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Rainfall and Temperature Variation Study in Rural Kebeles of Dire Dawa Administration of Ethiopia

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***Abstract*— This study initiated as the result of impacts of climate variability which has been affecting the livelihoods of DDA rural community due to weakening of indigenous coping and adapting mechanisms used by community for many years. The reality of climate change and variability is now a well-accepted reality and there is emerging evidence that climate variability poses a massive threat for development especially in poor countries. An understanding of the emerging trends of climate change and its effects in local ecologies is an important starting point in addressing the impacts of climate variability. This study sought to understand the impact of climate variability on the livelihoods of local communities, focusing on DDA rural kebeles. The objective of the study was to assess the trend of climate variability in the study area for a duration of thirty years. The analysis indicates continuously rising temperature, low volume of rainfall and inconsistency in livelihood of the local people. The production and productivity of agricultural product have been decreasing because of less rainfall. Scarcity of water for irrigation has been started so the communities are being unable to cultivate in time. There was a general consensus among many HHs in DDA that climate variability being experienced is leading to significant agricultural transformation especially reductions in crop and livestock productivity. It is argued that these climatic transformations are threatening the sustainability of the agricultural activities in the study area.**

***Index Terms*— rainfall, temperature, livelihood, agriculture**

I. INTRODUCTION

The Intergovernmental Panel on Climate Change (IPCC) forecasts that during this century, there will be an increase in the average global surface temperatures by 2.8ºC, with best-guess estimates of the increase ranging from 1.8 to 4.0ºC (IPCC, 2007). There is evidence in recent years of a direct linkage between the larger-scale warming and short-term weather events such as heat waves. In some regions there has been a tendency for an increase in precipitation extremes, both wet (including floods) and dry (droughts). These observations over the past several decades are consistent with what theory and global climate models would suggest (Weather Channel, 2007). These changes could bring about serious long-term social and economic consequences. Specifically, the potential of agricultural production will be substantially affected by the predicted changes in temperatures and rainfall patterns. Agriculture sector is affected largely by the negative consequences of extreme climate variability. It is estimated that every 1ºC increase in temperature is likely to lead to a 5- 10% reduction in yields of some crops (Pachauri, 2010). Complete crop failure usually occurs w hen severe drought stress takes place during the reproductive stages (Nguyen, 2011). Widespread research findings have revealed that climate variability and change have significant impacts on global and regional food production systems particularly on the performance of common staple food crops in the tropical sub-humid climatic zone (UN-OHRLLS, 2009).

The contribution of agriculture to the gross domestic product in Africa is far higher than in developed regions. This is perhaps nowhere more obvious than in sub-Saharan Africa, where economies are extremely sensitive to environmental and/or economic shocks in the agricultural sector. Ethiopia's climate is influenced by general atmospheric and oceanic factors that affect the weather system and the time of inception and intensity of the rains (Bekele, 1997). The summer rainfall contributes about 74% of the annual rainfall in the country. Therefore, the failure of the summer rainfall has disastrous consequences for the country and the rest of East Africa.

In response to the recurrent droughts and related environmental calamities, farmers in Ethiopia have developed different coping strategies. (Belay et al 2005, MoFED 2007), (Devereux and Guenther, 2007) all identified main coping strategies employed by farmers during climate extreme events, especially drought. According to Abdu (2010) a considerable loss was observed in households livestock assets in rural households of Dire Dawa Administration. The Dire Dawa administration has experienced both warm and cool years over the last 30 years. However, the recent years are warmest than the early years. The annual maximum temperature has been rising faster than the minimum temperature. It is most probable that this is an indication of climate change. A trend of decreasing annual rainfall and increased rainfall variability is also contributing to drought conditions in many parts of Dire Dawa. The average annual rainfall patterns of Dire Dawa for the periods 1999 to 2008 and 1984 to 1991 show two important trends. First, annual average rainfall has declined from the mean value by about 8.5% and 10% respectively. Secondly, the variability of rainfall shows an overall increasing trend, suggesting greater rainfall unreliability. These rainfall patterns have led to serious drought episodes throughout the Administration (DDAEPA, 2011).

Higher temperatures, reduced rainfall and increased rainfall variability reduce crop productivity that would be affected food security in low income and agriculture-based economies. Thus, the impact of climate change is detrimental to countries that depend on agriculture as the main livelihood (Edwards-Jones, 2009). Climate change causes climate

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variability of temperature and precipitation as well as the frequency and severity of weather events. Some indirect effect of climate change includes, changes in soil moisture, land and water condition, change in frequency of fire and pest infect and the distribution of diseases. The potential for a system to sustain adverse impact on agriculture is determined by its capacity to adapt to the changes (Mohan and Rob, 2005).

