CLIMATE CHANGE:
WHAT IT MEANS FOR AGRICULTURE IN EASTERN AFRICA

Climate change is real and it is happening. Recent studies indicate that it is happening faster than envisaged by the International Panel on Climate Change (IPCC) and that the impacts are overshooting even the worst scenarios that were predicted. The 2007 IPCC assessment, the most comprehensive and respected analysis of climate change and its impacts involving thousands of scientists from about 130 countries, has provided sufficient evidence to conclude that the current global mean surface temperature was about 0.42°C to 0.54°C above the 1961-1990 annual average. The report further ranked 11 of the last 12 years (1995-2006) among the 12 warmest ever on record and more recent assessments indicate that the decade 2000-09 has been warmer than any other decade in the previous 150 years.

Perhaps the most convincing and clear evidence of climate change comes from the dramatic changes observed in the extent of ice sheets and mountain glaciers, the most sensitive natural systems to global warming. After an extensive review of all the available evidence, the IPCC concluded that "the warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean sea level, widespread melting of snow and ice, and rising global average temperature". Even if the global community agrees on limiting and/or cutting back on greenhouse gas emissions and the emissions are reduced to zero, the planet would continue to warm until the energy stored in the system equilibrates.

The fact that we are going to live in an increasingly warmer climate raises several questions: what changes will climate change bring to Eastern Africa? What impact will these changes will have on agriculture in the region? How can we mitigate and adapt to the negative impacts of climate change?

Despite the availability of overwhelming evidence in support of climate change, uncertainty prevails over the precise nature of these changes, especially at local level, making it difficult to plan and develop appropriate adaptation strategies, programmes, and technologies. Global predictions become less clear as to the magnitude and timing of the changes at national and local levels, and, according to the IPCC, difficulties remain in reliably simulating changes at smaller scales. Even at the global scale, there will always be uncertainty in predicting future climates, partly due to uncertain levels of future greenhouse gas emissions and partly due to inadequacies in our understanding of the global climate system. Hence, it is not surprising that the scientific community is unable to tell with any amount of certainty what the climate would be in 20, 50 or 100 years from now at any given location.

Season	Temperature response (oC)				Precipitation Response (%)						Extreme Seasons (%)		
	Min	25	50	75	Max	Min	25	50	75	Max	Warm	Wet	Dry
DJF	2.0	2.6	3.1	3.4	4.2	-3	6	13	16	33	100	25	1
MAM	1.7	2.7	3.3	3.7	4.5	-9	2	6	9	20	100	15	4
JJA	1.6	2.7	3.4	3.6	4.7	-18	-2	4	7	16	100		
SON	1.9	2.6	3.1	3.6	4.3	-10	3	7	13	38	100	21	3
Annual	1.8	2.5	3.2	3.4	4.3	-3	2	7	11	25	100	30	1

Notes: The table shows the minimum, maximum, median (50 %), and 25 and 75 % quartile values among the 21 models for temperature (°C) and precipitation (%) change. Numbers in the Extreme Seasons columns indicate a change in frequency of extreme seasons the increase is positive.

Table 1: Temperature and rainfall projections for Eastern Africa (12^{0}S and 22^{0}E to 18^{0}N and 52^{0}E) from a set of 21 global models for the A1B scenario by 2100 (IPCC, 2007)

Existing analyses summed up by IPCC indicate that the global average temperatures will increase by about 1.1-2.9^{0}C under low emission scenario and by 2.4-6.4^{0}C under high emission scenario by the end of the present century. For Eastern Africa, the predicted changes under a medium emission scenario (A1B) are summarized in Table 1. The median predictions show an increase in both temperature and rainfall. Annual temperature of the region is projected to increase by about 3.2^{0}C and rainfall by about 7% towards the end of this century.

Though there are problems in predicting accurately where, when, and how climate changes, the following can be expected based on our current understanding and available information. The magnitude and direction of these changes need to be reviewed and modified as and when new scientific information becomes available.

1. The region will be warmer by about 1^{0}C by 2030 and by about 2^{0}C by 2050
2. The region is expected to receive slightly higher rainfall, especially during the period September to February
3. The region will also experience an increase in the frequency of both extreme wet and dry seasons
4. There are indications that the variability in rainfall between and across the seasons will increase

For a region, where agriculture is mainly rain-fed and is the main source of livelihood for nearly 85% of the population, impacts of climate change on agriculture are a major concern since it can only make a fragile situation worse. The 10 countries in the region regularly experience food crises, water shortages and disease outbreaks due to a combination of climate variability and vulnerability to climate-related hazards. Prolonged and highly destructive droughts were recorded in 1973-74, 1984-85, 1987, 1992-94, 1999-2000 and more recently in 2005-06. Most countries in the region are threatened by famine at least once in each decade while localised and nationwide droughts, especially in Eritrea, Ethiopia, Somalia and Sudan, have now become more frequent.

