

**REDUCING THE IMPACT OF  
ENVIRONMENTAL EMERGENCIES  
THROUGH EARLY WARNING AND  
PREPAREDNESS - THE CASE OF EL  
NIÑO-SOUTHERN OSCILLATION  
(ENSO)**

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**IMPACTS OF THE 1997-98 EL NIÑO EVENT IN  
KENYA**

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## **EXECUTIVE SUMMARY**

This project was carried out for the country Kenya, which lies between latitudes 5° North and 5° south and between longitudes 34° and 42° east. Kenya has land area of about 569,137 km<sup>2</sup>. It has a great diversity of landforms ranging from glaciated mountain peaks with permanent snow cover, through a flight of plateaus to the coastal plain. The country is split by the Great Rift valley into the Western part which slopes down into Lake Victoria from the Mau ranges and Mount Elgon (4,300m) and the Eastern part which is dominated by Mt. Kenya and the Aberdare ranges that rise to altitudes of 5,200m and 4,000m respectively.

The socio-economic problems experienced by Kenyans are varied including those arising from inequitable patterns of land ownership, high population growth rate, rural-urban migration of the population, poorly planned urbanization, deforestation, low level of literacy, and high levels of unemployment. Kenya's population growth rate is still one of the highest in the world at 2.6 %. This implies that the economy of the country has to support a large and growing number of young people. This has also created rural-urban migration that over-stretches the resources in the urban areas leading to a decrease in the standards of land management, infrastructure, water, sanitation and municipal services. The result has been a steady decline in health and environmental standards as well as increased vulnerability to human-made and natural disasters. Due to the population growth, there has been a noticeable rural-rural migration to the ASAL areas, affecting the

ecosystems of these regions and rendering them more vulnerable to disasters, such as drought and environmental degradation.

The above problems are coupled with high levels of poverty prevalent in all sections of Kenyan society. According to a 1994 Welfare Monitoring Survey, 48% of the rural population is food poor, while 47% of the rural population and 29% of the urban population were identified as absolute poor. A large number of the poor are living on either subsistence agriculture or employment in the urban informal sector. The recent El Niño (1997-98) and the heavy rains of 1999 showed that those most affected by these natural occurrences are the poorer sectors of the population living in slums and squatting along flood and landslide areas. Poverty also seriously affects their resilience to disasters given the constant challenges for survival that many face.

Kenya is characterized by its limited natural resources, especially water, minerals and agricultural land. This condition, coupled with the fragility of its ecosystems and vulnerability to increased pressure by human activities, raises critical environmental issues related to bio-diversity, deforestation, desertification, drought, floods and pollution. Forest resources and soil cover are being depleted due to the rapid increase in population and the demand for human settlements and agricultural land, grazing, sourcing of construction materials, food, fuel-wood, essential oils and herbal medicines.

These factors make Kenyans highly vulnerable to any major disruptive activities, for example, damages caused by natural hazards such as floods and droughts. The number of deaths and injuries to both human beings and animals, damages to infrastructure, disruption of public services, and economic losses from man-made and natural hazards are on the increase and present a threat to the socio-economic development of the country.

In order to reduce the impacts of these hazards, it is necessary to put in place measures to manage the hazards before and as they occur. To do this, an early warning system must be in place to create awareness of the impending disasters and hence enhance preparedness. A system should also be in place to deal with the effects of an ongoing hazard. This requires the setting up of disaster mitigation and emergency response facilities. The main objective of this assessment is to review forecasts and impacts of the 1997-98 El Niño, as well as the climate-related early warning and natural disaster preparedness systems in Kenya in order to improve its ENSO coping mechanisms. Based on this assessment, the project identifies research and policy needs and form a basis for developing preliminary guidelines for future regional and national natural disaster preparedness plans for ENSO warm and cold events and their impacts. Specifically, the project is aimed at forming the basis for:

- Identifying policy needs which can then be developed or incorporated into appropriate operational disaster management and research programs. This would include, but would not be limited to, those relating to the potential yet-to-be-identified linkages between ENSO and climate change.
- Developing a preliminary set of guidelines for national and regional preparedness for ENSO.
- Designing a capacity-building program for fellowship and training of mid-level resource and sector managers, post-graduate education, and outreach to the international academic and scientific community.

