
POTENTIAL IMPACTS OF CLIMATE CHANGE ON AGRICULTURE

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ABSTRACT

Climate includes patterns of temperature, precipitation, humidity, wind and seasons. Climate change affects more than just a change in weather, it refers to seasonal changes over a long period of time. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economics and cultures that depend on them. Because so many systems are tied to climate, a change in climate can affect many related aspects of where and how people, plants and animals live, such as food production, availability and use of water and health risks. Analysis of the impacts of climate change suggests that agro-ecological system is the most vulnerable sectors. Further warming is expected to reduce crop productivity adversely. It seems obvious that any significant change in climate on a global scale should impact on local agriculture, and therefore affect the world food supply.

KEY WORDS: Climate change, Agriculture

INTRODUCTION

Agriculture is undoubtedly the most important sector in the economics of most non-oil exporting African countries. It constitutes approximately 30% of African's GDP and contributes about 50% of the total export value with 70% of the continent's population depending on the sector for their livelihood. Production is subsistence in nature with a high dependence on the rain (CEEP, 2002). The debate on climate change and its impacts on agriculture is therefore very crucial, to the very survival of the continent and its people. The continent is particularly susceptible to climate change because it includes some of the world's poorest nations.

The climate change in African is predominantly tropical in nature which is broadly classified into three main climate zones: humid equatorial, dry, and humid temperatures. Within these zones, altitude and other localized variables also produce distinctive regional climates. The climate also varies cyclically over periods of decades, centuries, and millennia as well as from year to year. Climate change especially indicated by prolonged drought is one of the most serious climate hazards affecting the agricultural sector of the continent. As most of the agricultural activities in African countries hinges on rain fed, any adverse changes in the climate would likely have a devastating effect on the sector in the region, and the livelihood of the majority of the population (CEEP, 2002).

GLOBAL WARMING AND CLIMATE CHANGE

Global Warming is the relatively rapid increase in temperature cause by greenhouse gases which can contribute to changes in the global climate patterns. It is generated by human influence on naturally occurring phenomenon called the greenhouse effect (Ofoh, 2009). The earth is surrounded by an atmosphere through which solar radiation is received. The atmosphere is not static but contains air, in constant motion being heated,

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cooled and moved, water being added and removed along with smoke and dust. Only a tiny proportion of the sun's energy reaches earth and some of this is reflected back into space (from clouds). When the radiant energy reaches the land surface, most of it is absorbed, being used to heat the earth, evaporate water and to power photosynthetic processes (University of Reading, 2005). The earth also radiates energy but, because it is less hotter than the sun, this is of a longer wavelength and absorbed by the atmosphere. The Earth's atmosphere, thus acts like the glass of a greenhouse, hence the greenhouse effect.

The problem today is that the concentration of the greenhouse gases (carbondioxide (CO₂), methane (CH₄) nitrous oxide (N₂O), produced by human activity has increased significantly. These greenhouse Gases (GHGs) trap a greater quantity of rays which are reflected on to the earth and cause it to heat up and the situation created is commonly called "Global warming. The heat trap causes many unusual and dangerous changes to our climate and weather systems, best described as climate change. Climate change refers to any significant change in measures of climate such as temperate, precipitation, or wind lasting for an extended period. It is the permanent departure of climate patterns from mean values of observed climate indices (Obioh, 2002).Climate change many result from:

- ❖ natural factor such as changes in the sun's intensity or slow changes in the orbit around the sun,
- ❖ natural processes within the climate (e.g. changes in circulation,
- ❖ human activities that change the atmosphere's composition(through burning fossil fuels and the land surface use (deforestation, reforestation,urbanization, desertification)

SOURCES OF GREEN HOUSE GASES (GHGS)

The main GHG is carbon dioxide (CO₂) which accounts for about70% of human induced GHGs. About six billion tonnes are produced by burning fuels for industry and transport annually. Western countries are responsible for the largest volumes of emissions with the USA leading, though china and India are catching up fast. Another 1.6 billion tonnes is produced by countries in the south by deforestation. Methane is the second most important GHG produced by agricultural activity such as anaerobic fermentation of rice paddies and in flooded areas. It is also feared that the defrosting or melting of permafrost (soil in the artic regions) could release billions of tonnes of CH₄ and CO₂ into the atmosphere.Nitrous oxide (**N₂O**) form 16% of the GHGs emissions and [is produced by intensive agriculture (pesticide use), deforestation and chemical processes such as aerosols(Spore, 2008).

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It seems obvious that any significant change in climate on a global scale should impact local agriculture, and therefore affect the world's food supply.Despite technological advances, such as improved varieties, genetically modified organisms and irrigation systems, weather is still a key factor in agricultural productivity, as well as soil properties and natural communities.The effect of climate on agriculture is related to availabilities in local climates rather than in global climate patterns. The earth's average surface temperature has increased by one degree in just over the last century.

