change risk have vital role to reverse impacts.

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### Introduction

Climate change refers to a statistically significant variation in either the mean of the climate or in its variability which may be due to natural processes or external forcing or to persistent anthropogenic changes in the composition of the atmosphere or in land use [1]. According to there has been an unprecedented warming trend during the 20th century [1]. The current average global surface temperature 15C is nearly 0,60C higher than it was 100 years ago and most of the increase has been a consequence of human activity. The average temperature of the earth's surface has risen by 0.74 degree centigrade since the late 1800s [2]. Throughout the history of earth climate has always been changing. IPCC also predict serious effects including reduced crop yield crop yields in tropical areas which will result in increased risk of hunger, spread of climate sensitive diseases and an increased risk of extinction of all plant and animal species [3]. Revealed that up to 250 million people in Africa by 2020 could be exposed to greater risk of water stress. Zimbabwe has been a victim of this global climate change. In dry parts of the country such as Guruve, the crop production has been affected. It is because of all these changes in climate that has resulted in the need to analyze the impacts of climate change on agriculture in Guruve, specifically on crop production as people depend on agriculture. It also became important to consider the adaptation strategies by small scale crop producers in the face of climate change.

Adaptation generally refers to actions taken to adjust to the consequences of climate change either before or after impacts is

experienced. An adaptation to climate change takes place through adjustments to reduce vulnerability in response to observed or expected change in climate and associated extreme weather events of people who rely on climate dependent resources for their livelihoods [4]. Adaptation occurs in physical, ecological and human systems. Adger noted that adaptation involves changes in social and environmental processes, perceptions of climate risk, practices and functions to reduce potential damages or to realize new opportunities [5]. Adaptation strategies range from technological options to behavior change at an individual level. Other strategies include growing drought resistant crops, practicing zero tillage and conservation agriculture. Therefore adaptation strategies should be implemented in the national and local level against the impact of climate change on crop production. According to Esterling adaptation can be both autonomous and planned [6]. Depending on subjective assessment of risks and vulnerability small scale farmers make certain adjustments in their choice of technologies and production and consumption decisions called autonomous adaptation. Adaptation encompasses the implementation of the existing knowledge in response to the perceived changes in climate. Appropriate adaptation clues will promote local people to change farming technology, season of cropping, prevention from health hazards, and choice of crops. Adaption strategies can be more successful if they are identified and developed by local actors because they are likely to be consistent with local priorities, norms and institutions [7]. Local actors and institutions have to be involved in mainstreaming as they play the key role in knowledge transfer and policy development management adaptation required differ as vulnerabilities differ [8].

IPCC 2001 also predict serious effects including reduced crop yields in tropical areas which will result in increased risk of hunger, spread of climate sensitive diseases and an increased risk of extinction of all plant and animal species [3]. Revealed that up to 250 million people in Africa by 2020 could be exposed to greater risk of water stress.

### **Objective**

To review the effects of climate change on crop production and its adaptation mechanisms.

### **Literature Review**

#### **Climate effects on crop production**

Ethiopia, like most developing countries, is an agrarian economy with a very small industrial sector. The agricultural sector, on average, accounts for around 50 percent of GDP, 80 percent of employment, and 90 percent of the total foreign exchange earnings [9,10]. Smallholders dominate the sector and produce more than 90 percent of the total agricultural output and cultivate close to 95 percent of the total cropped land. Crop production accounts for over 60 percent to agricultural GDP and the rest comes from the livestock subsector. Out of the total grain crop area, cereals cover 80 per cent of the cropped land and contribute 86 percent of crop production. Maize, wheat, and teff 2 together constitute 52 percent of the grain crop land and 56 percent of the total grain production [11].

Cereal production is highly susceptible to moisture stress and for most developing countries variation in average yields is caused by weather variability. The low level of productivity- enhancing input use does not counterbalance effects of weather variability.

Changes in temperature and precipitation directly affect crop production and can even alter the distribution of agro-ecological zones. In his review of the economics of climate change, Stern indicates that existing geographic disparities in rainfall distribution will be heightened and sub-tropical areas will be the worst hit by drought, with a 2 degree rise in temperature; these sub-tropical areas could lose as much as 30 percent in rainfall volumes [12,13].

#### **Food availability reduction**

Above which it causes damage to crops. But an increase in temperature and a decrease in precipitation will result in a fall in farm net revenues [14].

Production of food and other agricultural commodities may keep pace with aggregate demand, but there are likely to be significant changes in local cropping patterns and farming practices. There has been a lot of research on the impacts that climate change might have on agricultural production, particularly cultivated crops. Some 50 percent of total crop production comes from forest and mountain ecosystems, including all tree crops, while crops cultivated on open, arable flat land account for only 13 percent of annual global crop production. Production from both rainfed and irrigated agriculture in dryland ecosystems accounts for approximately 25 percent, and rice produced in coastal ecosystems for about 12 percent.