Through an improved understanding of early warning, the project ultimately contributes to the safety and welfare of people and the environment by enhancing preparedness for the impacts of future ENSO events.

In achieving the main objective, the project considered the effects of the 1997-98 El Niño phenomenon on various sectors of Kenya. The responses of Kenyans to the phenomenon were also studied. In particular, the project studied the water resources, agricultural, transport, human health and the socio-economic sectors.

The short rains, which normally occur during the months of October to December, were extremely magnified during the 1997-98 ENSO episode. The rains, which started as normal rains in October in most parts of the country, picked up to flooding levels during the beginning of November and continued at high levels into January the following year. They subsided slowly and ended by mid February 1998 in most parts of the country.

It was determined during the project that the Kenya Meteorological Department (KMD) issued a forecast for the 1997-98 El Niño event as early as July 1997. According to KMD, this forecast was sent to the Office of the President, Ministry of Agriculture, and the Ministry of Information, Transport and Communications, which are usually on their mailing list. The information was also sent to the Kenya Power and Lighting Company who normally use the monthly and seasonal rainfall forecasts for planning. This forecast was subsequently widely published through the electronic and print media. However, it was received with skepticism due to alleged earlier “wrong” forecasts from KMD. It was therefore not taken seriously and hence no mitigation nor emergency response procedures were put in place. In general, a sizable percentage of the Kenyan population were aware of the impending heavy rainfall in advance, but did very little to safeguard against their effects.

As the heavy rains hit the country and continued into December 1997, almost everybody realized that the warnings from KMD were real and immediately thereafter, almost anything that happened to the water resources in the country was attributed to the El Niño. The interest and awareness of El Niño was enhanced when its devastating impacts were seen throughout the country. The various articles and presentations on the print and electronic media created more interest and awareness on the subject. Due to its uniqueness, intensity and destructive power, the 1997-98 El Niño event was an intriguing phenomenon to many in the country, even to those who are involved in the ENSO research. It was therefore not surprising that the 1997-98 El Niño was blamed for almost all the problems, that individuals, groups and the Kenyan population as a whole were facing, be they the worsening national economy, social ills and diseases, retarded national development or even domestic hardships. The resultant floods had wide-ranging positive and negative impacts on various sectors of the national economy. The sectors identified to have been seriously affected were agriculture, water resources, transport and communications and health.

### ***Water resources sector***

The water resources sector was both negatively and positively affected by the 1997-98 El Niño event. The negative impacts included widespread flooding that led to the destruction of property in several sections of the country, increased soil erosion in areas with poor land use and management practices, and increased frequency of mud/landslides especially in the sloping areas. Other negative impacts included surface and ground water pollution, destruction of small storage

earth dams, and the increased sedimentation and siltation in the rivers and streams that led to the sedimentation and siltation of the major water storage reservoirs. The general cost of these negative impacts amounted to about USD 9 million. However, this sector also benefited from the excess rainfall during this period. Pollution loads were reduced through the washout effect of the rainfall, soil water for agricultural production was enhanced, and the water reservoirs were adequately recharged boosting the levels of the hydroelectric dams.

### ***Agriculture sector***

The agricultural sector was also negatively and positively affected by the phenomenon. The abundance of rainfall resulted in increased plant and animal diseases that affected the livestock and crop production in several regions in the country. The flooding also affected the farms through water logging leading to further reduction in yields, and destruction of livestock water facilities. Several cases of deaths of animals through drowning were also reported. The estimated combined loss suffered by this sector reached USD 236 million.

However, in the arid and semi-arid areas the rains were a welcome relief from the perennial drought situation leading to development of good pasture and the resultant improved livestock performance. Agricultural production in some areas increased due to the enhanced availability of moisture for the crops. The rains enhanced and prolonged the time of moisture availability for the biological soil and water conservation structures to take up. Tree planting and survival rates were generally increased by nearly 100 percent.

