Climate Risk Assessment in Kenya:
Identifying Knowledge Gaps & Immediate Research Priorities

Synthesis Paper Presented at a National Workshop

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1.0 Development Profile (3 pages – poverty focus)

This chapter describes the current development activities/plans in Kenya, and how climate variability and change in combination with other non-climatic changes are likely to influence realization of the expected achievements. It also presents an analysis of how the existing pre-conditions are vulnerable to changes in climate variability and change and how these impacts on socio-economics.

National development vision, objectives and priorities

The thrust of Kenya's development agenda hinges on alleviating poverty, improving human capital, reducing the disease burden among its citizens and fostering economic prosperity as a nation (GoK, 2003; 2007a). To achieve this, development programmes largely focus on improving agricultural production both to enhance food security and to generate foreign earnings (MoA; 2009); promotion of tourism industry (GoK 2009d); and venturing into manufacturing among others (Ronge *et. al.* 2000). In the year 2009 for example Agriculture contributed 25.5% of the national GDP, while industry contributed 19%. Tourism a sub sector of the service sector contributed 10% of the national GDP while the overall service sector contributed 56% to the GDP. Agriculture on the other hand accounts for 65% of the total exports from Kenya, and provides about 70% of the informal employment especially in the rural areas (World Bank 2010; GoK 2010).

In 2003 upon the coming to power by the National Alliance Rainbow Coalition (NARC) government, actions designed to meet the mid-term objectives for economic recovery (ERS) were initiated aimed at creating grounds for economic growth through Wealth and Employment Creation from 2003 to 2007(Obunde, et. al., 2007 GoK 2003). This strategy has been the main blue print of government development agenda until a new platform was unveiled under the flagship of Vision 2030 (GoK 2007b). Following improvements in governance and the implementation of strategic reforms, Kenya's economy grew from a GDP of 0.5 in 2003 to 7.1 in 3007 (GoK 2007b) but due to the post election violence of 2007, the GDP fell to 1.7% by the end of 2008 (WB 2010).

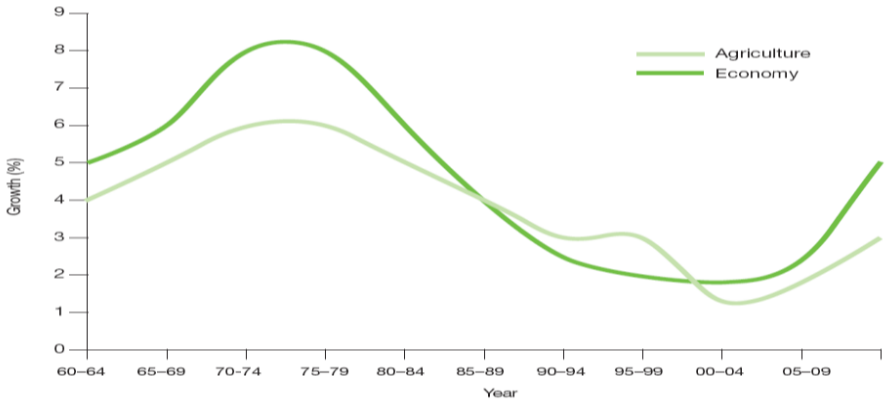


Fig.1. Trends in agricultural and economic growth 1960-2008): Source GoK, 2010.

Vision 2030 is founded among others on continuity in governance reforms; enhanced equity and wealth creation opportunities for the poor; infrastructure development; improvements in energy production; and land reforms. On this foundation lie three pillars that support sector development activities: 1) economic, 2) social and 3) political. Vision 2030 aims to promote agriculture through innovative, commercially focused agricultural practices through: i) increased productivity ii) transformation of key institutions, iii) introduction of land use policies, iv) development of more irrigable areas in the ASALs, v) improving market access for smallholders through better supply chain management (GoK 2007b). The blue print also sets a way for securing a sustainable environment by 2030 through: (i) promoting environmental conservation to better support the economic and social pillars' aspirations; (ii) improving pollution and waste management through the application of the right economic incentives; (iii) commissioning of public-private partnerships (PPPs) for improved efficiency in water and sanitation delivery; (iv) enhancing disaster preparedness in all disaster-prone areas and improving the capacity for adaptation to global climatic change. Following this blue print sector based strategic plans are being revised to be aligned to vision 2030. For example, the revised strategic plan for agriculture (MoA, 2009) is aligned to Vision 2030 strategy alongside other development programmes as outlined in the new Agricultural Sector Development Strategy - ASDS 2009 – 2018 (MoA, 2009).

The agriculture sector that is the main driver of development is comprised of six subsectors: industrial crops, food crops, horticulture, livestock, fisheries and forestry (GoK 2010) and utilizes land and water for production (table 1).

Table 1. Importance of Agriculture to the national economy (Source (GoK 2010)).

Agriculture sector	25.5% to GDP 70% informal employment (mostly rural) 65% of export earnings	Sub sector contributions to agricultural exports
Horticulture subsector	335 of Agricultural GDP (AgGDP)	38% of agricultural export
Food crops	32% of AgGDP	0.5% of agricultural exports
Livestock	17% of AgGDP	7% of agricultural exports
Industrial crops	17% AgGDP	55% of agricultural exports

Agricultural subsectors performance from 2002 to 2007 indicates that most food crops recorded increased production. Maize increased by 33% from 2.4 million tonnes in 2002 to 3.2 million tonness in 2006, but reduced to 2.9 million tonnes in 2007. Beans and root crops increased from 481,225 tonness to 531,000 tonnes and 1.1 million tons to 1.8 million tonnes respectively between 2002 and 2007 (GoK 2010). Performance of other food crops declined over the same period due to heavy rains, pests, diseases (GoK 2010). Sixty six percent of households in Kenya won livestock and 84% of them are in the rural areas (AfDB, 2007- Kenya Country Gender Profile).

Other sectors that are vehicles for delivering services to people and fostering development in Kenya in addition to agriculture include tourism and industry among others. The tourism sector currently accounts for about 10% of Kenya's Gross Domestic Product (GDP), making it the third largest contributor to the GDP after agriculture and manufacturing (GOK 2009c). The hotel and restaurant capacity a major determinant of performance in tourism recovered strongly from a decline of 20.3% in 2003 to a growth of 14.9% in 2006, with an annual growth rate of 37% in hotel occupancy. In the strategic plan the ministry aims at formulating and implementing appropriate policy and legal frameworks to stimulate development of the sector, develop new products and diversify source markets. Some of the activities under these broad objectives include developing and implementing tourism area management plans (GoK 2007b). The Kenya industrial sector that contributes 19% of the National GDP (GoK 2007) focuses on manufacturing for export (Ronge *et. al.* 2000) where manufacturing alone contributes 10% to GDP. The overall goal of the sector is to increase its contribution to Gross Domestic Product (GDP) by at least 10 per cent per annum. The transport and communication sector experienced a strong growth from 3.5% in 2003 to 10.8% in 2006 (GoK 2007b).

Kenya's economy depends on the following energy systems: wood fuel, fossil fuel, electricity, ethanol, coal, wind and solar energy. In the current situation energy consumption is composed of 68% fuel wood, 22% petroleum, 9% electricity while others including coal make up to about 1%. Electricity generation comprise of 51.2% hydro power, 30.8% thermal oil, 17.7 % geothermal, 0.09% co-generation, 0.01% wind power and 0.2% of imports. Electricity demand in Kenya is projected to reach 8,561GWh in 2013 up from 4,752 GWh in 2006 (Kirai, 2009).A comparison of wood fuel demand and supply from 1992 to present and projected to 2015 shows a growing deficit (WB 2009). An evaluation of changes in key health status in Kenya between 1993 and 2003 by the world health organization (WHO, 2009) shows stagnation in some health indicators and decline in others. The rate of deaths of less than 5 years old children for example has stagnated between 93 and 92 children per 1,000 live births between 1993 and 2003. The rate of maternal mortality has increased from 365 in 1994 to 441 in 2003 (WHO, 2009, MOH, 2007).

National development conditions, trends and challenges.

As Kenya's development is highly dependent on agriculture, conditions that affect agricultural production will ultimately affect overall development performance of the country. Agricultural productions are largely dependent on rainfall especially in the vast rainfed cultivation and open range grazing. About 98 percent of Kenya's cropping is rainfed, thus being highly vulnerable to rainfall variability. Irrigation comprising of about 2 percent of cropland is carried out 46% by smallholders, 42% by larger commercial firms and 12% by public schemes. Only 20 percent of Kenya's potential area is equipped for irrigation (WRI 2007) out of an estimated 539,000 hectares total area suitable for irrigation (GoK, 2008). Crop production per hectare of land and per household has tended to decline due to declining soil fertility and reduction in land sizes per household (Gicheru *et. al.* 2006; Gichuki, 2000). Reasons for this have been due to increasing intensification of land use, low farm inputs, and increase in population. This decline has been observed across all sectors of the economy (Kibaara *et. al.* 2008).

Spatial analysis of land cover changes in Kenya by Bai and Dent 2006, indicate reductions in net primary productivity and decline in rain use efficiency in 17% of Kenya's land surface. The analysis covering a 23 year period from 1981 to 2003 found that peak season plant biomass increased in 79% of the land surface and decreased in 21% of the land surface area but as for the whole country there was a trend of increasing biomass. However, there were relative and absolute decreases in biomass production in the cropped areas especially where cultivation extended in to the marginal lands (Bai, and Dent 2006).

Along with agriculture fisheries provide food for about 11.2 million Kenyans (Mogaka et. al 2006). Kenya's fishing industry contributed 0.5% of GDP in 2006, and provides employment and income to over 500,000 Kenyans (GoK 2008). An economic survey conducted by Kenya bureau of statistics in 2004 reported a downward trend in fish production between for a period of 4 years from 1999 to 2002 after which production increased by about 15% in 2003. However, the same study reported that while the production was declining

the amount that was exported increased from 16,951 tonnes in 1999 to 18, 536 tonnes in 2001 and 19, 462 tonnes in 2003, implying that the deficit affected the local consumers (GoK 2008).

The industrial sector has remained an integral companion of the agricultural development in Kenya. The sector that is largely agricultural-based employing an estimated 254,000 people and a further 1.4 million employed in the informal side of the industry contributes about 19% of GDP (GoK 2008). A comparison of economic performance of agriculture, industry and services sectors during 2008 financial year reveals that industry sector had the highest performance among the three with 6% growth followed by services sector with 4% growth while the agriculture sector recorded a negative growth of 4% (WB 2009).

According to the Human Development Report released by UNDP in November 2010, Kenya's Human Development Index (HDI) was ranked 128 worldwide with an improvement rank of 87. The fact sheet below shows an analysis of Kenya's performance in human development analysis (Table 2).

Table 2 Fact Sheet (UNDP 2010)

Years	1980	1990	1995	2000	2005	2009	2010
HDI	0.404	0.437	0.435	0.424	0.443	0.464	0.470

HDI in 2010	Value = 0.470		Population affected by natural disasters	94,520 / million people
HDI Inequality adjustment	-1		Prevalence of under nourished	30%
HDI growth rate	0.37		Population in urban centers	22.2%
People below poverty line	46.6%		Mortality of under 5 years children	128/ 1000 live births
People without access to clean water	41%		Mortality of infants	81/ 1000 born
People without sanitation	69%		Gender inequality index	0.738
People living in degraded lands	31%		Life expectancy at birth	55.6 years

While the analysis shows an improvement on human development index in 2010 compared to the previous year of analysis, it is worth noting that inequality is high as nearly half of the population lives below the poverty line, 69 % have no sanitation facilities and that 41% of the population have no access to clean water. The population affected by natural disasters is quite high considering that most of these people are in the arid and semi arid areas where impacts of these disasters are very damaging due to lack of alternative sources of livelihoods (UNDP 2010).

Major barriers to achieving targets in development and poverty reduction

The agricultural strategic plan for 2008 to 2012 identifies climate change as observed through frequent droughts and floods and the lack of mitigation measures including disaster preparedness and response as one of the major constraints affecting agricultural production. The report also indicates that pests and diseases are a problem to production. As reported in this plan land is under exploited at all ecological potentials (GoK 2007b) in some cases due to poor productivity, disease infestation like trypanosomiasis, and lack of adequate market opportunities. Poor productivity is in some cases caused by bad weather. The ministry of Agriculture for example reported a reduction of maize cultivated areas by 15% and a drop in yields of about 40% due to bad weather (MoA 2009) that delayed the planting time and rains being too little. Kenya's land per capita has reduced from 9.5 ha in 1950 to below 2 ha in 2010 (UNDP 2010).

Development similarities and differences at national and regional levels

Over a five year period 2003, to 2008, Kenya GDP grew from 2.9% in 2003 to 6.3% in 2007 (Bertelsmann 2010). In 2008, GDP growth slowed down to 2.2% due to global economy crisis and the post-election violence. Kenya's GDP per capita income rose in recent years from $526 in 2005 to $623 in 2007. On the Human Development Indicator, Kenya ranked 148th out of 179 countries (Bertelsmann, 2010), and in 2010 it was ranked 128th. Nationally Kenya suffers from a high degree of inequality between regions (UNDP 2006; WB 2009). Kenya is ranked 117th among the countries with most gender unequal in the world (UNDP 2010). Poverty incidence rates vary considerably between and within regions. Areas with high concentrations of poverty are the Western, Nyanza, Eastern and Coastal Provinces. The least poor province is Central Province; however, even 40% of the population there is considered poor. A deteriorating health system complicated by environmental factors, such as droughts and floods, further act as barriers to development (Bertelsmann 2010). As in previous years, Kenya has suffered a drought in 2008, which has led to food shortages in several parts of the country. Kenya appears to be lagging behind several other countries in the region in regards to percentage growth of GDP during 2009 and the estimates of 2010. However, Kenya's GDP that is lower than the average for Sub Saharan Africa during 2008, was significantly higher than the average for sub-Saharan Africa during 2009 (WB 2009). Comparisons at the regional level show that Kenya's GDP growth was much lower than the average among sub Saharan Africa countries during 2008, but was much higher in 2009. Comparisons of economic growth rates among east African countries show that during 2009 Kenya had the least growth among all her neighbors (WB, 2009).

