

Feature Article: Climate Variability and Change

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Introduction

Climate variations and change affect human activities and life styles, which in turn affects development and economic production. Climate change is not easy to predict with precision because many variables involved are difficult to quantify. Climate change and variability brings impact on food security, natural resources leading to conflict and migration over limited resources (water, pasture etc) as well as health (Alemayehu and Peter, 2008).

Recent climatic patterns characterized by high temperatures, erratic rainfall and frequent and intense cyclones are global concerns due to interactions with all sectors of economy. Prolonged droughts especially in arid and semi arid areas of the tropical regions, increased frequency and intensity of El Nino and tropical cyclones as well as emergence of highland malaria are attributed to the changing climatic patterns.

Problem statement

There is no clear distinction between climate change and variability. The questions being asked by users outside the climate circle are (i) what is the difference between climate change and variability? (ii) Which of these phenomenons contribute to recent observed climate patterns? To answer these questions an understanding of the difference between climate variability and change causes and how they are detected are important. The livestock sub- sector in East African is growing faster. In Eastern African Pastoralists depend entirely on livestock husbandry as their livelihood option. Pastoralists together with their herds are supported within the rangelands where the animals absolutely graze and browse. However, the 2006 FAO report highlighted by Steinfeld et al. (2006) has blamed the livestock sector as being the generator of green house gas on earth even than the automotive transportation sector. The report further blames the livestock sub-sector as a major source of land degradation and found to be the most significant contributor today's most serious environmental problems that lead to climate change. To curb the situation, the FAO report calls for urgent remedial actions.

This paper tried to use FAO document and other relevant available literature to address and present the information knowledge on climate change and variability and the contribution of livestock from Eastern Africa Rangelands Production System on climate change.

Objectives

Objectives of the paper include:

- To clarify the terms used to define climate change and variability;
- To identify and list the most possible livestock related activities that lead to green house gas emission as highlighted by Steinfeld et al. (2006) from the Eastern African Rangeland Perspective; and
- To propose priority research areas suitable to address issues on climate change related livestock activities in Eastern African Rangelands.

Definitions

Climate Variability

Climate is the average state of the atmosphere of an area over a long period of time preferably 30 years. On average climate of an area can be classified as wet, dry, cold, windy, hot and humid. However, the average value is sometimes exceeded or not obtained at all leading to surplus (above mean) or deficit (below mean). Fluctuations of climate parameters about the mean from time to time (season or year) of an area are known as *climate variability*. Climate variability is evident in seasonal or annual fluctuations about the mean associated with floods and droughts. It is a cycle that recurs or repeats after a certain interval of time.

Climate Change

Unlike climate variability that fluctuates about the mean, climate change refers to long term or permanent shift in climate of an area. Some of the evidence of climate change includes, global temperature (min./max) rise; increased frequency in occurrence and severity of droughts, floods, tropical cyclones; reduced (decreased trends) in annual rainfall amounts; reduction in glacial cover over mountains and rising sea levels. Recent studies attribute the emergence of highland malaria to climate change.

Attributions to climate change and variability

Causes of climate variability

Climate variability is caused by changes in the intensities in climate indicators such as El Niño southern Oscillation (ENSO), Indian Ocean Dipole (IOD), Quasi Biennial Oscillation (QBO), Sea Surface Temperatures (SSTs), Tropical Cyclones (TC), Subtropical Anticyclones, Monsoons, Easterly waves, Meso-scale circulations and

Intra-seasonal Oscillations (MJO) and subtropical disturbance. Among the indicators, ENSO and IOD are the major modes of inter-annual variability (year to year) in the tropics while the MJO is the main mode of the intra-seasonal Oscillation. Warm ENSO (El Niño) is associated with excessive rainfall in some parts of Eastern Africa and drought in other parts. Combination of these indicators increases the intensity of climate variability. For example, 1997/98 and 2006/09 rainfalls were caused by a combination of warm ENSO and positive IOD.