The negative impacts of climate are not limited to the years with extreme climatic conditions. Even with normal rainfall, the countries in the region do not produce enough food to meet their people's needs.

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There are several major ways by which climate change will affect the performance of crops. Firstly, changes in temperature and precipitation lead to changes in evaporation from the soil and evapo-transpiration from vegetation. Hence, higher temperatures will lead to increased demand for water by plants, which are difficult to meet, especially when rainfall is expected to decline and become more variable. Secondly, different crops have different optimal growing conditions and high temperatures can make the crops unsuitable for growing in some areas where the current climatic conditions are already close to the maximum tolerable limits. For example, assessments indicate that some areas in the region will no longer be able to support tea and coffee production if the temperatures increase by 2^0C or more from the current levels. Thirdly, crops grow faster and mature earlier under warmer temperatures. The available data indicate that duration of several crops will be reduced by about one-two weeks with every degree increase in temperature. This reduction in the time that a crop takes to mature will also reduce the productive potential of these crops. Studies using crop simulation models broadly indicate that potential for biomass production will decline by about 500 kg/ha with every one week reduction in the duration of the crop.

In addition to these direct effects, climate change will also impact crop production indirectly by reducing the capacity of natural resources to support productive agriculture. These effects include decline in soil fertility from increased mineralisation, nutrient leaching and erosion, reduced availability of water, and changes in the distribution and incidence of pests and diseases including weeds. All these changes will have significant impact on productivity, food security, and profitability both at household and national level. The scientific evidence leaves little room for doubt that our climate is changing and it will have a significant impact on agriculture. This makes adapting agriculture to climate variability and change an essential component of agricultural research and development programs.

Address the current challenges:
Climate change brings new challenges. It also highlights the need to address more comprehensively the same old problems that agriculture in the region is struggling to cope with. - water Managing vulnerabilities associated with current variability in climate provides a good starting point to deal with future changes.

Create awareness and promote strategic and tactical decision making:
To some extent the issue of climate change is over-dramatised. Any extreme event now is considered a result of climate change, even though events of similar and or of bigger magnitude have happened in the past when climate change was not on agenda. There is a need to improve understanding of extension and other service providers on issues related to climate variability and on the range of possible responses that farmers should consider when making management decisions through proper use and application of climate information including forecast information.

Strengthen and promote sustainable management of natural resources:
Some of the recommendations that are aimed at addressing climate change are simply good management practices such as improved agricultural water management, efficient use of fertiliser and manure, and linking and improving the market access. Such practices, while enhancing the productivity and profitability of the systems, have the potential to sequester atmospheric CO2 in biomass and soils, decrease the rate of land clearing for agriculture, increase efficiency of farm inputs such as fertilizers, and pesticides, and decrease N2O and methane emissions.

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Promote risk management strategies:
Adaptation to climate change is characterized by uncertainty and decision making under uncertainty requires a thorough assessments of risks and opportunities.

Strengthen early warning systems:
One of the predicted impacts of climate change is increased intensity and frequency of occurrence of extreme events such as drought, floods, heat waves, and cyclones. The ability of the meteorological institutions to predict and forecast such events has also increased but the timely communication of the same in user friendly formats remained underdeveloped.

Risk covering options:
Pilot studies were conducted in several countries to examine the use of insurance to help reduce vulnerability and adapt to climate change. The region should explore the opportunities to help people adapt to some of the unavoidable risks associated with climate.

Strengthen the capacity to make better assessments using new science tools:
Understanding how systems perform under a changing climate and how the negative impacts can be mitigated is an important prerequisite for formulating effective adaptation options. The region has very limited capacity to use such tools and there is an urgent need to strengthen the formal and informal education to include them in the curricula.

Conclusion:
Though climate change is real and happening, uncertainty prevails over the exact nature and consequences of climate change especially at local level, making it difficult to plan and develop appropriate adaptation strategies, programs, and technologies. The predicted impacts of climate change on agriculture are largely negative but the same can be effectively addressed by integrating climate change issues into the general agricultural and risk mitigation strategies.