2.0 Climate Profile *(4 Pages – Climate variability and change focus)*

This chapter shows analyses of Kenya's current climates in respect to the observed spatial and temporal trends, variablilities and hazards caused by extreme events. The chapter also shows the projected short and long term climate trends at national and regional levels according to availability and accessibility of information and subject to quality and comparability of such information.

2.1 National Weather and climate context

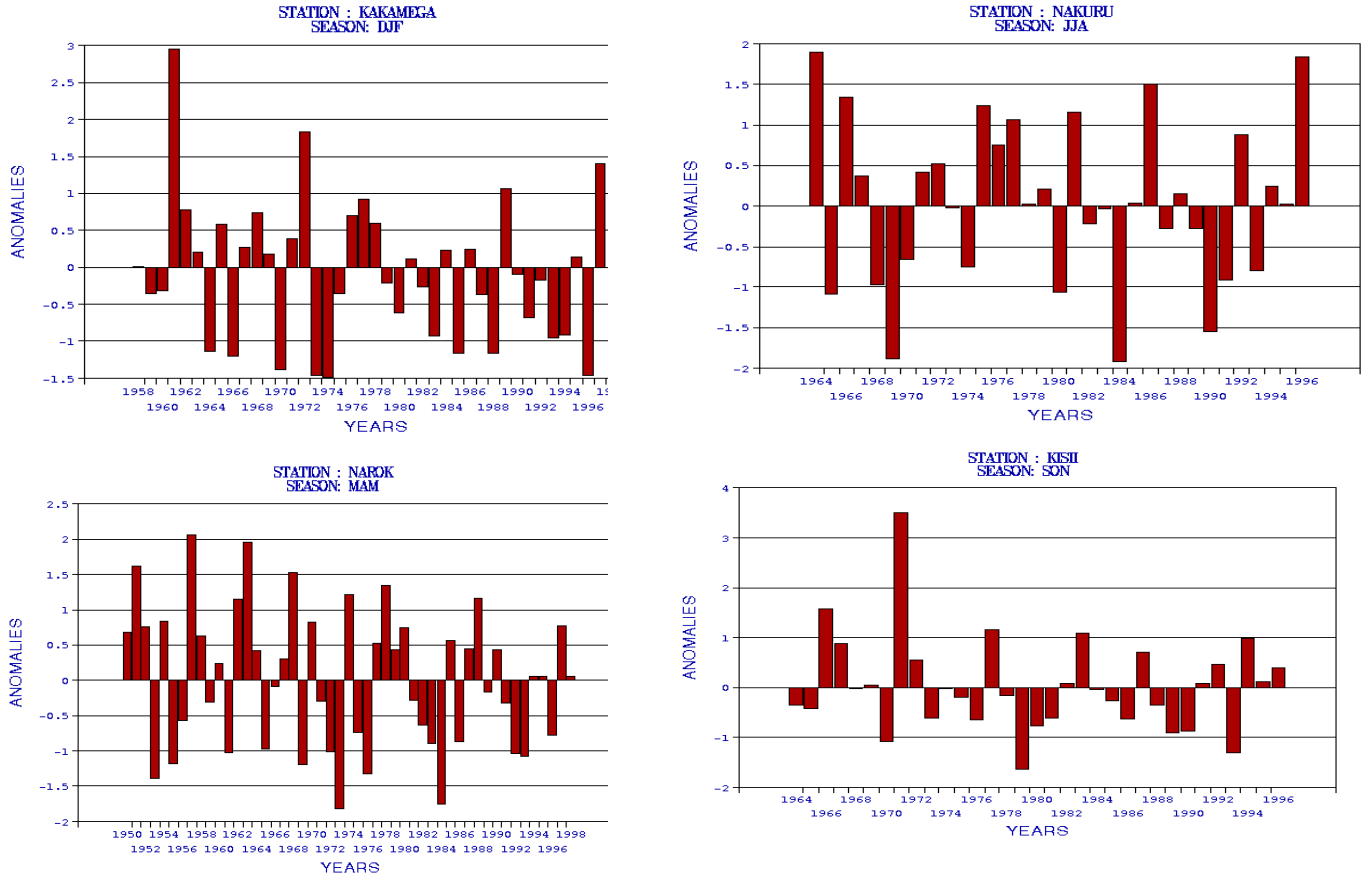
Kenya located at latitudes 6°S to 6°N has a tropical climate, moderated by diverse topographical features across the country rising from the coastal plains to the eastern edge of the East African Plateau, and the Great Rift Valley. The central highlands are substantially cooler than the coast, with the coolest (highest altitude) regions at 15°C compared to the 29°C at the coast (EU 2006; JICA 2002). Annex 2.1 shows rainfall patterns of Kenya. Mean annual temperatures vary little throughout the year for a particular location, but may drop by around 2^0C in the coolest season (MENR 2002; MEMR 2009; UNDP No ate 2). Kenya's climate ranges from the warm and humid coastal regions through the hot and dry savannahs to the central highlands that are characterized as cold and humid (UNEP 2009). The central part of Kenya is characterized by the Great Rift Valley that extends northwards dividing western and central Kenya. The northern part of the country is generally hot and dry all year round except for a few days during the wet seasons. During the wet seasons some areas like Wajir experience floods.

As reported in MEMR 2002 "Seasonal rainfall in Kenya is driven mainly by the migration of the Inter-Tropical Convergence Zone (ITCZ), a relatively narrow belt of very low pressure and heavy precipitation that forms near the earth's equator. The exact position of the ITCZ changes over the course of the year, migrating southwards through Kenya in October to December, and returning northwards in March, April and May. This causes Kenya to experience two distinct wet periods – the 'short' rains in October to December and the 'long' rains in March to May". The amount of rainfall received during these seasons varies greatly from place to place (EU 2006, Sombroek *et. al.* 1982). Kenya is divided into seven agro-ecological zones largely based on precipitation patterns. Annex 2.2 and 2.3 show the distribution of the zones and the typical weather characteristics in temperature and rainfall ranges in each of them.

2.2 Current climate variability and climate extremes

Kenya has a highly variable spatial climatic patterns usually described as a agro-climatic zones which have been mapped according to annual ranges in rainfall, temperatures and moisture index (annexes 2.2 and 2.3). Areas with moisture index greater than 50% have high potential for cropping, and are designated zones I, II, and III. These zones account for 12% of Kenya`s land area. The semi-humid to arid regions (zones IV, V, VI, and VII) have indexes of less than 50% and a mean annual rainfall of less than 1100 mm. These zones are generally referred to as the Kenyan rangelands and account for 88% of the land area (EU 2006, Sombroek *et. al.* 1982). To show the anomalies in temporal and spatial rainfall amounts across the country figure 2 below present a 50 year climate records from 4 stations in different parts of the country. The records show that rainfall varies in space and time and that, droughts are almost always followed by floods. Annexes: 2.4; 2.5; and 2.6 show respectively, changes in the national temperature and rainfall amounts per Eco Region; Annual minimum temperature changes; annual maximum temperature changes from 1960 to -2010.

Figure 2. Records of year to year climate fluctuations in four stations over a period of 50 years. Source MENR, 2002 ; Oludhe 2005.



Extreme events

Droughts and floods are the most widespread climate extremes experienced in Kenya. Between 1975 and 2006 Kenya has experienced at least eight major droughts and four major floods. While droughts are generally widespread throughout the country, floods are usually localized (Table 3).

Table 3. Prevalence of droughts and floods in Kenya (Amwata no date)

Year	Type of Disaster	Area of Coverage	Number of People Affected	Source: (SEE BELOW)
2004 – 2006	Drought	widespread	3.4 million	KMD
2004	Landslide	Nyeri, Othaya, Kihuri	5 deaths	UNDP
2003	Flood	Bundalangi	28,000	UNDP &KM
2002	Floods	Nyanza, Busia, Tana River Basin	150,000	UNDP
2002	Landslide	Meru, Muranga, Nandi	2,000	UNDP &KMD
1999/2000	Drought	Widespread	4.4 Million	UNDP &KM
1997/98	El Nino Floods	Widespread	1.5 Million	UNDP &KM
1995/96	Drought	Widespread	1.41 Million	UNDP &KM
1991/92	Drought	ASALs	1.5 Million	UNDP &KM
1985	Floods	Nyanza, Western	10,000	UNDP &KM
1983/84	Drought	Widespread	200,000	UNDP &KM

1982	Floods	Nyanza	4,000	UNDP &KM
1980	Drought	Widespread	40,000	UNDP &KM
1977	Drought	Widespread	20,000	UNDP &KM
1975	Drought	Widespread	16,000	UNDP &KM
1971	Drought	Widespread	150,000	UNDP &KM

Samuel Muchemi -no date; Amwata – no date; KMD; UNDP, Kenya Disaster Profile – no date. *(all in the references)*

Epidemics are the most prevalent type hazard in Kenya constituting about 44% of all hazards while droughts that affect the highest number of people (65%) have a prevalence of 25%. Floods affect the least number of people but kill or adversely affect the highest number of people nationally.

Table 4. Types of hazards and impacts on people (UNEP 2008)

Extreme events	Drought	Epidemics	Floods	Famine	Windstorms
% age Prevalence	25	44	27	2	2
% of people affected	65	30	5	-	-
% age of people killed or adversely affected	2	38	60	-	-

In addition to the hazards shown above forest fires are frequent and cause destruction of natural vegetation in the forest work large amounts of money. Annex 3.3 give records of forest fire occurrences, areas burnt of different forest types and estimates of losses incurred from 1990 to the year 2000 (UNDP, no date). From the analysis presented in the annex damages from forest fires are increased over time. Landslides do not occur as often as droughts and floods but when they occur they affect economic activities of many people. Annex 3.4 show areas affected by landslides in 199 and 2000, the economic activities and the number of people affected (UNDP, no date).

2.3 Observable changes in climate variables and hazards

The mean annual temperature in Kenya is reported to have increased by 1.0°C since 1960, at an average rate of 0.21°C per decade. This increase has been most rapid during MAM (0.29°C per decade) and lowest (0.19°C per decade) during JJAS (UNDP 2007). The trend indicates an increase in hotness for both minimum and maximum temperatures with the minimum getting hotter to a higher extent (Muchemi, no date). The degree of coldness has decreased with that of the cold nights decreasing much more rapidly than days but with wide variability between months of the year (EU, 2006, UNDP 2007). It has been observed in the recent past that Kenya has experienced high variablilities in temperature and rainfall across the country. These variablilities have resulted in droughts, floods and landslides has outlined in table 3 on climate related disasters. Kenya Meteorological Department in the ministry of Environment and Mineral Resources has shown the trends of changes in temperatures and rainfall over the past 50 years. On regional bases there is a relatively higher increase in temperatures in northern parts of the country from October to February period and at the same time there is a relatively higher (1^0C) drop in minimum temperatures in the northern parts of Kenya coast compared to 0.3 ^{0}C in the southern part of Kenya coast. Due to relatively warmer sea surface temperatures in western Indian Ocean, and relatively cooler conditions in eastern parts of the Indian Ocean, there has been more rainfall during the short rains extending to the normally hot and dry months of January and February. On the intensity of rainfall the trends indicate a reduction except in the coastal regions where there are indications of more intense rainfall occurring more frequently (MOEMR, 2002).

Trends on occurrences of droughts and impacts

Kenya experiences drought on a cyclic basis. Major droughts come every ten years and the minor ones come almost every three to four years (Amwata- no date). Kenya has in the past recorded deficits of food supply due to droughts resulting from shortfalls in rainfall in the following years 1928, 1933-34, 1937, 1939, 1942 - 44, 1947, 1951, 1952-55, 1957-58, 1984-85, and 1999-2001. The 1983-84 and 1999-2001 droughts are recorded as the most severe resulting in loss of human lives and livestock. Government incurred heavy

expenditures in response facilitation and there were general high economic losses of unprecedented levels in all sectors. After the El-Nino induced rains of 1997 and 1998 Kenya experienced prolonged drought in many areas leading to famine and starvation (UNDP 2007; UNDP, no date).

2.4 Projected climate trends

The IPCC report (IPCC 2007) give a summary of 21 GCMs predicting the annual changes in temperature and rainfall in East Arica from present to the end of 21st century (Cooper et al. 2008). The summary shows that much of Kenya will experience increase in rainfall under global warming. High rainfall events are projected to increase both for the short and long rain seasons. Dry seasons may be less severe in the northern parts of Kenya. These predictions are similar to the Land Climate Interactions Project (CLIP) predictions that northern and western Kenya may be slightly wetter in 2050 than present, and that central and coastal Kenya may be drier than present. According to these two analyses, Kenya is a country of mixed fortunes in as far as climate change impacts are concerned (IPCC 007; Olson *et. al.* 2008).