### ***Transport and communications sector***

The El Niño rains devastated the transport sector. The accompanying floods and landslides wreaked havoc on the roads and transport system throughout the country. Several bridges and an estimated 100,000 km of both rural and urban roads were destroyed leading to a general paralysis of the transport system in most parts of the country. The estimated cost of these damages was about USD 670 million. The aviation and shipping industries were also disrupted through the flooding of the facilities. Scheduled and chartered flights were disrupted due to poor visibility and the submergence of the navigation equipment and runways by floodwaters. The docking facilities at the shipping ports were also submerged in floodwaters making it impossible to offload merchandise from the ships. Telecommunications were severely affected by falling trees that destroyed the communication cables. The underground cable channels were also flooded causing a disruption in the services. Interruptions of electrical energy supply were experienced as some equipment was destroyed by floodwaters, falling trees and collapsing buildings. However, a positive effect of the event was experienced by the energy sector in the complete recharging of the hydroelectric dams and hence the enhancement of the production of electricity.

### ***Health sector***

The El Niño event greatly affected the health sector. Over 300,000 families were adversely affected by the phenomenon. The country's health resources were stretched beyond manageable levels. Several health facilities were physically destroyed, water sources were contaminated, and there were increases in the number of stagnant water ponds, overgrowth around homesteads and market centers, blockage of sewers and open drains, and fly breeding due to decomposition of

refuse. These factors lead to an upsurge of disease epidemics and an increase in the morbidity and mortality rates.

## **Socioeconomic Impacts**

All the above impacts directly or indirectly affected the socio-economic well being of Kenyan society. Education sector was hit, with schools being inaccessible due to flooding, leading to closures or low attendance rates. The end-of-year examinations were adversely interfered with. Businesses were seriously affected through transport and energy disruptions. The political general elections, scheduled for end of 1997, were affected and the period extended due to the problems in the transport sector. The heavy rains experienced also adversely interfered with social functions, such as weddings, funerals and church services, during this period.

Considering the impacts of the 1997-98 El Niño event on various sectors of Kenya, it is evident that Kenyans were not adequately prepared and had no facilities in place to cushion the adverse impacts. Although the forecast was out in July 1997, no mitigation or emergency procedures were put in place. Due to the low frequency of widespread flooding problems in the country, the Government of Kenya had neither a flood disaster management policy nor the institutional framework to monitor and manage flood disasters prior to the 1997-98 El Niño floods. The only disaster management institution that was in operation during the early periods of the 1997-98 El Niño floods, was The National Famine Relief Program, whose mandate is almost exclusively related to the monitoring and management of negative impacts of droughts. This program was not well equipped to manage the impacts of heavy rains. Further, an attempt by the government to mitigate the effects of the negative impacts of the 1997-98 El Niño floods was hampered by the diversity of the impacts, which could not, therefore, be handled by any one government Ministry in isolation.

However, after the effects of the rains started being felt, the government acted by setting up a National Disaster Operation Center to oversee and coordinate all efforts put into addressing the serious impacts. It also embarked on a public awareness creation campaign through the electronic and print media and declared the floods a national disaster. Despite the limitations of the existing economic and financial constraints, the government spent large amounts of money to purchase and transport emergency food, water treatment chemicals and medical supplies to the worst affected communities. It also approached donor countries and agencies to help defray the costs of rehabilitation and emergency operations.

The media played an important role during the 1997-98 El Niño event by publishing, on a daily basis, stories related to the effects of the event. It raised the awareness of the common man as well as that of the policy makers. The private companies responded to the emergencies by pooling their resources and participating in the rehabilitation of the infrastructure around them. They resorted to the use of diesel-generated power in cases where there were power interruptions and hence maintained some production levels.

From the devastating impacts of the 1997-98 El Niño event, several lessons were learned. The scientific community, which is involved with research on the ENSO phenomenon and rainfall characteristics in the region, has learned that the warming (or cooling) of the Indian as well as Pacific Oceans adversely affects the rainfall patterns in Kenya considerably. However, research has not as yet revealed clearly the quantitative association between ENSO and the rainfall in this

region. A lot of effort is therefore being made to understand the frequency and occurrence of extreme rainfall events, and how these are related to the ENSO phenomenon. Several research papers have been produced on this phenomenon furthering our knowledge on it. The relationship between the El Niño and the rainfall over Kenya is now relatively better understood, leading to better rainfall forecasts.

The 1997-98 El Niño event hit the country when the government had no plans or policies in place to deal with the associated flood hazards. The country had neither a national plan nor policy for responding to flood disasters that can impact negatively on national economic sectors. The government has learned that such a plan or policy should be developed or added to either the National Disaster Plans or the National Water Policy, with clear flood warning and management mechanisms.