Causes of Climate change

Climate change is caused by accumulation of Green House Gases (GHGs) in the atmosphere, which leads to global warming. Based on IPCC report, some of the GHGs in the atmosphere include carbon dioxide (CO₂), methane (CH₄) and nitric oxide (N₂O).

Climate change and variability detections

Climate change detection refers to statistical methods of identifying the climate change and variability.

Detections of climate variability

Climate variability is obtained by plotting time series of climate anomalies (deviations). High deviations from mean indicate high variability while low deviations represent normal fluctuation about the mean.

Detections of climate change

Computer based climate models are used to project climate change based on the climate trends. The expected climate changes are developed based on population, technology and socio-economic scenarios.

Interactions between climate change and variability

Global warming has impact on most of climate indicators such as ENSO, IOD, SSTs and TC. Climate change is expected to intensify and increase the frequency of occurrence of climate indicators thereby increasing climate variability. In turn the frequency and intensity of extreme climate events and the associated impacts are expected to be on the increase. The indicators of climate change include climate/weather variability (floods, and droughts), increased greenhouse gas emissions and temperature changes (Alemayehu and Peter, 2008).

Eastern Africa Rangeland Livestock Production System and Climate change

Out of the six livestock related sources that lead to green house gas emission as highlighted by Steinfield et al. (2006) only three of them may apply to livestock production systems existing in Eastern Africa Rangelands. This is because livestock production in this region is mainly pastoral; thus, does not involve intensive management; and is neither industrial. In Africa, livestock, mainly cattle are herded in traditional ways and serve largely as tokens of their owners' wealth. The concerns in Eastern Africa Rangelands, considering the production system existing in this region are outlined below:

- **Methane release from the break down of animal manure:** In developing countries, however, most manure is spread as fertilizer, emission from these practices is poorly quantified but likely is low since most decomposition takes place aerobically, however, this leads to more CO₂ emission (OTA, 1991)
- **Land use change for grazing** – Land transformations have characterized the entire 10,000- year history of agricultural development and continued on a large scale today, and the concern over deforestation now focuses on tropical areas, although many temperate forests have also been cleared at least once during the last few hundred years. CO₂ is emitted in this process, and also when grassland and savannas are burned to enhance grazing conditions, and when carbon contained in soil organic matter is carried by erosion (OTA, 1991)
- **Land degradation-** Land degradation from over grazing is taking a heavy economic toll. In the early stages of over grazing, the cost shows up as lower. However, if the process continuous, it destroys vegetation, leading to the erosion of soil and the eventual creation of wasteland. In Africa, the annual loss of rangeland productivity is estimated at \$7 billion (Brown, 2002). Thornton et al. (2002) report that, in Africa, most of the cattle are in or near the Sahel, the higher-potential areas of Eastern Africa (including Ethiopian highlands), Zimbabwe and South Africa. Sheep are also concentrated in these areas, and in parts of northern Africa. Therefore, with this regard, land degradation related to livestock in the Eastern Africa rangelands is of major concern.

Priority Research Areas

With emphasis on the impacts of livestock related activities on the world's climate from Eastern Africa rangelands perspective, research areas that need to be addressed include the following.

- Research to find impacts of livestock related activities on the world's climate, from Eastern Africa Rangelands perspective are needed. Along this, researches to quantify

the magnitude of green house gases emitted from disposed manure (e.g. in heaps and lagoons) in pastoral areas of eastern Africa Rangelands are recommended;

- Research on Land use change that favor grazing animals – on the amount of land converted from other uses to pastureland, emphasizing the emission resulting from burning forest and grassland in favor of re-growth for grazing livestock;
- The extent of land degradation tied to livestock in Eastern Africa Rangelands needs to be addressed. e.g. on blockage of soil efficiency in fixing above ground carbon dioxide due to compaction by livestock;
- Research on the reduction of efficacy of vegetation to assimilate carbon due to vegetation removal by grazing in the Eastern Africa Rangelands; and
- Study on climate change indicator and moodily are also needed.

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