Rainfall projections by Canadian Climate Center Model (CCCM) for 2030 indicate that the region extending from Lake Victoria to the central highlands east of the Rift valley may have a mild increase in annual rainfall. The reminder of the country is according to the model expected to receive reduced annual amounts of rainfall. According to the analysis the highest amount of rainfall increase will be seen in the area around Mt. Elgon. At a national scale of analysis temperature increase in Kenya by 2100 will range from 2% to 4% relative to the mean values of 1970- 1999 (fig. 3) and the annual rainfall mean will increase by around 20% (fig. 4) compared to the means of 1970- 1999 (UNDP no date 2).

A recent report by USGS and USAID published in 2010 (USGS/USAID, 2010), give spatial distributions of observed changes in temperatures and precipitation and projections to 2025 for the months of March April May and June (MAMJ) showing that the whole country in 2025 will be warmer than present with temperature increases in western Kenya ranging from 0.9^{0}C to 1.1^{0}C while in the eastern part of the country the increase will be more variable ranging from 0.5^{0}C in the southern coastal area to 1.1^{0}C in the northern tip of eastern Kenya (fig. 5). Contrary to most other models (15 models used in the IPCC report, and the CLIP model) the USGS/USAID report indicated that most of the country will experience reductions in precipitation by 2025 up to about 150mm less than present except some parts of the coastal region, and western Kenya including the area around Lake Victoria that may have a an increase in rainfall up to about 50mm more than present.

Figure 6 shows a comparison of four models' projections on rainfall for Kenya by 2030 (ILRI GIS). Although the models show some little variability they all agree on increased precipitation over the whole country based on comparisons with 2000 precipitation levels. This is in agreement with a report to COP 15 meeting in Copenhagen made by Stockholm Environmental Institute that reports future temperatures for Kenya to increases in the mean annual monthly records by between 1 and 3.5^{0}C by 2050. Associated with this there will be increase in sea level. The report further sows that most climate models show that rainfall will increase on average, but may vary by place and season (SEI 2009b).

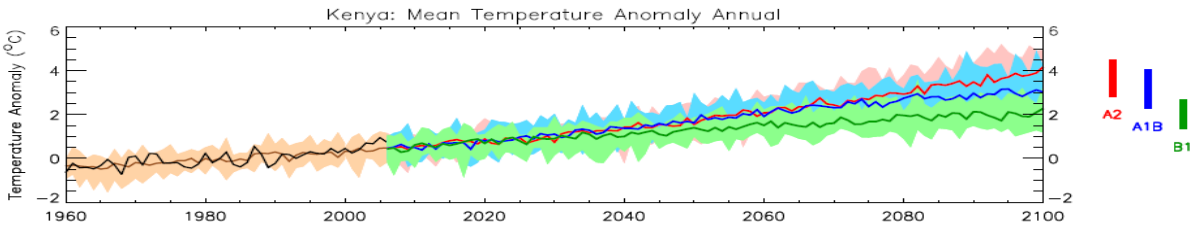


Figure 3. Trends in mean annual temperatures in the recent past and projected future. All values shown are anomalies, relative to the mean climate values for 1970-1999. Black curve show the mean observed data 1960 to 2006. Brown solid curve show the median and shading show the range of 15 model simulations. Coloured bars on the right show simulation ranges based on three emission scenarios. (UNDP no date 2).

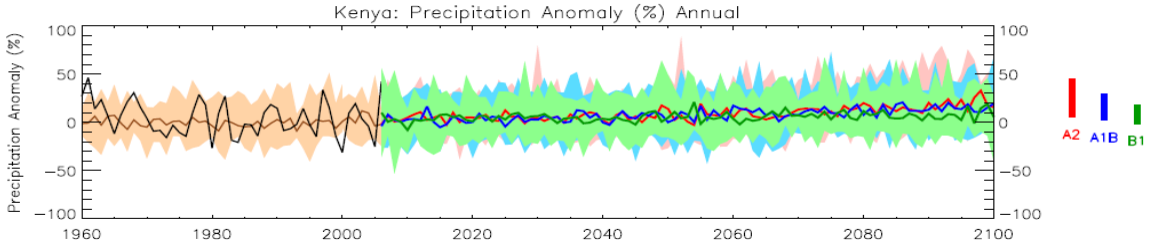


Figure 4. Trends in mean annual precipitation in the recent past and projected future. All values shown are anomalies, relative to the mean climate values for 1970-1999. (UNDP no date 2)

Projected changes in temperatures and precipitation reported by the USGS/USAID models (fig 5) appear to be modest compared to those reported by IPCC 4th Assessment report, CLIP model (Olson 2008) and those presented in figure 6. The spatial patterns of these changes also seem not to follow either the current patterns of rainfall distribution in Kenya or the current agro-ecological zones. However, these projections are for 2025 while others are for either 2030 or 2050.

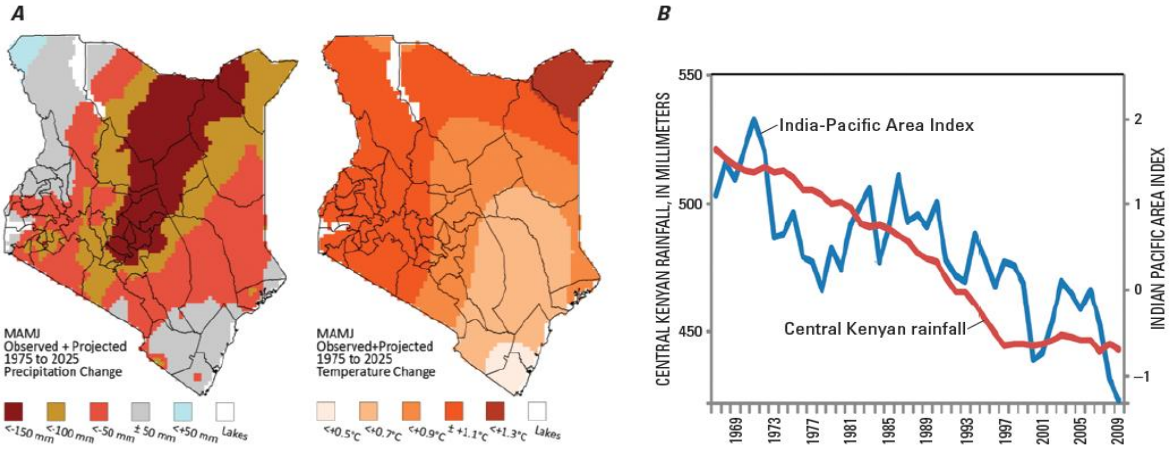
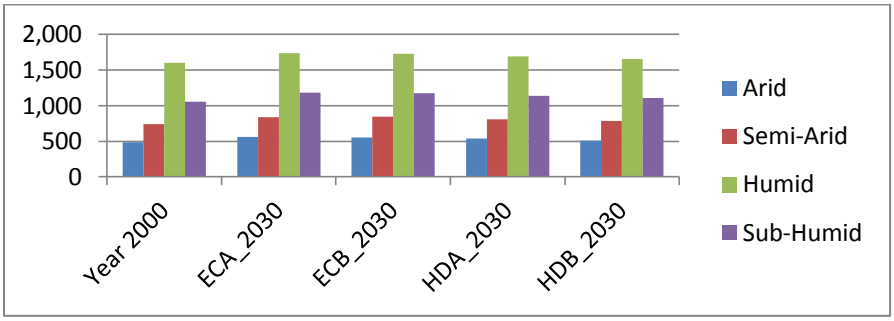


Figure 5 **A.** Observed and projected changes in rainfall and temperatures, together with smoothed central Kenya Rainfall and **B**. a smoothed version of the Indian-Pacific – Area climate Index. Source USGS/USAID, 2010

Figure 6. A comparison 2030 annual rainfall (mm) projections for Kenya by different models



ECA= EC Model with Scenario A; ECB= ECA Model with Scenario B; HDA= HD Model at scenario A; HDB= HD Model at scenario B.

2.5 Status of climate and hazard information at national and regional levels

According to the national climate change response strategy the level of understanding of climate change and its impacts is very low nationally (MEMR, 2009) consequently information of climate hazards is also very low. Available information at the regional is mainly from the Intergovernmental Authority on Development (IGAD), while national and sub national levels; the source of information is the Kenya Meteorological Department (Karanja et. al. 2007; Muchemi – no date; MOSSP 2009; Republic of Kenya 2004; Suda 2000; UNEP 2002).

3.0 Climate Risk Profile (*5 pages – DRR, CCA, development focus)*

This chapter gives a summary of hazards and associated risks across different exposure units in Kenya in respect to economic sectors / regions/ populations including climate risks to the provisioning of ecosystem services. It reports on the impacts of all identified risks and disasters showing their relationships with the current climate vulnerabilities, variablilities and change. It also gives an assessment on the extent to which past impacts of extreme events are indicators of future impacts.

Past climate hazards & disasters impacts and present risks

A number of observable changes in the status, structure and functions of several systems in Kenya (UNEP, 2002; WRI 2007; Olson 2004) and other countries in East Africa (UNEP 2002;) have been associated with past climate related disasters. In Kenya more than 70% of the natural disasters are related to climate extreme events (MOSSP, 2009). These include drying up of rivers, reductions in lake levels, human injuries and death, migrations, destruction of property, deforestation, reduction of ice cover on Mt. Kenya and Mt. Kilimanjaro, loss of biodiversity as well as a general land degradation among others most of which are brought about by either too much or too little rain and higher than normal temperatures. The impacts of these changes cut across all components of environment and sectors of development from the extent and state of natural resources to agriculture, tourism, energy, health, infrastructure and trade. While most of the impacts have largely been negative, some are positive as they give new opportunities for investment and new options to support livelihoods.

The most common types of climate hazards are droughts, floods, epidemics, landslides and to lesser extent windstorms. Table 3 in the previous section gave the history of droughts, floods and landslides with the areas and the number of people affected by each hazard. To show the history of climate related disease epidemics in Kenya, table 5, gives incidences and areas affected by Malaria, Cholera, Yellow Fever, Dengue Fever, and Rift Valley Fever since 1980s to 2009. Disease epidemics kill the highest number of people compared to all other climate disasters.

Table 5. Climate related disease epidemics and areas affected

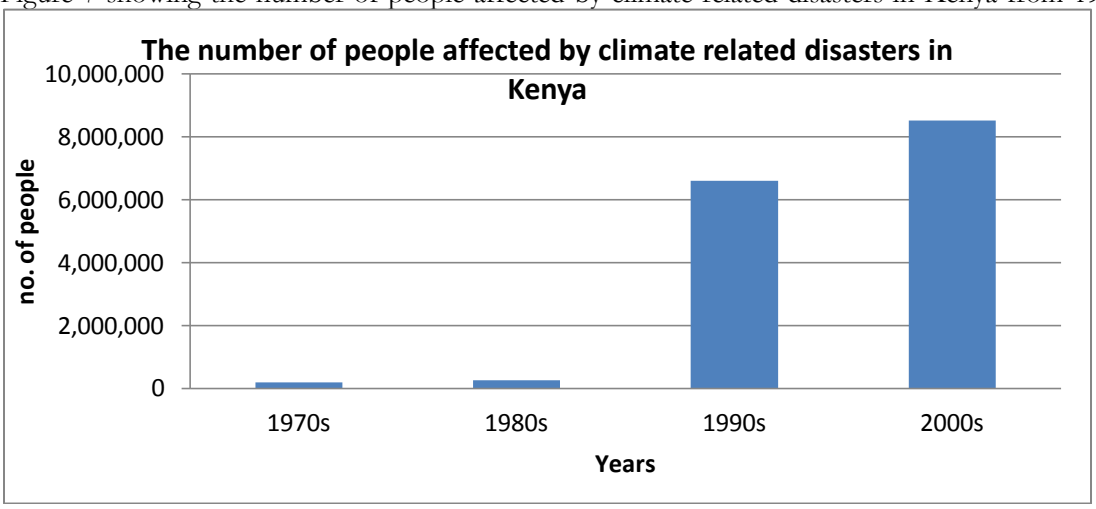
Disease	Month/Year	Area affected	People affected
Malaria	July – Aug 1991	Nandi, Kericho, Uasin Gishu	Data not reported
	Jan-March 1993	Samburu	Data not reported
	July-Aug 1994	Nyamira, Nandi, Kericho	Data not reported
	Jan-March 1995	Uasin gishu, Nandi, Samburu	Data not reported
	June –Aug 1996	Nyamira	Data not reported
	Jan-March 1997	Samburu	Data not reported
	June-Aug 1997	Uasin gishu, Nyamira, Kericho, Samburu	Data not reported
	Jan-March 1998	Nyamira,Samburu, K ericho, Wajir, Nyanza	400 dead
	June 2002	Riftvalley, Nyanza	300 dead, 158,000 affected
Cholera	June-Aug 1997	Migori/nyanza	29 dead, 555 affected
	Dec 1998-Jan 1999	Nyanza, Eastern, Nairobi, Riftvalley	25 dead, 1025 affected
	Feb-May 2007	N.Eastern, Nyanza, Coast, Riftvalley	35 dead, 625 affected
	Nov 2007	Nyanza, N. Eastern, western, Rift valley	

	March-April 2009 October-Nov 2009	Nyanza, Western, Eastern, N. Eastern, Rift valley, Coast, Nairobi.	274 dead, 11,769 cases
Yellow fever	Sept-March 1993	Kerio valley	5 dead, 54 affected
Dengue fever	1982	Malindi/Kilifi	
Rift Valley Fever	1997/98		478 dead, 89,000 affected
	2006/07	N. Eastern , Coast, Central, Nairobi	148 dead