In addition, there are many uncoordinated efforts among different Early Warning Units in various Departments/Ministries such as Kenya Meteorological Department (KMD), Central Bureau of Statistics (CBS), Department of Resource Survey and Remote Sensing (DRSRS), and Arid Lands Resource Management Project (office of the President), among others. It has therefore been proposed that coordination among such Departments/ Ministries be strengthened and an early warning unit be established and be well equipped to enable it effectively monitor the situation on the ground and collect reliable data which would enable the Ministries to respond appropriately to disaster in the sector.

Other lessons learned include:

- The weather forecast should, if possible, be for longer periods than 3 months for effective control measures to be put in place.
- The storm drainage systems in the urban areas should be maintained and serviced regularly.
- The government should educate the public through active awareness campaigns regarding disasters, well in advance.
- The Kenya Meteorological Department weather forecasts should be as accurate as possible.
- The settlement of potential disaster areas, especially those settlements in the flood plains, should be discouraged through a clear government policy.
- In the future the planners should always incorporate climate and weather information in their planning activities.
- The government should institute a policy or plan that supports flood prevention through integrated watershed development programs in eroded mountainous regions and also support the design and management of strategic food security reserves.
- There is need to find a lasting solution to future disasters through intervention by capacity building for early warning and disaster preparedness.

## **1. KENYA'S SOCIO-ECONOMIC SETTING**

### ***1.1 Physical location***

Kenya is located on the Equator and is bisected by the Western side of the Great Rift Valley. The country lies between latitudes 5° North and 5° south and between longitudes 34° and 42° east. The land area of Kenya is about 569,137 km<sup>2</sup>, with a great diversity of landforms ranging from glaciated mountain peaks with permanent snow cover, through a flight of plateaus to the coastal plain. The country is split by the Great Rift Valley into the Western part, which slopes down into Lake Victoria from the Mau ranges and Mount Elgon (4,300m) and the eastern part dominated by Mt. Kenya and the Aberdare ranges which rise to altitudes of 5,200m and 4,000m respectively.

### ***1.2 Socio-Economic Setting***

Kenya has continued to experience socio-economic pressures such as inequitable patterns of land ownership, a high population growth rate, rural-urban migration of the population, poorly planned urbanization, deforestation, a low level of literacy, low growth of domestic product and high levels of unemployment. Economic performance has deteriorated over recent years with the Gross Domestic Product (GDP) growth rate falling from 4.8% in 1995 to 1.8% in 1998.

The Government has adopted long, medium and short-term policies to reverse these trends. The long-term policy framework is contained in the Sessional Paper No.2 of 1996 on Industrial Transformation by the year 2020 and the National Poverty Eradication Plan 1999-2015. The former presents policies that will lay the foundation for transforming Kenya into a Newly Industrialized Country (NIC) by the year 2020. The latter provides a national policy and institutional framework for action against poverty.

The medium-term policy framework is contained in the eighth National Development Plan 1997-2001. It focuses on raising economic growth and investment levels, promoting export-oriented industries and restructuring the role of government to focus on providing an enabling environment for economic growth. Kenya's short-term policy framework is outlined in Policy Framework Papers (PFP) and annual budget statements.

### ***1.3 Population Growth***

The population of Kenya is projected to increase to 33.3 million by 2003 and 34.6 million by 2005. The projections assume a moderate decline in fertility and death rates, and also take into account the AIDS epidemic (Okeyo, et al., 1999). Despite a remarkable decrease over the past decade, Kenya's annual population growth rate is still one of the highest in the world at 2.6 %. This has three major implications. Firstly, over 50% of the population is less than 15 years of age, which means that the economy has to support a large and growing number of young people. Secondly, population growth rates in densely populated regions have led to rural-urban migration. This has over-stretched resources in the urban areas. Decreasing standards of land management, infrastructure, water and sanitation and municipal services have led to a steady decline on health and environmental standards as well as an increased vulnerability to human-made and natural disasters. Thirdly, there has also been a noticeable rural-rural migration to the ASAL areas,



affecting the ecosystem of these regions and rendering them more vulnerable to disasters such as drought and environmental degradation.