Land and labor are considered as crucial livelihood assets for maintaining meaningful rural livelihoods in Ethiopia. Apparently, access to land is one of the important factors as non-farm employment opportunities are very rare in the country. According to FDRE ministry of information (2001), Ethiopian current development strategy is also based on utilizing available land and human resource as there is acute scarcity of capital. However, land and labor issues are paradoxical. On one hand it has been said that the country posses rich natural resource endowment with huge agricultural potential' (fertile land, water resources, large biodiversity, huge livestock and human resources, diverse agro ecology suitable for different crop and livestock production). On other hand, the low performance of agriculture is mainly reflected by low level of land and labor productivity (EEA/EEPRI, 2005).

Agriculture in Ethiopia is dominated by small-scale farmers, which accounted for 97% and more than 90% of cultivated area and total agricultural output (Ayele et al., 2003). Moreover, it is heavily depend on rainfall, fragmented small plots of land, limited application of agricultural technologies and inputs, its productivity is very low and exposed to vagaries of nature (EEA/EEPRI, 2006).

Therefore, this study was conducted to assess the impact of climate variability on the livelihood and its coping mechanisms in Dire Dawa Administration rural kebeles.

Objective

To assess the trends of major climate variability (rainfall and temperature) in Dire Dawa Administration

II. METHODOLOGY

Study area

The Dire Dawa Administration (DDA) is geographically located in the eastern part of the country specifically lying between 9° 27'N latitudes and 41° 38'E and 42° 19'E longitudes. and the town is 515 Km from Addis Ababa the capital city of Ethiopia and 333 Km from the international port of Djibouti. The total area of the administration is 128,802 ha out of which 2928 hectares or 2.27% is the urban portion while 125,877 hectares or 97.73% is rural (Dire Dawa Administration, 2012). The Administration shares common boundaries with Somali National Regional States in the West, North and East and with the Oromia National Regional State in the Southern part of the country.

Research Design

The purpose of this study is to find out the generally seen effect of climate variability on the rural community of DDA. For this purpose primary data were collected by interview survey, key informants interview and observation method. Secondary information was collected from various relevant publications, other national and international journals published recently and from NMA. In this process, I tried to present mainly the impact of climate variability on crop and livestock production and the local coping mechanisms towards the impact by the HHs. Collected information were accumulated, tabulated and analysed by the established research technique.

III. RESULTS AND DISCUSSION

Trends of Climate Variability

As far as agriculture is concerned in the Ethiopia, the most important climatic parameters to consider are rainfall and temperature. In addition changes and variations succeeded rainfall and temperature variations have adverse influence on ecosystem. Ethiopia's rainfall condition shows high spatial and temporal variability. The highest mean annual rainfall (more than 2,700 millimeters) occurs in the southwestern highlands, and it 38 gradually decreases in the north (to less than 200 millimeters), northeast (to less than 100 millimeters), and southeast (to less than 200 millimeters) (World Bank, 2003).

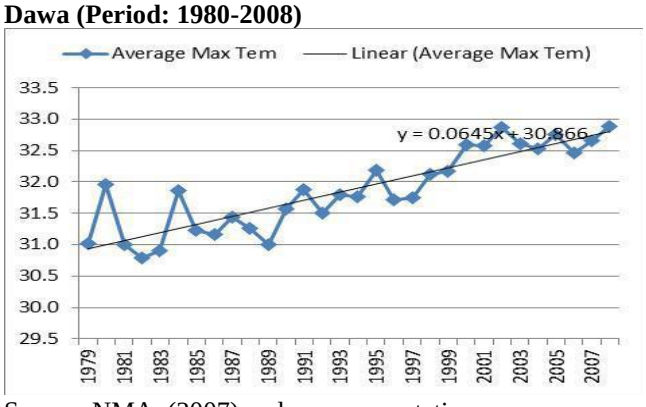
Temperature variability and trend

As per Koppen's classification, the Dire Dawa Administration is characterized as Hot Semi-Arid Zone with the mean annual temperature which lies between 17 ºC and 27 ºC. According to the National Meteorological Agency (NMA, 2007), the mean minimum temperatures has been increasing throughout the country particularly during the cool months by 0.37ºC per decade in the last sixty years.

The year to year variation of annual minimum and maximum temperatures is expressed in terms of temperature differences from the mean. Annual maximum temperatures over the last 30 years (between 1980 and 2008) show upward trend at the analyzed meteorological stations located in DDA.