Source: Malaria. www.malaria.who.int/docs/ek_report. Cholera. www.who.int/cholera/countries. Yellow fever. www.who.int/vaccines_documents. Dengue fever. www.tropika.net/review. RVF. www.arbo-zoo.net and www.rr-africa.oie.int

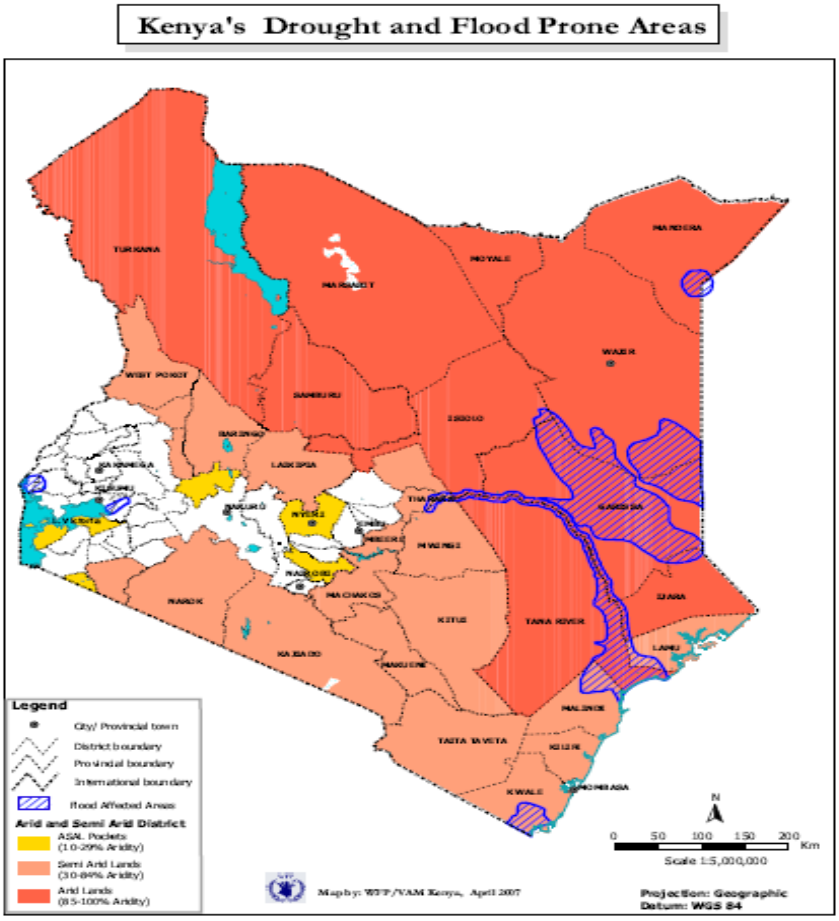
Table 4 in section 2 of this report gave the types, prevalence and effects of different climate hazards in Kenya. Figure 7 below gives the total number of people affected by climate disasters in Kenya grouped in 10 year periods. The figure shows that more than 80% of climate related disasters on people have occurred during the last 20 years.

Figure 7 showing the number of people affected by climate related disasters in Kenya from 1970s to 2000s



Over 36 per cent of all the rural poor Kenyans living in marginal lands are particularly vulnerable to environmental degradation, such as in floodplains, coastal areas, and degraded hillsides (UNDP 2002; 2007). While these impacts have certainly affected many parts of the country, some areas like Machakos, Kitui, Taita Taveta and in general all Arid and Semi-Arid lands (ASALs) have been adversely affected. Along the coast of Kenya, higher Indian Ocean temperatures have resulted in loss of coral reefs (Obunde, 2007). The mangroves have also experienced die-offs due to erosion of sediments. Due to drought many rivers have reduced their volumes of water and many seasonal ones are dry for most of the year (Verschuren et al. 2000). Based on different case studies, the trends in occurrence and severity of droughts are increasing (UNDP No date). Areas prone to droughts in Kenya are the eastern and northern parts of the country including parts of rift Valley and coast provinces (fig. 8). Most areas prone to floods are within areas that are also prone to droughts (fig 8). On a more positive note there are reports that some crops may do better in the new conditions than before and may be suitable for cultivation in larger areas than now (Olson et. al. 2008; GoK 2010). These crops include maize cultivation in central Kenya.

Figure 8 drought and flood prone areas of Kenya (WFP/VAM Kenya, April 2007)



It is estimated that about 30% of Kenya's population live in the ASAL areas prone to droughts and the major livelihood in these areas is pastoralism (GoK 2007; Gullet et. a. 2006). Floods the second most important climate related disaster after drought, seasonally affects parts of Nyanza (fig. 8), especially around the basin of Lake Victoria but affect larger areas in the Tana River drainage basin. The latest widespread flood caused by 1997/1998 El- Nino affected approximately 1.5 million people in the country. Landslide prone zones are mainly in the central province where the hilly landscapes combined with higher rainfall and intensive cultivation make them more vulnerable to landslides. Landslides in many cases cause instant deaths but are fewer and much more localized compared to droughts and floods. Annex 3.1 give history of floods in Kenya (UNDP, No date 2).

The consequences of the identified hazards on specific sectors, regions vulnerable groups in terms of losses by hazard type and impacts, number of people affected etc.,

Droughts affect many parts of the country at different magnitudes but there are four main provinces that are repeatedly affected namely: Northeastern, Rift Valley, Coast and Eastern (UNDP No date 2). In the rift valley most parts of Baringo, Laikipia, Turkana, Samburu, Narok, Kajiado are affected (GoK 2002; MOENR 2001). In the eastern province two districts are severely affected namely Marsabit and Isiolo. The other provinces are North Eastern and Coast.

The livelihoods most at risk due to droughts are pastoralism and agro-pastoralism. In these livelihood adaptations, droughts result in high livestock mortality, and since nearly all people depend on livestock, they are left without food, source of cash and virtually nothing to depend on. In these conditions people turn to

food aid from the government and humanitarian agencies (Morton 2001; Campbell 2003). A survey of impacts of drought on livelihood strategies in Kajiado district found that during 2003, as many as 65% of people in Loitokitok division turned to dependence on food aid after losing their livestock to drought (Campbell 1999, Campbell et.al., 2003). Table 6 gives estimates of economic losses to livestock keepers in Kenya during the 1999-2001 droughts.

In agriculture and food security, recurrent droughts have reduced famine cycles from 20 years (1964-1984); to 12 years (1984 -1996); to 2 years (2004 – 2006) and to yearly in 2007, 2008, 2009 (Mogaka et. al. 2006).
Analysis of climate change impact on agriculture shows that there will be areas with increased production and areas with reduced production. Annex 4.1 gives the analysis of maize projections based on CLIP model (Olson, 2008). Analysis of impacts of climate change on the length of growing seasons shows that central and western parts of Kenya will by 2030 have significant reductions in the number of days for both seasons implying poor performance of the crops growing in those areas (Thornton et. al. 2006). The analysis shows that parts of northern Kenya may have longer lengths of growing periods that may result in more grass cover and some area becoming suitable for cultivation of crops. Annexes 4.2 and 4.3 show the spatial distributions of n the lengths of growing periods.

In tourism reduced water availability during droughts results in massive deaths of wildlife, increased influx of livestock into the national parks thereby reducing the potential of the parks to attract tourists. Drought related deaths of elephants alone were 14 in 2007, 28 in 2008, and 37 in 2009 (MEMR, 2009). Climate change is likely to alter the current distribution of vegetation and water resources in the designated national parks. This will ultimately result into more conflicts with humans and livestock and wildlife thereby adversely affecting the tourism industry (Viner David and Maureen Agnew, 1999).

Closed forest cover in Kenya occupies about 1.7% of the total land cover (GoK 2007). A study by Violet Matiru in 1999 (Matiru 1999) shows that indigenous forests comprise of about 88.57% of the closed canopy forests while plantation forests are 11.43%. In forest reserves about 64% are indigenous forests while 25% are covered by non-forest vegetation types, with the rest comprising of plantations. About 85.5% of indigenous forests are found in forest reserves while 14.5% are found outside the gazetted forest reserves (Matiru 1999). Deforestation and conversion of forestland into cultivations is the biggest threat to forests in Kenya as was recently observed in the excisions of Mau forest (UNEP 008), but in several places reductions in forest cover is associated with changes in climatic conditions. The decline in the cover of Tana gallery forests for example is linked to changes in water table in the Tana basin and alterations in annual Tana river flood regimes by the construction of dams and irrigations schemes upstream (Matiru, 1999). One of the gaps in the forestry subsector is that no analysis has been done on the spread, status, composition, and the role forests outside forest reserves play in provisioning of goods and services (GoK 2009).

In the energy sector droughts reduce water levels in rivers and dams lowering the capacity to generate hydro electricity. For example between 1999 and 2000 Kenya's economy dropped by 0.6% due to losses in the manufacturing sub sector as a result of prolonged droughts that lead to widespread power cuts, while KPLC lost 4.1 billion shillings in revenues(Mogaka et. al. 2006). For a long time demands for wood fuel has been exceeding supply resulting into escalation of prices. Increases prices of wood fuel affect mostly women in the rural areas who are responsible for household cooking and due to high levels of poverty have no alternative sources of energy (Mogaka et. al. 2006). Annex 3.2 shows the changes in water availability per capita.

Health aspects that are most vulnerable to climate change are; spread of vector borne diseases in new areas and increase in prevalence in the areas the diseases already exist. A well known observation is the spread of malaria in Kericho highlands where malaria was not found before. With the warmer climates mosquitoes are now able inhabit highland areas and transmit malaria (Githeko and Ndegwa, 2001).

In the industry sector manufacturing subsector contributed 10% to the national GDP in 2009, where manufacturing of agro based products contributed 29% to the sector's GDP, 26% of the sector exports; and

36% of people employed in the sector (GoK 2008 -Industry sector report for vision 2030). Production of industrial crops such as tea and pyrethrum are likely to reduce due to higher temperatures and low rainfall especially around Mt. Kenya region where tea may be replaced by coffee that is expected to shift upwards to higher altitudes (ITC, 2010).

Kenya is considered as a chronically water scarce country. Water per capita has dropped to 503 m^3 of water availability down from 1854 m^3 in 1969 and is projected to be 359 m^3 in 2020. The decreasing availability of water is a big challenge to Kenya's agricultural based vision 2030 development blue print that is in the progress of expanding water use in irrigation. Lack of water during droughts causes huge losses in many development sectors especially agriculture, energy, industry, health and tourism. "Between 1998 and 2000 for example drought resulted in 40% loss in rice production, 30-40% loss of business in agro- industries; KSh 2.82 billion losses in grain deficits; 40% deaths of livestock; and over 80% of earth dams and pans in Ewaso Ng'iro South basin dried up increasing incidences of diseases" (Aklilu Yakob and Mike Wekesa, 2002). During floods losses are incurred through damage of property. The El-Nino induced floods of 1997/1998 for example resulted in USD 151.4 million losses in private and public property damage (Aklilu Yakob and Mike Wekesa, 2002).

Table 6 Estimated economic losses from livestock deaths during 1999-2001 drought (Aklilu Yakob and Mike Wekesa, 2002)

	Livestock species		
	Small stock	Cattle	Camels
Northern rangelands	43% mortality	35% mortality	18% mortality
Southern rangelands	16% mortality	25% mortality	Negligible
Average	30% mortality	30% mortality	18% mortality
Total at risk at peak of drought	8m	3m	80,000
Likely number lost	2.4m	900,000	14,400
Average price/animal during drought year	KSh500	KSh5,000	KSh6,500
Total loss/species	KSh1.2bn ($16m)	KSh4.5bn ($60m)	KSh94m ($1.25m)
Grand total loss	**KSh6bn ($77m)**		

The critical thresholds to which people become highly vulnerable and to which their ability to respond is exceeded.

Natural and human systems always respond to climate and other external stimuli (Campbell, 1999. These responses are usually complex dependent on the nature, strength and duration of the stimuli. Generally systems are self regulatory or governed by thresholds within limits of acceptable or known oscillations. The term threshold refers to the point at which systems undergo an abrupt change due to an external effect. Thresholds occur when external factors cause instabilities in a system causing changes to propagate in a manner that is potentially long term and could be irreversible. Ability of people to cope with climate change is said to be exceeded when 1) the social capital diminishes; 2) technological ability gets to the limits; 3) management options are exhausted; and 4) production alternatives have been tried and failed. Within the natural systems resilience thresholds are determined by critical limits within: 1) biodiversity status; 2) soil characteristics; 3) water availability; and 4) disturbance dynamics.

In the livestock sector a threshold value as described by the International Committee of Red Cross (ICRC, 2005) is "the number of animals required to support a person or a family if that person or family was to rely totally on animals for his or their needs". ICRC reports that the basic threshold for a household is 3 or 4 TLU (Tropical Livestock Unit). A TLU comprises of 1 cattle, 6 goats or sheep and 0.8 camels. In northern Kenya,

ICRC study reports that Turkana and Samburu pastoralists estimate about 70 small stocks as the minimum to support a family. However, most families supplement their livestock based diets with cereal food crops like rice and maize either from market or from food aid.