The impacts of mean temperature increase will be experienced differently, depending on location. For example, moderate warming (increases of 1 to 3 °C in mean temperature) is expected to benefit crop and pasture yields in temperate regions, while in tropical and seasonally dry regions, it is likely to have negative impacts, particularly for cereal crops. Warming of more than 3 °C is expected to have negative effects on production in all regions [2].

For climate variables such as rainfall, soil moisture, temperature and radiation, crops have thresholds beyond which growth and yield are compromised [15]. For example, cereals and fruit tree yields can be damaged by a few days of temperatures above or below a certain threshold [16]. In the European heat wave of 2003, when temperatures were 6 °C above long-term means, crop yields dropped significantly, such as by 36 percent for maize in Italy, and by 25 percent for fruit and 30 percent for forage in France [2]. Increased intensity and frequency of storms, altered hydrological cycles, and precipitation variance also have long-term implications on the viability of current world agro ecosystems and future food availability.

#### **Scarcity of water**

Even without climate change, the global water economy is already in trouble. A major study, Water for food, water for life, released in 2007 by Earthscan and the International Water Management Institute (IWMI), reveals that one in three people today face water shortages [17].

Water use has been growing at more than twice the rate of population increase in the last century, and although there is no global water scarcity as such, an increasing number of regions are chronically short of water. As the world population continues to increase, and rising incomes and urbanization cause food habits to change towards richer and more varied diets, even greater quantities of water will be required to guarantee food security [18].

Increasing water scarcity and changes in the geographic distribution of available water resulting from climate change pose serious risks for both rainfed and irrigated agricultural production globally. With a more variable climate and less reliable weather patterns it will be essential to increase the water storage capacity for agriculture, to maintain global food supplies while satisfying other competing uses for agricultural water [19].

#### **Crop yield reduction**

The changes in crop production related climatic variables will possibly have major influences on regional as well as global food production [1]. The likely impacts of climate change on crop yield can be determined either by experimental data or by crop growth simulation models [2]. To predict future impacts on crop yields, crop models present valuable approaches with a number of crop simulation models, Water-Atmosphere-Plant) and Info Crop [2].

#### **Adaptation Mechanisms**

##### **Using participatory approaches**

Ethnographic research suggests that the current mismatch between the understanding and interpretations of climate by farmers who rely on traditional knowledge and the understanding and interpretations of the scientific research community constitutes an important challenge for climate adaptation work that aims to provide climate information for a range of decision makers, with differing education and resource levels [21]. Participatory approaches to climate predictions have become a popular way of eliciting farmers' understanding of climate and climate information and determining how to improve the relation between these perspectives and scientific forecasts. Roncoli argues that participatory technology development and collaborative learning would be promoted by a better understanding of how scientists' cultural models may (or may not) be affected by interaction with farmers and other stakeholders, including other scientists, funding agencies, policymakers and the media [21].

### Promoting insurance schemes for climate change risk

In 2007, the World Economic Forum outlined the five core areas of global risk as economic, environmental, geopolitical, societal and technological. Within these, climate change is seen as one of the defining challenges for the twenty-first century, as it is a global risk with impacts far beyond the environment [22]. The insurance industry is among the economic sectors that are already experiencing adverse impacts of climate change.

Wealthy countries depend heavily on the private insurance industry to protect their citizens against natural disasters. According to a recent report, these countries account for 93 percent of the global insurance market [23]. This market is increasingly strained as it tries to respond to astronomical increases in claims related to the impacts of extreme weather events in North America and Europe.

### Summary and Conclusion

This paper review on the climate change on crop production and its adaptation mechanisms. As mentioned above on paper, Climate effects on crop production are; food availability reduction, scarcity of water and crop yield reduction. Then after, adaptation mechanisms indicated are; using participatory approaches of relevant stakeholders and promoting insurance schemes for climate change risk. The availability of both service and productivity function to the community have been reduced yearly. Due to changes in temperature and precipitation directly affect crop production and can even change the distribution of agro ecological zone. Ethiopia like most developing countries is an agrarian economy with a very small crop production .due to the climate change. Adaptation is generally refers to action taken to adjust to the consequences of climate change either before or after impact is experienced.

### Recommendation

Based on the above conclusion the following are recommendation are forwarded

- From this paper the following recommendation are made:
- There is need for awareness on the climate change cause, impact adaptation which must be given through the training program.
- Drought resistant crop varieties should be distributed to the farmers in order for them to cope up with the negative impact of climate change.
- There is need to enhance the adaptive capacity of the farmers through technical support.
- There is need for collaboration and cooperation among the farmers, Agritex office, and Nongovernmental organization to deal with the impact of climate change on crop product

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