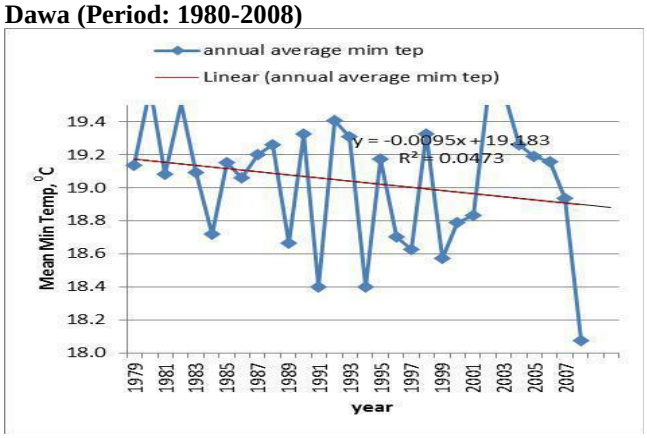
Figure 5 and 6 clearly reveals that there has been a warming trend in the annual maximum temperature over the past 30 years. It has been increasing by about 0.67 ºC every ten years. On contrary the past 30 year trend of the minimum temperature has been gradually dropping by 0.01ºC per decade. The Administration has experienced both warm and cool years over the last 30 years. However, the recent years are warmest than the early years. This analysis shows sustained warming. As it can be seen from the figure, the annual maximum temperature has been rising faster than the minimum temperature. It is most probable that this is an indication of climate change. Although rainfall does not show significant changes for the past 30 years, there is no doubt that, temperature has increased tremendously.

Figure: 5 Annual Maximum Temperature Trend of Dire Dawa (Period: 1980-2008)



Source: NMA, (2007) and own computation

Figure: 6 Annual Minimum Temperature Trend of Dire Dawa (Period: 1980-2008)

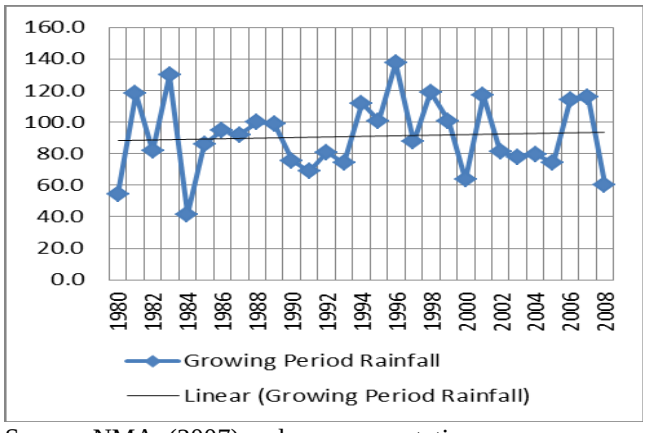


Source: NMA, (2007) and own computation

IV. Rainfall Variability and Trend

The climate of the Administration is dominated by various inter-related factors, altitude being the most determinant factor. The mean annual rainfall varies from 410 millimeters to 800 millimeters and above. The average duration of the dry season is 6 to 7 months. However, recently, rainfall pattern has become much more unpredictable with some areas/zones receiving extremely minimum and maximum rainfall per year. Analysis of the average annual rainfall trends in the past three decades in Dire Dawa shows a more or less constant trend. However, the last 10 year trend shows us a decrease in rainfall amount. For example the rainfall amount registered between the periods of 1999-2008 shows that only three year that have pluviometric excess i.e. 2001, 2006 and 2007. Figure 7 shows the annual rainfall trends observed from 1980 to 2008 at Dire Dawa meteorological station. Rainfall can vary considerably even within few distance and different time scale. This implies that crop yield is exceedingly variable over space and time which will have a big effect in determining the kind of crop to be grown, farming system to be adopted and the sequence of farm operations (Adejuwon et al., 2005).

Figure 7: Annual Rainfall Trend of Dire Dawa Administration, 1980-2008



Source: NMA, (2007) and own computation

V. Summary and Conclusion

The analysis indicates continuously rising temperature, low volume of rainfall and inconsistency in livelihood of the local people. The production and productivity of agricultural product have been decreasing because of less rainfall. Scarcity of water for irrigation has been started so the communities are being unable to cultivate in time. There was a general consensus among many HHs in DDA that climate variability being experienced is leading to significant agricultural transformation especially reductions in crop and livestock productivity. It is argued that these climatic transformations are threatening the sustainability of the agricultural activities in the study area.

Awareness on climate variability and its impact must be raised on rural communities. People are experiencing changing climate but they don't know the cause and consequences of climate change and variability. Capacity building in climate variability knowledge and skills across all the sectors of development and farmers would positively contribute to reduced impacts.

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