Qualitatively, Fagre et. al. 2009 and Meze-Hausken – no date, give a complex analysis of thresholds in the tourism sector induced by temperature and precipitation change (fig.7)

Annex 7 showing examples of human climate thresholds (from Meze-Hausken)

		Thermal extremes	Water availability	Tourism destination choice	Migration both pull and push
Stimulus		Temperature	Precipitation (Temperature/ Evaporation	Combined temperature, precipitation, cloudiness , wind	Temperature, precipitation, wind (too much too little)
Physiological thresholds	Supply system		Drinking water, food availability		Resource availability
	Physical forces of extreme events		e.g., flooding	Likelihood of extreme events	Storms, floods, sea level rise
	Temperature extreme	Heat/ cold events		Heat waves	Unfavourable to health / pleasure
Subjective thresholds	Perceptions of change	Time of year, frequency	Used to water deficiency/ harsh conditions	Experience from other travels, comparison with other tourists	Environmental degradation, Climate improving at prospective destination
	Choices, needs capacity	Shelter, heating , cooling, availability	Price of water, distance to wells, other indirect sources of water (e.g., milk)	Destination options Economic restrictions, distances, reason for holiday	Financial capacity, health, comfort, needs for elderly, able to combine with job elsewhere.
	Expectations, wants	e.g, prospect of cooling later in the day	Expected duration of crisis, recurrence, despair when crisis return with high frequency	Image of destination, weather forecast	Climate change prognoses, better life quality somewhere else.
Response impacts		Heat stress, sickness, Freezing to death, heat stroke	Die, Migrate, health problems	Choosing a certain destination	Migration
Adaptation		Buying air conditioning Staying in shade/ indoors	Building dams, resettlements, water rationing	Switch from camping to hotel , change expectations about hotel etc.	Better conditions at new destination
Policy response		Heart alerts, Defining emergency	Providing emergency help, Long term plans	Marketing, adjust tourism infrastructure.	Settlement planning, improving conditions at place

	thresholds, Emergency response plans and training	for building wells, resettlements, education		of departure to reduce migration, adjustment of infrastructure plans at place of destination

Maitima *et. al* 2009) listed key causal effects that initiate primary responses to climate change on various systems as follows: Agriculture - less crop yields; less food available from cultivation; crop failure – poor harvest due to less rain or too much rain; crop loss to pests and diseases; reduction in choice of crops that do well in specific seasons; and excessive weed growth and or invasion by alien weed species (UNEP 2002) but the report also fall short of giving threshold values. On the livestock sub-sector: lack of pastures for livestock; lack of drinking water; death of livestock due to disease epidemic; and invasive species out competing pasture species in growth and abundance (Lemoine, and Böhning-Gaese, 2003). On water resources: rivers drying up more often or for longer periods; dams drying up faster; collecting water from more distant places; water getting polluted; and more conflicts between communities over scarce water resources.

Future risks from climate variability and change on the country's development

Information on extreme events (floods and droughts) is much more variable and future projections vary widely. Many models indicate an intensification of heavy rainfall in the wet seasons, particularly in some regions and thus greater flood risks. Droughts are likely to continue but the projections are more varied - some models project an intensification of these events, particularly in some regions, though other models indicate reductions in severity (SEI, 2009b).

Studies on future risks of climate variability and change on the country's development are limited considering the diverse economic activities across the country, and diverse ecological settings upon which agriculture is based. Studies on the effects of global warming on crop productivity predict a 1% gain in crop yields within the high potential areas and 21.5% loss in the medium and low potential areas (Kabubo-Mariara and Karanja, 2007). A model by the Geophysical Fluid Dynamics Laboratory (GFDL) predicts a loss of USD 32 per hectare in the high potential areas compared to a loss of USD 178 in the medium and low potential areas by 2030. Results of crop-climate modeling using the results of the CLIP climate model indicate that maize yields may increase somewhat in areas expected to experience increases in rainfall (in some areas in northern Kenya) but decline elsewhere in other parts of Kenya. The main exception is in the highlands where warmer temperatures will enhance production of maize in areas previously too cool for maize cultivation (Olson 2008).

Except in the northeast, rangelands will generally become drier and less productive, and the plant species composition may change towards less palatable species for livestock and wildlife. In the northeast, the increase in rainfall may lead to an increase in bush cover (Olson et. al. 2008; Thornton et. al. 2009). Throughout the country, droughts will impact people and animals more quickly and more severely because of the higher temperatures and more rapid evaporation, and the frequency and intensity of droughts are expected to increase (Thornton et. al. 2009). Other ecosystems expected to be particularly vulnerable include wetlands due to reduction in water and increase in use, the highlands due to rapid warming, coral reefs due to warmer surface water, and coastal zones due to more intense storms and salt water intrusion.

If temperatures rise by 2°C, large areas of Kenya currently suited to growing tea would become unsuitable, with enormous impacts on the Kenyan economy especially on the rural poor (Olson et. al. 2008). Some 400 000 smallholders grow 60 per cent of the country's tea, with large estates growing the rest (MoA 2009). While large tea estates can likely afford extra irrigation and other inputs to cope with the effects of climate change, smallholders face difficult challenges in adapting. Change in the production of commercial crops like tea will consequently affect the agro-processing industry due to low output from agriculture.

Rift Valley Fever has occurred in Kenya about eight times since 1950: 1951-42; 1957; 1961-62; 1968-69; 1977-79; 1982; 1989; and 1997-98. Occurrence of this mosquito transmitted disease is linked to above normal and vegetation being green for longer periods of time (Linthicum et. al. 2007; Anyamba et. al. 2001). Areas project to have above normal in the future may have higher risks of Rift Valley Fever. Similarly malaria cases in the highlands will increase with increase in temperature (Githeko and Ndegwa, 2001) as conditions in these areas become habitable for mosquitoes.

An assessment of how future socio-economic trends have been taken into account in the projections.

The pertinent socio economic factors that need to be taken into account in assessing future climate change impacts on socio-economics include: population growth, social equity, gender, education and human capacity. All these except population growth and the associated implications have been taken into account in the formulation of Vision 2030 the current blue print of development In Kenya. In the Vision 2030 document the annual incomes per person is to be raised from the 2006 level of USD $650 to USD 3,000 which is reported to be consistent with the rapidly industrializing countries. The document also reports that poverty level is to be reduced by between 3 and 9 percent from the current 46% (UNDP, 2010; GoK 2007) as well as implementing policies to reduce disparities in wealth distribution. Vision 2030 puts special attention to the marginalized groups in the arid and semi-arid lands, urban slums and pockets of extreme poverty in other areas.

Distribution of poverty and livelihood strategies across the country has been mapped showing areas with low and high poverty rates (GoK 2007), and how people derive their livelihoods in different areas of the country (GoK 2007) respectively. Several baseline studies have been done to show how climate change affects agriculture and livestock production across the country and the economics of different land uses (Maitima et. al. 2010; Kabubo-Mariara and Karanja 2007); to show how climate affects disease prevalence among people and livestock (Githeko and Ndegwa, 2001; Wandiga 2006; Anyamba et. al. 2001).

On future projections a few studies have been done to show the effects of climate change on crop production in different parts of the country to 2050 (Olson 2008). A study has been done to show the effects of 20C temperature rise will have on tea production. There is need for more studies to be done on the impacts of projected climate change will have on different crops.

Methodological challenges and knowledge gaps in assessing climate risks and impacts

The degree to which information on climate risk impacts has been linked to the socio-economic data and the possible results.

There are a number of initiatives linking climate risk information to socio-economic activities in Kenya. The early warning systems operating in arid and semi-arid lands for example, use climate information to advice and guide farmers on climate risks some of their socio-economic activities face ahead of time. This system helps herders to avoid losses to drought by destocking their livestock and selling them before drought strikes.

Another system that utilizes climate risk information to protect livelihoods is the index based insurance programme for livestock. Through this system insurance firms calculate the risks associated with droughts in a given place and insure livestock against death based on time to time risk analysis. Climate risk is main driving force behind the nomadic migrations practiced by pastoralists in the arid and semi-arid lands.

Daily weather reporting by Kenya Meteorological Department through radio and television networks is very informative to people especially those who work on farms and those who live along rivers that flood occasionally. Occasional 3 month weather reports carried by news papers are very useful to guide farmers on the timing of planting seasons. These short term weather forecast are very important to famers as they predict

on whether to expect normal, below or above normal amounts of rainfall in the coming season and the timing of the onset of seasons.

Methods on how climate risk vulnerable groups have been identified or climate risks awareness and responses to disasters have been measured in existing studies and the convergence of approaches across regions and assessors / actors.

Several methods have been used to identify climate risk vulnerable groups. These include Remote Sensing and GIS analysis as applied by DRSRS to map distribution of natural resources, mapping of spatial distribution of livelihood strategies, mapping of variablilities in poverty densities across the country; mapping of land use and land cover, distribution of human, livestock and wildlife; and mapping disaster risk areas in the country (WRI/ILRI/GoK). The remote sensing analysis is usually accompanied by field observations for verifications. Further to Remote Sensing and GIS analysis, ground observations have been used to identify and assess the communities affected by disasters like floods, droughts, landslides and epidemics when they occur in a more reactionary approach than anticipatory (WHO 2003; UNDP/ DFID 2008).

Social and econometric analysis has been used to characterize social responses to climate disasters, and to measure economic impacts of disaster events (Kabubo-Mariara, and Karanja 2006; MEMR, 2009). These have used group discussions, rapid appraisal techniques, and Ricardian economic analysis.

The National Climate Change Response Strategy (MEMR 2009) prepared by the ministry of Environment and Mineral Resources has suggested a study to be done to harmonize and prepare national guidelines on the methodologies to use in identifying climate risk groups and assessing vulnerability to climate risks and impacts caused by climate hazards.

The extent to which climate variability and risk studies have been analyzed in respect to gender and the possible results.

A number of studies have analyzed gender in respect to climate variability and risks. The African Development Bank study on gender profile in Kenya has analyzed women participation in the labour and found that the proportion of women in both formal and informal sectors was 30% in 2005. The analysis shows that despite women contributing up to 80% of labour in the farms, it is only 5% of them who own land titles implying that most do not have right of ownership on the land they till. Changes in socio-cultural practices associated with recurrent droughts have made women in pastoral areas, to participate in cattle, camels, bee keeping and trading with small animals in order to provide food for their families. These activities have traditionally been responsibilities of men (ADB, 2004; 2007)

The first national communication to UNFCCC from Kenya, recognizes that women would be most affected by climatic variabilities and other related impacts of climate change as they affect food production, water availability, health, energy scarcity and technological changes. Participation of women in decision-making on issues of land management and ownership is limited. The communication reports that the issue of gender on climate change issues is being addressed through policy and legislative reforms. Analysis of the prevalence HIV/AIDS, malaria and TB has been done by sex, age, levels of education and geographical distribution. This has been done through analysis of hospital records of treatment UNDP, 2010. A report by Syd Forum (Forum 2008) shows that of all Kenya's active women population, 69% work in the rural areas engaged in subsistence farming. Given that subsistence farmers in the rural areas are among the most poor, this relative dependence of women on subsistence farming shows their high vulnerability to climate change risks. This problem is most severe in the ASAL areas where women spend a great deal of time searching for water and fuel (AfDB, 2007). As availability of resources reduces due to climate change, for example, women will be the most affected than men. The report also indicates that female-headed households are particularly poor and among the most vulnerable (Forum 2008).

4.0 Climate Risk Management Profile *(5 pages – DRR, CCA, development focus)*

Climate Risk Management (CRM) is the approach and practice of managing uncertainty to minimize potential harm and loss from risks to climate hazards (Hellmuth, 2007). This chapter discusses the institutional and policy arrangements that are in place at national and local levels to manage uncertainties and minimize the negative impacts of climate risks. The chapter also summarizes the existing climate risk management activities (including coping and adaptation measures) at national and regional levels, and presents an assessment of Kenya's capacity to cope and / adapt to climate change at different levels.

4.1 Institutional and policy arrangements for addressing CCA and DRR

Currently Kenya lacks a coordinated institutional framework for dealing with disasters. However, a number of governmental and non-governmental institutions reactively respond to disasters in sectoral arrangements involving different institutions. The most significant effort made by Kenya government towards addressing issues of disaster risk management is the preparation of a policy on disaster risk management in 2009. The policy that is now at a final draft stage establishes a national framework and institutionalizes procedures for dealing with disasters (MOSSP, 2009). The policy establishes a directorate for Disaster Risk Reduction and Preparedness (DRRP) within the Ministry of State for Special Programmes (MOSSP) and a National Disaster Operation Centre (NDOC) under the office of President Provincial Administration. The policy calls for the establishment of provincial and district disaster management committees and lists up 15 types of hazards and the key organizations within the government and NGOs that should play either a leading or supportive role in managing each particular disaster (MOSSP, 2009).

DRRP in MOSSP that is already in place works with key focal point offices / persons in all key ministries (Ministry of State for Special Programmes; Provincial Administration and Internal Security; Foreign Affairs; Health; Water and Irrigation; Agriculture; Livestock; Defence; Environment; Information; Planning and Treasury), who participate in disaster management operations. The role of DRRP is to coordinate an inter-ministerial and other stakeholder's participation in disaster management. NDOC on the other hand working with DRRP coordinates ground operations during disaster rescue missions and other interventions to minimize risks (MOSSP,2009).

As contained in the draft policy for disaster management and reported by NDOC during the national workshop on climate risks assessment, currently the government has no coordinated policy framework or legal basis in disaster management. What exists is a spontaneous reactionary system involving government agents and development partner institutions that assists to respond to disasters when and where they occur (MOSSP, 2009). In the absence of a coordinated system to deal with disasters a number initiatives involving multiple stakeholders have in the past proved to be helpful. These include: Kenya Food Security Meeting (KFSM); Kenya Food Security Steering Group (KFSSG) and the Arid Lands Resource Management Project (ALRMP).