On the other hand agricultural trade has grown in recent years, and now provides significant amounts of food on a national, level to major important countries as well as comfortable income to exporting ones. The international aspect of trade and security in terms of food implies the need to also consider the effects of climate change on a global scale.

Climate change induced by increasing greenhouse gases is likely to affect crops differently from region to region. For example, average crop yield is expected to drop down to 50% in Pakistan, whereas corn production in Europe is expected to grow up to 25% in optimum hydrologic conditions. Climate change could affect agriculture in several ways:-

Crop growth

Plants grow through the well-known process of photosynthesis, utilizing the energy of sunlight to convert water from the soil and carbon dioxide from the air into sugar, starches, and cellulose - the carbohydrates that are the foundations of the entire food chain. CO_2 enters the plant through its leaves. Greater atmosphere concentrations tend to increase the difference in partial pressure between the air outside and inside the plant leaves, and as a result, more CO_2 is absorbed and converted to carbohydrates. Crop species vary in their response to CO_2 . Wheat, rice, and soybeans belong to a physiological class (called C_3 plants) that responds readily to increased CO_2 levels. Corn, sorghum, sugarcane, and millet are C_4 plants that follow a different pathway. The latter, though more efficient photosynthetically than C_3 crops at present levels of CO_2 , tend to be less responsive to enriched concentration. Higher levels of atmospheric CO_2 also induce plants to close the small leaf openings known as stomatas through which CO_2 is absorbed and water vapor is released. Thus, under CO_2 enrichment crop may use less water even while they produce more carbohydrate

Effects of higher temperature

In middle and higher latitudes, global warming will extend the length of potential growing season, allowing earlier planting of crops in the spring, earlier maturation and harvesting and the possibility of competing two or more cropping cycles during the same season. In warmer, lower latitude regions, increased temperatures may accelerate the rate at which plants release CO_2 in the process of respiration, resulting in less than optimal conditions for net growth. When temperatures exceed the optimal for biological processes, crops often respond negatively with a steep drop in net growth and yield. Another important effect of high temperature is accelerated physiological development resulting in hastened maturation and reduced yield.

Available water

Agriculture of any kind is strongly influenced by the availability of water. Climate change will modify rainfall, evaporation, runoff, and soil moisture storage. Changes in total seasonal precipitation or in its pattern of variability are both important. The occurrence of moisture stress during flowering, pollination, and grain-filling is harmful to most crops and particularly so to corn, soybeans, and wheat. Increased evaporation from the soil and accelerated transpiration in the plants themselves will cause moisture stress; as a result there will be a need to develop crop varieties with greater drought tolerance. Finally intensified evaporation will increase the hazard of salt accumulation in the soil(UNO, 2007).

Climate variability

Extreme meteorological events, such as spells of high temperature, heavy storms, or droughts, disrupt crop production. Where certain varieties of crops are grown near their limits of maximum temperature tolerance, such as rice in heat spells can be particularly detrimental. Similarly frequent droughts not only reduce water supplies but also increase the amount of water needed for plant transpiration.

Soil fertility and erosion

Higher air temperatures will also be felt in the soil, where warmer conditions are likely to speed the natural decomposition of organic matter and to increase the rates of other soil processes that affect fertility. Additional application of fertilizer may be needed to counteracts these processes and to take advantage, of the potential for enhanced crop growth that can result from increased atmospheric CO₂.

Pests and Diseases

Conditions are more favorable for the proliferation of insect pests in warmer climates. Longer growing seasons will enable insects such as grasshoppers to complete a greater number of reproductive cycles during the spring, summer, and autumn. Warmer winter temperatures may also allow larvae to winter over in areas where they are now limited by cold, thus causing greater infestation during the following cropping season. Altered wind patterns may change the spread of both wind - borne pests and of the bacteria and fungi that are agents of crop diseases. Livestock diseases and increase in pest infestations will result and may bring about greater use of chemical pesticides to control them.

Sea-level rise

Global warming is predicted to lead to thermal expansion of sea water with partial melting of land - based glaciers and sea-ice, resulting in a rise of sea-level which may range from 0.1 to 0.5 meters (4 to 20 inches) by the middle of the next century (Rosenzweig and Hillel,2004).

CONCLUSION

Climate change and agriculture are interrelated processes, both of which take place on a global scale. Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, precipitation, and glacial run-off. These conditions determine the carrying capacity of the biosphere to produce enough food for the human population and domesticated animals. Raising carbon dioxide levels would also have effect, both detrimental and beneficial on crop yields. The overall effect of climate change on agriculture will depend on the balance of these effects.

Climate change could affect agriculture in several ways-productivity, in terms of quantity and quality, agricultural practices through changes of water use and agricultural inputs such as herbicides, insecticides and fertilizers; environmental effects in particular on relation of frequency and intensity of soil damage (leading to nitrogen leaching), soil erosion, reduction of crop diversity rural space, through the loss and gain of activated lands, land speculation, land renunciation, and hydraulic amenities, Rapid climate change could harm agriculture in many countries especially those having poor soils and climate condition.

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