In addition to establishing the DRRP and NDOC, the draft national disaster management policy sets a high level decision making body to formulate policesy related to disaster management. This body called National Disaster Executive Committee (NDEC) which is made up of Cabinet Ministers and chaired by H.E. the President. Ministers in the committee are from: Ministry of State for Special Programmes; Provincial Administration and Internal Security; Foreign Affairs, Health, Water and Irrigation; Agriculture; Livestock; Defence, Environment; Information; Planning and Treasury. The executive arm of NDEC is the National Disaster Coordination Committee (NDCC) which comprises of permanent secretaries in the ministries outlined above and is chaired by the permanent ministry in MOSSP. The main functions of NDCC are to execute policies. To deal with activities of disaster management on a day to day basis, the policy calls for the establishment of a National Disaster Management Authority (NDMA) that will be semi- autonomous from government, and a National Disaster Management Resource Centre whose work will be to monitor, collect and collate information and data regarding disasters and the early warning information.

The existing key institutions responsible for funding, implementing, and coordinating climate risk management activities at different scales.

Kenya has implemented many projects with technical and financial assistance from various donors around the world. All the foreign assistance into the country is coordinated by the Division of External Resources in the Ministry of Finance and Planning. The main donor countries and agencies active in the environment sector in Kenya includes USA, World Bank, DFID, Netherlands, European Unions, Denmark, Sweden, Belgium, France, Finland, Austria, Italy and Germany (WWF 2009). Based on past records the following key institutions have been involved in the implementation of funded projects are follows: Ministry of Environment, Ministry of forestry and Wildlife, Ministry of Water and Irrigation; Kenya Wildlife Services; national Museums of Kenya, and Kenya Forestry services among others (WWF 2009).

Projects currently running and addressing climate change in Kenya during the 2010-2011 financial year are funded by various organizations to different ministries and for different amounts. To give an overview of current donor involvement on climate change activities, the International Development Association has sponsored 14 projects; European Development fund 4 projects, African development fund 4 projects; Danish International Development Agency 6 projects Swedish International Development Agency 1; Government of Switzerland; Belgium; Italy; China, USAID, UNEP each 1 project and the government of Spain 3 projects. German Financial Cooperation 5, government of Japan 6, UNDP 5 and the International fund for rural development 6 projects. Ministries implementing these projects are: Environment, forestry and wildlife, northern Kenya development, special programmes, water and irrigation, agriculture, and fisheries among others (Information gathered by Eng. Omedi Ministry of Environment and Mineral resources).

4.2 Major relevant activities already in place or ongoing towards climate risk management.

Kenya government is making various efforts towards climate risk management. The following are some of the initiatives in various sectors of development.

In order to reduce loss of life arising from drought, floods and other calamities, the Government has established a National Food Reserve to be managed by the KFSM (MOSSP, 2008). This comprises: 3 million bags of maize and hard currency adequate to import another 3 million bags of maize. Of late, other food stuffs like powdered milk, beans, rice, and have been incorporated into the food reserves. To boost food production the government through vision 2030 activities plans to raise the 114,600 ha under irrigation by another 90,000 ha by 2012 (GoK 2008).

To reduce losses of livestock in the ASAL areas during droughts, the government has rehabilitated Kenya Meat Commission so as to buy livestock from farmers (Gok 2007a). The ministry of livestock has made aggressive efforts to access to international markets where animals and meat can be sold to encourage farmers to sell animals especially before the onset of dry seasons. In 2004, for example, 5,128 beef cattle were exported from Kenya to the Middle East (EPZ 2005). To help in securing and maintaining these foreign markets the government has initiated creation of disease free zones in various parts of the country where animals are contained for a period of time to ensure that they are disease free before they are exported. This has significantly improved access to lucrative markets of Mauritius and the Middle East.

Farmers tend to reduce their herd sizes and some alter the composition of the herds to more shoats than cattle among the pastoralists who traditionally are cattle herders. Among the mixed crop-livestock keepers to cope with scarcity of pastures during dry seasons, farmers tether their livestock around homes and bring in feed through cut and carry (Bourn, 2005). In order to reduce losses of cattle when drought strikes, farmers are creating strategic feed reserves for their cattle by making forage or hay that is stored for use during the drought period. Though large scale farmers have machines for baling hay, poorer farmers are using more labour intensive technologies for silage making (Winston 2006).

To increase water availability government encourages water harvesting and has recently stepped up investments on building water dams and drilling boreholes in the arid zones of Turkana, Samburu, Baringo,

Kitui and Machakos districts/ counties. Through interventions by government extension system and development agencies there is remarkable increase in the number of manually dug and operated shallow wells around homes that provide water for domestic purposes and watering of kitchen vegetable gardens. In the ASAL areas, some of the strategies used to cope with water scarcity are scooping into sand beds of the dry streams to get water. Another technique used to harvest water is construction of infiltration ditches upstream to collect water upslope and feed crop lands down slope (Obunde *et. al.* 2007). Cut off drains are increasingly being used due their dual purpose of protecting cultivated land from erosion and directing water to the crops. These drains are constructed across a gradient to intercept surface run-off and carry it to a reservoir such as a dam or water pan. Another way Kenyans adapting to increased frequency of drought is irrigation development either through individual, communal or government initiatives (GoK 2007). Various agricultural related policies have laid emphasis on irrigation to reduce possible losses that may result from erratic rainfall.

The government has a well established extension system to help farmers deal with environmental problems including those caused by climate risks. Among the support services provided through the extension system is the management of soil and water conservation, which promote land management practices that enhance soil fertility, reduce erosion, and increase soil moisture retention to sustain crop production. The government through the ministry of Regional Development, for example, is implementing catchment conservation programmes covering vast areas under the jurisdiction of six regional development authorizes such as the Kerio Valley Development Authority (KVDA), the Tana and Athi Rivers Development Authority (TARDA); Ewaso Nyiro South Development Authority (ENSDA); Coast Development Authority (CDA); and Ewaso Nyiro North Development Authority (ENNDA). CDA for example has trained communities in planting and management of trees in Kwale, Kilifi and Mombasa and has obtained funding from the African development bank to implement conservation programmes to protect forests and other natural resources in the northern parts of the coast.

The government intends to increase forest cover to 10% by 2030 up from the current 1.7% of the total land cover through implementation of appropriate incentives setting up forest plantations in privately owned lands. This will play a role in protecting water catchment areas, increase availability of wood and wood products including wood fuel to people a source of renewable energy (GoK 2008).

In the energy sector government plans to reduce dependence on hydro power and to diversify energy sources (GoK, 2008). As reported in energy sector plan for 2008-2012, to meet energy demands in the medium term, the sector plans to inject 1618 MW (Mega Watts) into the national grid commissioning additional geothermal plants to generate 175MW, hydro plants 70MW, coal fired plants 620MW, medium speed diesel plants 448MW and 305 MW from wind plants (GoK 2008 Energy sector). To reduce demand for wood fuel the government and several non-governmental agencies have been promoting use of energy saving stoves, biogas digesters, wind and solar power (GoK,2008).

Promotion of health insurance to cover all people in Kenya is one undertaking that will increase the ability of people to manage health problems. A proposal to implement a national health insurance through the National Health Insurance Fund (NHIF) is at an advanced stage. In addition, the government through the current decentralization programme under the new constitution (constitution of Kenya 2010), plans to increase accessibility to health services by the rural populations.

In the vision 2030, the tourism sector proposes to adhere to strict environmental conservation measures in order to counter the climate change induced proliferation of invasive species in the national parks that are reducing pasture qualities for the wildlife. An example of this invasive species is the *Prosopis juliflora* that is replacing bushes in many national parks and other grazing areas.

4.3 Capacity needs assessment for climate risk management

Responsibilities for managing climate risks alongside other disaster causing hazards is vested in the Ministry of State for Special Programmes (MOSSP) in collaboration with the National Disaster Operation centre in the office of the President's provincial administration. Working with are line ministries responsible for sector interventions. As contained in the draft policy document on disaster management (MOSSP, 2009), there is lack of coordination in disaster risk management in that there is no policy framework to guide operations. Currently there is lack of a strong institutional setup to deal disasters including those of climate change. The draft policy seeks to establish institutions to manage risks, and staff them with personnel who will on full time basis deal with risk management. The draft policy reports that due to lack of policy framework, disaster risk management is currently limited to emergency responses and therefore there is no systematic approach of a planned disaster risk management (MOSSP, 2009).

A needs assessment for management of climate change issues in Kenya was done by the self capacity needs assessment project (GoK no date) but mainly on the capacity to respond to UNFCCC activities. The stakeholders participating in the project identified a number of areas that needs capacity building in Kenya and listed a number of needs based on three major categories namely: 1) systemic, 2) institutional and 3) individual. The main areas under which needs were assessed are: 1) Vulnerability and Adaptation; 2) Research, Systematic Observations and Data Management; 3) Awareness and Understanding of Climate-Change Issues; 4) Climate-Change Strategies and Policy Framework; 5) Transfer of Environmentally Sound Technologies; 6.) Climate-Change Convention Negotiating Capacity; 7) GHG inventories, Abatement, Sinks & Sequestration; 8) Clean Development Mechanism; 9) Synergies in the Multilateral Environmental Conventions. In a long list of needs reported by this study none was in the area climate disaster risks management. This may be an indication for a lack integration of climate change science with aspects of climate risks management. Below is a list of selected needs that has implications of climate risk management as reported by the study:

- 'Specialized institutions in V&A with special capacity to develop analysis in the economic impacts of climate change (economic vulnerability).
- An institutional framework that effectively guides and coordinates abatement actions.
- An integrated planning and management framework with realistic links to social and economic priorities and cohesive and clear functions across sectors.
- There is need for specialized training in aspects such as: -
    - Climate variability and change studies.
    - Specialized training on climate change in areas such as impact assessment, scenario developments, vulnerability assessments, etc.
    - Climate change model development and operationalization.
- Know-how to access available regional and international information and to create specific databanks for particular issues"

There is lack of studies on the adaptive mechanisms through which farmers like the livestock keepers avoid the impact of climate change in Kenya (Kabubo, and Karanja, 2008), other than the well known migrations practiced by the nomadic communities.

5.0 Conclusions

5.1 Major findings and existing gaps

Kenya's development is largely driven by the agricultural sector that provides for food security and foreign income earnings through export of tea, coffee, horticultural produce, pyrethrum, and cotton. Most of these crops are produced through rain-fed cultivation and productivity varies with fluctuating rainfall amounts. Tourism and industry are also important sectors for economic growth in Kenya, but like in agriculture this study has shown that their performance over the years has been greatly compromised by erratic weather conditions that have been characterized by unreliable rainfall, frequent droughts and in some place floods. To create an enabling environment for economic growth the government has since independence been developing policy reforms and institutional frameworks to guide developments in all sectors.

Climate in Kenya has in the past been very variable with frequent and widespread droughts, regular floods in several places. These variablilities are not uniform across the country as some parts have become warmer than others while others are experiencing higher reductions in precipitation than others. Climate related disaster are common and have a pattern of droughts almost being followed by floods and over the years the drought cycle has reduced gradually from once in every 20 years in 1950s to one almost every year since 2007. People affected by droughts and floods are many often ranging in millions per a disaster episode. In the areas affected by these disasters diseases have increased, ecosystems have been degraded, many people have turned into food aid from government and humanitarian agencies after their livelihoods have been totally destroyed. Climate variability has intensified in the recent past and damages from the associated disasters have escalated especially during the last 20 years. Available information from climate change simulations show that these variablilities in climate will continue to intensify with high variablilities in the amounts and spatial distribution of rainfall. Climate risks in Kenya affect all people in the country to some extent but the most affected are the vulnerable groups like the poor in urban and rural areas, people in the drought and flood prone areas, women and children.

Kenya government with its development partners as well as the NGOs are making frantic efforts to manage these risks through formulation and implementation of various policy instruments, institutional frameworks, inclusion of environmental conservation measures in all development projects and conducting environmental awareness among people who are most affected and whose livelihoods needs to be protected including those whose activities are crucial to mitigating the impacts. However, all these efforts are faced with challenges ranging from lack of adequate information on how to deal with the uncertainties of climate change in project implementation, the nature and magnitude of climate change impacts, to both the human and technological capacities of how to assess risks and develop options for managing the risks.

Although activities related to climate risk management have been going on in many sectors of the economy for several years, most have largely been designed to tackle specific problems of production or well being of people and ecosystems without necessarily targeting the reduction of climate change risks and impacts specifically. The National Climate Change Response Strategy of 2009 (GOK 2010), presents sets of interventions sector by sector as recommendations for action on how to enhance climate change adaptations and mitigation.

There are gaps in the knowledge of how to deal with climate change disasters at all levels from the technical backstopping at the national level to the community interventions at the local level. Although reactive responses to climate change disasters have in past been considerably effective, improvements can be made to develop more proactive response strategies for dealing with different climate risks and with information from future climate scenarios incorporate the strategies in an anticipatory manner for both the short term and long term projections.

6.2 Recommendations

In the process of carrying out this review several recommendation relevant to climate risk assessment have been reported. This section presents sector by sector the recommendations made in different reports in respect to filling identified gaps on climate risk assessment in Kenya.

Climate Change Information: Gaps on climate change information relate to scale in spatial coverage, future projections, and packaging of climate information for easy application. Recommendations to bridge this gaps have include, increasing weather stations across the country, strengthening of KMD with modern weather capture and analytical facilities and increasing the staffing levels (MEMR 2009). Recommendations have been made to establish climate change research specialized institutions to deal with climate change research in order to reduce the high levels of uncertainty especially on impacts.

In the agriculture sector calls have been for more analysis of climate change effects on crop productivity covering all crops on area to area basis in order to take into account the reported variabilities in climate change scenarios (Olson *et al,* 2008).

In the livestock subsector a need for analysis on how herders can cope with the more recurrent, more intense and more widespread droughts (Kabubo and Karanja 2007). Recommendations have been made for more research on how communities in drought prone areas can diversify the means of production to reduce impacts of drought on livelihoods.

In the forestry sector, recommendations have been made for analysis to document the status of forests in areas outside gazette state forests. This is to include forest cover, composition, and functions especially in regards to ecosystem services they provide. There need for more information on the quantity, quality and trends of growth and yields in order to better inform decision making (GoK 2008 – Sector Plan for environment, water and Sanitation for Vision 2030).

In the water sector need has been expressed for research on how climate change in the future will affect the already poor levels of water availability in the country focusing on catchment basin by basin, taking into account population dynamics and the increasing water demand.

In the energy sector a need has been expressed for better documentation of renewable energy resources in the country in the way of mapping their distribution and assessing the potential to generate energy.

In the tourism sector a need has been expressed for analysis of the impacts of climate change on habitat distribution, composition and functions in national parks and how they will affect wildlife.

Because of the complexity of climate induced risks and the associated natural and socio-economic systems response strategies studies have called for an integration of plausible existing indigenous knowledge systems acquired over time by the local communities with all efforts to develop workable adaptation strategies. This will benefit not only the process of developing best bet adaption options but also the uptake and adoption of the developed strategies as communities will identify with them as their own.

Kenya needs capacity building in all areas of climate risk assessment in order to identify vulnerable groups and determine the magnitudes of the impacts. The country needs capacity to anticipate climate change disasters at national and local levels of analysis in order to prepare and deal with them proactively in the future. This training needs to be in human skills trained at postgraduate levels in reputable institutions of higher learning. The training should cover methodological approaches, experiences in developing and applying appropriate diagnostic and analytical tools of climate risk assessment (MEMR, 2009). On climate change analysis studies have recommended preparation of a synthesis of methodologies for assessing climate change impacts so that impacts analysis can be compared across regions and over time (MEMR, 2009).

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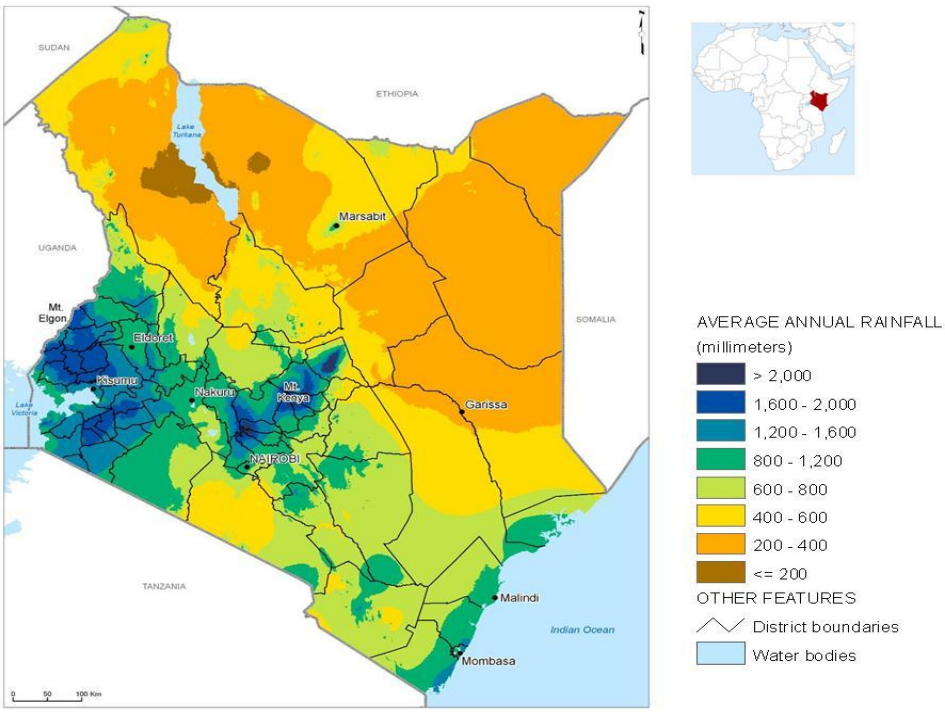
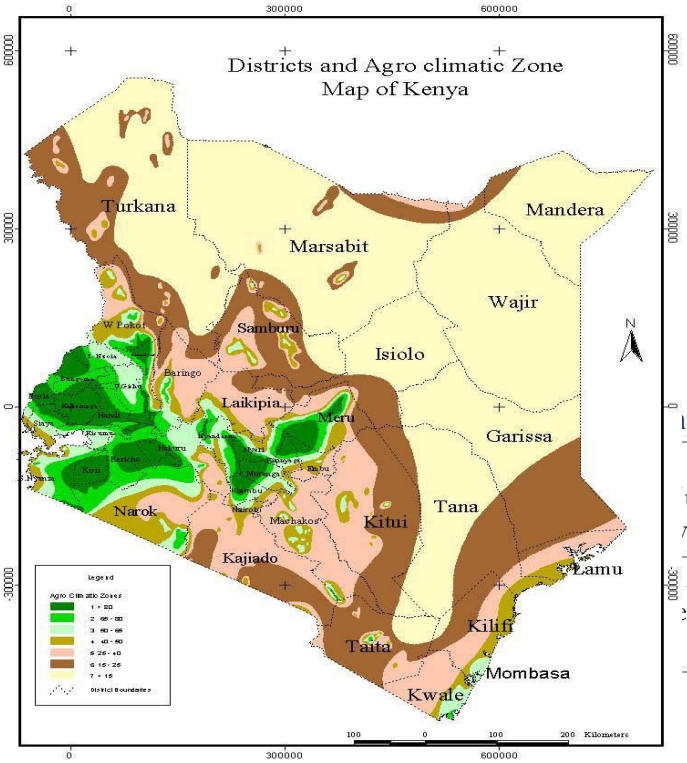
Annexes

Annex 2.1 Rainfall patterns in Kenya (WRI, 2007)



***Annex 2.2** Kenya Agro-ecological Zones From (Sombroek et. al. 1982)*



Ann **ll and proportion of land (EU, 2006)**

Nat clin	season – March to May and October to une to September /ind blows more intensely in April.				
Agr Clir Zor				Annual es	Annual Rainfall (mm)	Land Area (%)
I					1100-2700	
II	Sub-humid	65 - 80	20-26°C		1000-1600	12

III	Semi-humid	50 - 65	24-28°C	800-1400	
IV	Semi-humid to semi-arid	40 - 50	20-25°C	600-1100	5
V	Semi-arid	25 - 40	20-25°C	450-900	15
VI	Arid	15 - 25	24-28°C	300-550	22
VII	Very arid	<15	(>28°C	150-350	46

Modified from: Sombroek *et al.* (1982). Source: EU 2006

Annex 2..4 *National temperature and rainfall based on Eco Regions. (Source ILRI GIS)*

Ecozone	Temperature °C			Rainfall mm
	Minimum	Maximum	Average	Year 2000
Arid	19.1	32.4	25.5	483
Semi Arid	15.2	28.2	21.4	742
Humid	9.4	23.6	16.2	1,600
Sub Humid	11.6	25.7	18.4	1,058

Annex 2.5 *Annual minimum temperature changes 1960 -2010. (Source ILRI GIS)*

Region	**Trend**	**Magnitude °C**
Western	Increase	0.8-2.9
Northern and Northeastern	Increase	0.7-1.8
Central	Increase	0.8-2.0
Southeastern	Increase	0.7-1.0
Coastal Strip	Decrease	0.3-1.0

Annex 2.6 *Annual maximum temperature changes 1960 – 2010 (Source ILRI GIS)*

Region	**Trend**	**Magnitude °C**
Western	Increase	0.5-2.1
Northern and Northeastern	Increase	0.1-1.3
Central	Increase	0.1-0.7
Southeastern	Increase	0.2-0.6
Coastal Strip	Decrease	0.2-2.0

Annex 3.1 *Recent histories of floods in Kenya*

Year	Area Affected	Economic activities in the area	Estimated No. of People Affected
2003	Nyanza, Busia, Tana River	Rice, Sugar cane, subsistent food crops, mixed crop	170,000

		livestock and pastoralism	
2002	Nyanza, Busia, Tana River	(ad above)	150,000
1997/1998	Widespread		1.5 Million
1985	Nyanza Western Province, Tana River	As above	10,000
1982	Nyanza	As above	4,000

Source: UNDP Kenya Disaster Profile- no date

Annex 3.2 Water availability per capita

Year	**Population**	**Per Capita Water Availability M_3/yr**
1969	10,942,705	1854
1979	15,327,061	1320
1989	21,448,774	942
1999	28,686,607	704
2010	40,311,794	503
2020	56,481,427	359

*Sources: - * GOK Census; **1992 Master plan* Projections In: Kenya Water Development Report 2006 (in Literature folder)

Annex 3.3 Forest fires occurrence in Kenya from 1990 to 2000 (UNDP, no date)

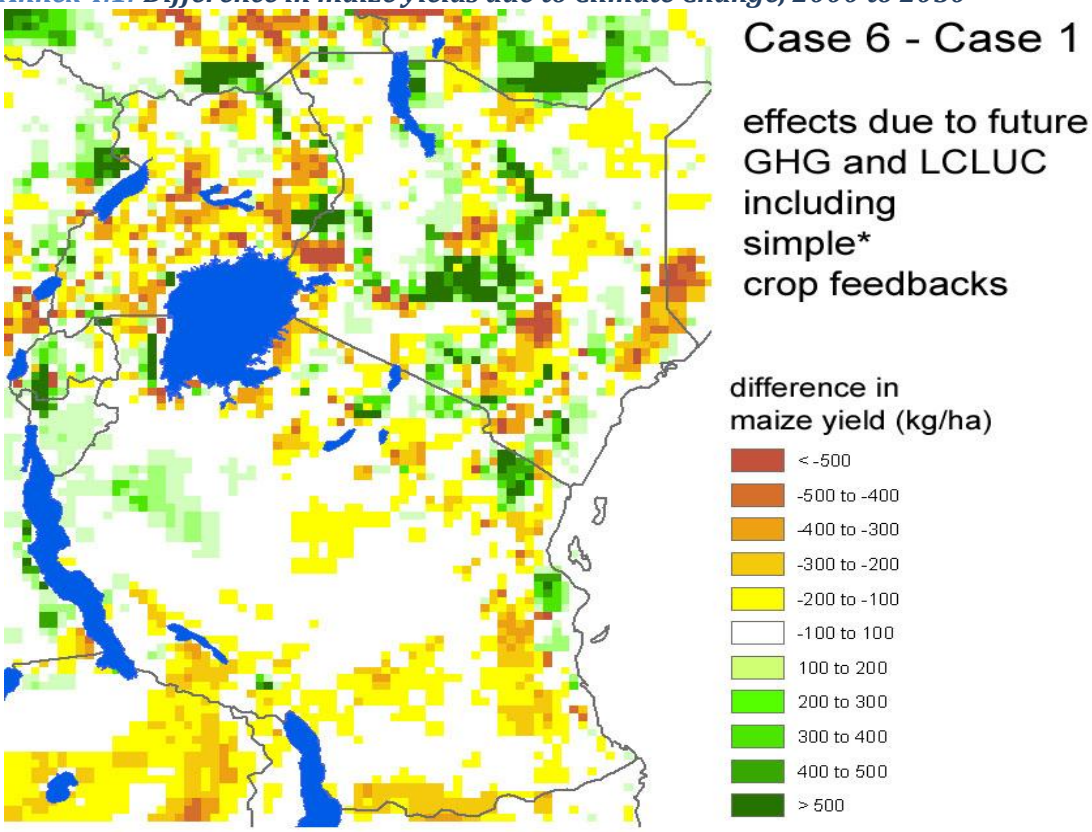
Year	Area Burnt (Ha)			Loss (K.Sh)	
	Plantation	Natural Forest	Bush and Grass	Suppression cost	Damage
1990	85	331	12,183	128,600	366,060
1991	1,705	236	6,697	456,420	2,996,340
1992	6,170	5,494	13,301	5,859,300	99,147,400
1993	1,731	515	1,718	500,820	11,901,420
1994	690	69	1,913	3,187,700	37,847,500
1995	-	-	-		-
1996	-	-	-	-	-
1997	4,726	2,961	7,729	47,727,733	51,979,918
1998	-	-	-	-	-
1999	1,449	317	2,041	24,878,790	28,606,232
2000	861.9	1,229	8,860.75	560,694	38,622,954

Annex 3.4 Areas affected by landslides in Kenya (UNDP, no date).

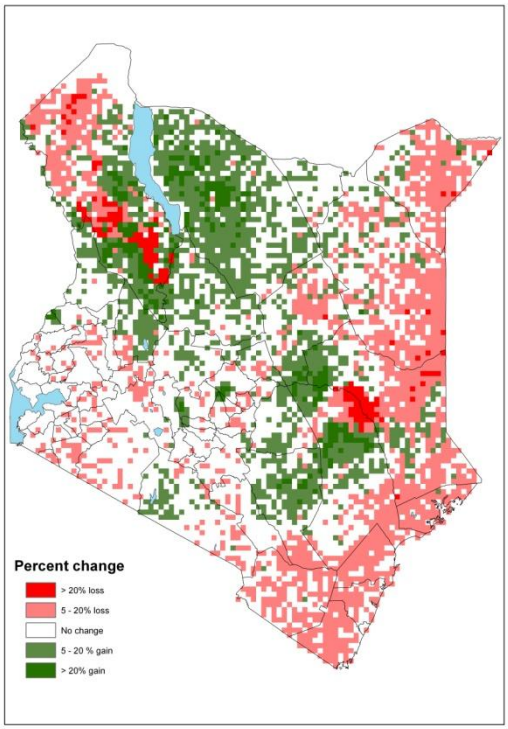
Areas Affected	Economic Activities	Population 1999	Population 2000
Muranga	Agriculture Horticulture Livestock	38,000	354,000
Kiambu	Agriculture Horticulture Livestock	743,000	801,000

Thika	Agriculture Horticulture Livestock	645,000	676,000
Maragua	Agriculture	388,000	405,000
Nyeri	Agriculture Cashcrop farming	660,000	692,000
Kirinyaga	Agriculture	457,000	489,000
Nyandarua	Agriculture	480,000	437,000

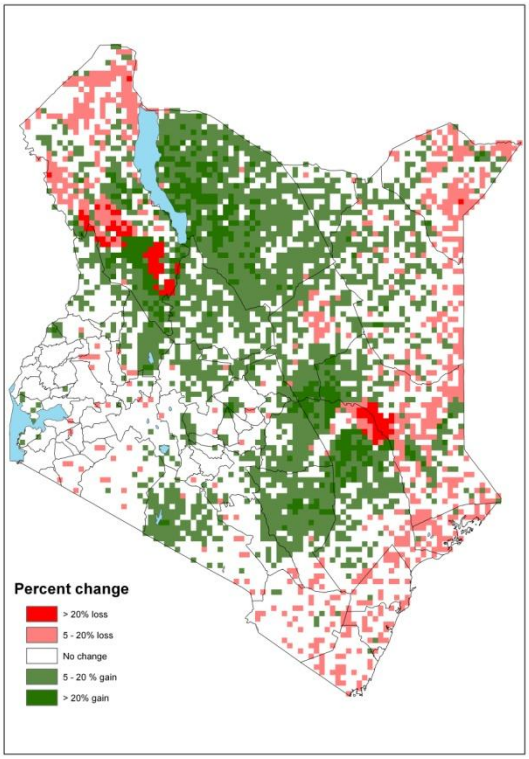
***Annex 4.1:* Difference in maize yields due to Climate Change, 2000 to 2050**



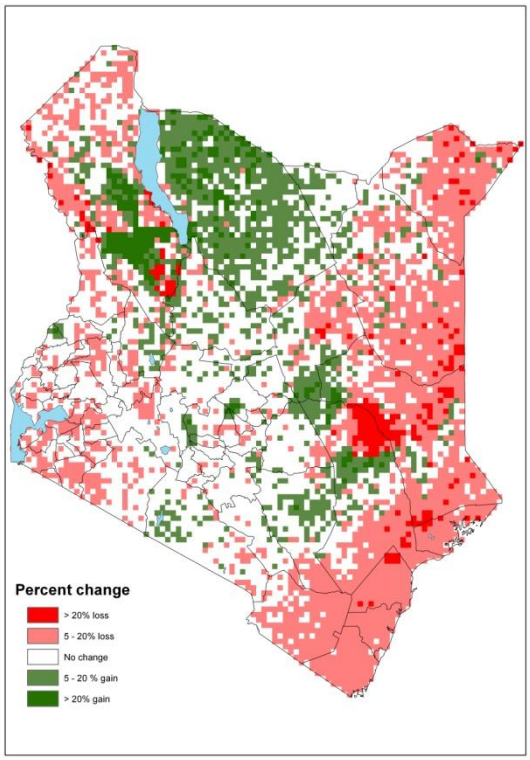
Annex 4.2 ***(a) Percent change in LGP (2000-2030)-ECA***



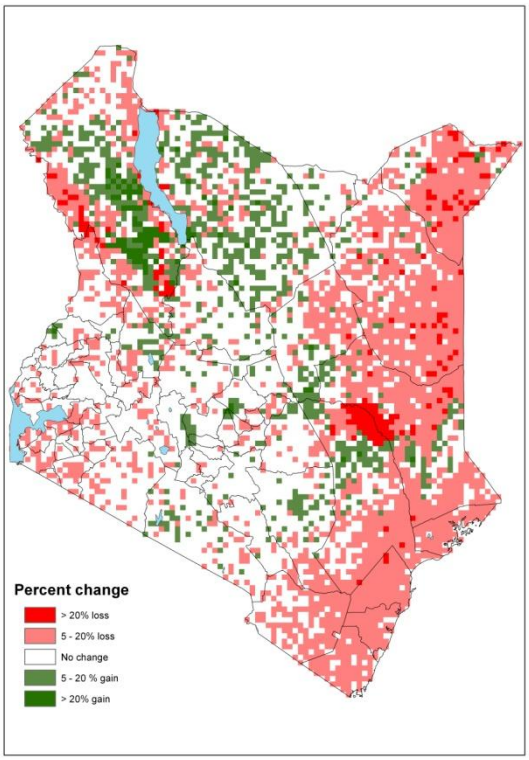
(b) Percent change in LGP (2000-2030)-ECB



(c) Percent change in LGP (2000-2030)-HDA

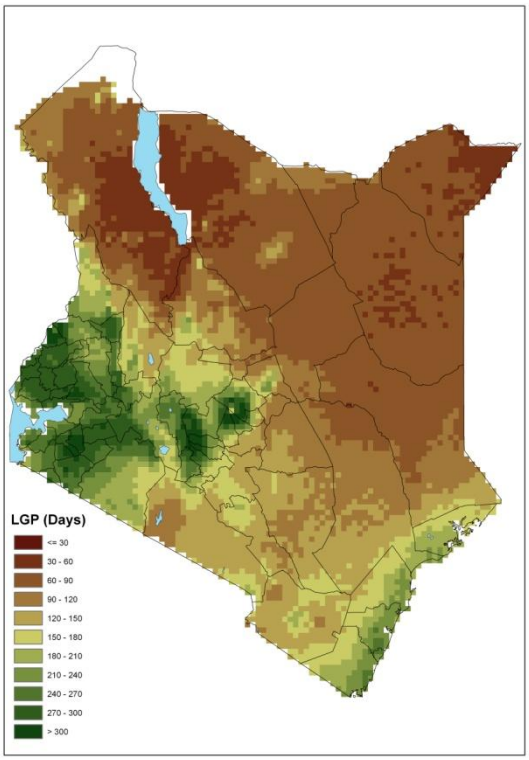


(d) Percent change in LGP (2000-2030)-HDB

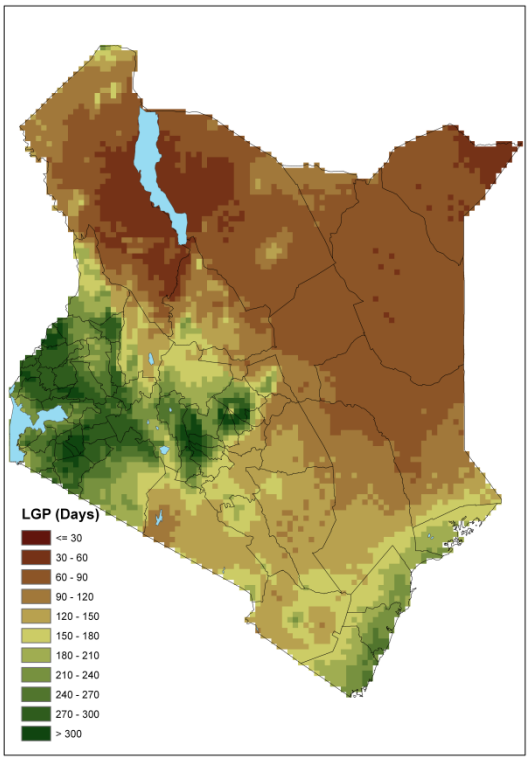


Annex 4.3

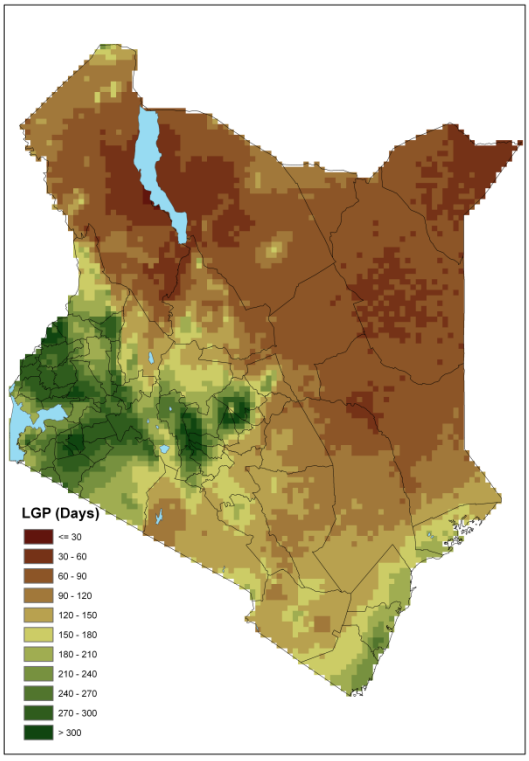
(a) LGP (Days) for 2030 - ECA



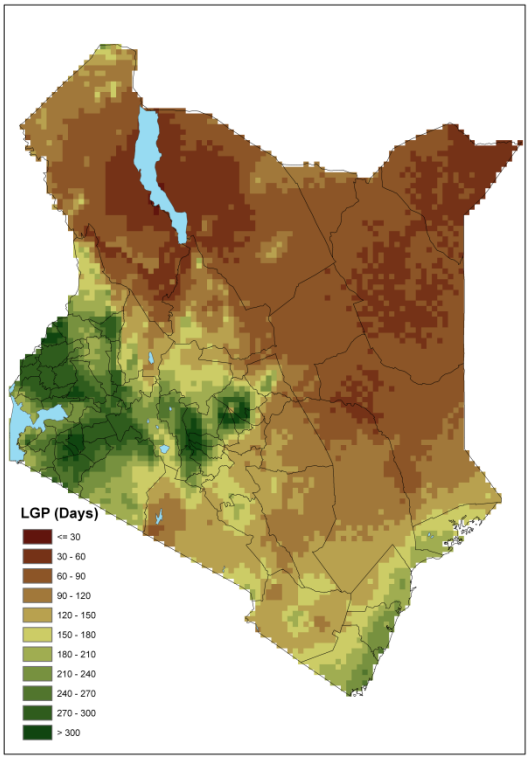
(b) LGP (Days) for 2030 - ECB



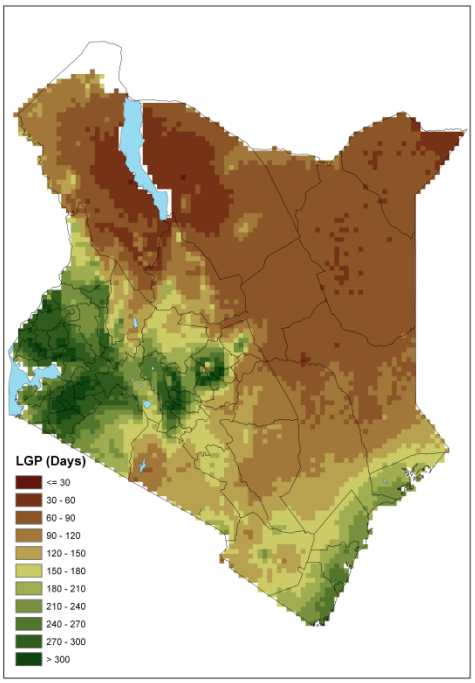
(C) LGP (Days) for 2030 - HDA



(d) LGP (Days) for 2030 - HDB



(e) LGP (Days) for 2000



Annex 5.4 *Some of the projects funded by donors, the implanting agencies and the activities (EU, 2006)*

Implementing Agency	**Sectors**	**Activities**
Ministry of Environment & Natural Resources (Directorate of Water Development)	Water and Sanitation	Community water service delivery Policy and Institutional Support Rehabilitation of water supply system and community capacity building
Ministry of water (National Water Conservation & Pipeline Corporation - NWCPC)	Water and Sanitation	Construction of dams for urban water supply Wetlands conservation to improve rural water supply and pastures in semi arid lands Education to improve water use and sanitation
National Museums of Kenya (NMK).	Natural Resources management – NRM Biodiversity	Improvement of biodiversity data management
Kenya wild life Services	Natural Resources management – NRM Biodiversity	Development of Management Plans for protected areas. (Lake Nakuru, Lake Naivasha, Lake Olbollosat, Saiwa Swamp, Nyando,Sdai and Fourteen Falls Research, training and monitoring of wetlands
Kenya Marine and Fisheries Research Institute	Natural Resources management – NRM Biodiversity	Research, monitoring and management of Lake Victoria and its catchment areas

		Conservation of resources of Tana River National Reserve Conservation of water in Rift Valley lakes of Kenya
Kenya Agricultural Research Institute	Agriculture	Agro- biodiversity Land Use planning
National Environmental Management Authority	Natural Resources management – NRM Environment	Development of adaptive management plans Wood fuel conservation to reduce land degradation
Kenya Forestry Service	Natural Resources management – NRM Forestry	Development of techniques for establishment of trees in ASAL areas Establishment of model farm Forests Training of extension agents Promote social forestry Management of Aberdare ecosystem and poverty eradication among the surrounding communities

Source: EU, 2006