#### ***1.4 Poverty***

The impact of disasters on the population is greatly influenced by the incidence of poverty. The ability to cope with disasters or the level of a community's disaster management capacity can be greatly limited by the incidence of poverty in the community.

According to the 1994 Welfare Monitoring Survey (WMS II) results, 48% of the rural population is food poor (NPEP, 1999-2015). Equally, in the same report, 47% of the rural population and 29% of the urban population were identified as absolute poor. A large number of the poor are living on either subsistence agriculture or employment in the urban informal sector. The condition of poverty is illustrated by factors such as large families, lack of productive skills, low levels of education, ill health, high incidence of AIDS and other disabilities and changes in social structures leading to the breakdown of facilities and support systems. These factors radically increase the vulnerability of the poor to natural hazards and human-made disasters. The recent El Niño (1997-1998) and the heavy rains of 1999 show that those most affected by these natural occurrences are the poorer sectors of the population living in slums and squatting along flood and landslide areas. Poverty also seriously affects their resilience to disasters given the constant challenge for survival, which many face.

One-third of the rural households are female headed, with as many as 60% of these having no male support. Female-headed households are especially vulnerable due to external factors such as the discriminatory access to the tenure of land in rural areas, housing in urbanized areas and their inability to access the job market on favorable conditions.

#### ***1.5 Urbanization***

The rate of urbanization in Kenya is one of the highest in the world. While the estimated annual rate of growth of the urban population in Kenya is at 7.05% for the period of 1995-2000, the average for African cities is 4.37% and 2.57% for the world. This has over-stretched the capacity of infrastructure and services in the large towns, to the extent that large sectors of the population have to squat or live in slums, exposing themselves to numerous hazards such as floods, fires and epidemics. More than half of the urban residents live in poverty. They dwell in peripheral urban areas, have limited incomes, education, and poor diets and live in unsanitary and overcrowded conditions. Safe drinking water, the disposal of solid waste, decent housing and transportation are particularly lacking. Urban residents are exposed to increased levels of contamination from factories where environmental protection is minimal. Poor construction and the unplanned nature of these informal settlements expose dwellers to the effects of landslides and flooding.

#### ***1.6 Natural Resources and the Environment***

Kenya is characterized by its limited natural resources especially for water, minerals and agricultural land. This condition, associated to the fragility of its ecosystems and vulnerability to increased pressure by human activities, raises critical environmental issues related to bio-diversity,

deforestation, desertification, drought, floods and pollution. Forest resources and soil cover are being depleted due to the rapid increase in population and the demand for human settlements and agricultural land, grazing, sourcing of construction materials, food, fuel-wood, essential oils and herbal medicines.

### **1.7 About this study**

The UN Environmental Programme (UNEP) in cooperation with the National Center for Atmospheric Research (NCAR) in Boulder Colorado, USA, was awarded a grant by the United Nations Fund for International Partnerships (UNFIP) to carry out a 19-month study on the impacts of the 1997-98 El Niño event on sixteen countries in four major areas. These areas included Asia, Southeast Asia, sub-Saharan Africa, and Latin America. These countries are Peru, Fiji, Costa Rica, Cuba, Vietnam, China, Indonesia, Ecuador, Papua New Guinea, Philippines, Paraguay, Panama Canal, Ethiopia, Mozambique, Ecuador, and Kenya.

The study runs from May 15, 1999 to December 15, 2000. This study is a partnership among United Nations agencies. In addition to UNEP and NCAR's Environmental and Societal Impacts Group there are the World Meteorological Organization's World Climate Program (WMO), The International Decade for Natural Disaster Reduction (IDNDR – now the International Strategy for Disaster Reduction: ISDR), and the United Nations University's Environment and Sustainable Development Programme.

This assessment will review forecasts and impacts of the 1997-98 El Niño, as well as the climate-related early warning and natural disaster preparedness systems in the selected countries in order to improve their ENSO coping mechanisms. Based on this assessment, the project will identify research and policy needs and develop preliminary guidelines for regional and national natural disaster preparedness plans for ENSO warm and cold events and their impacts.

#### **The review and assessment will form the basis for:**

- Identifying policy needs which can then be developed or incorporated into appropriate operational disaster management and research programs. This would include, but would not be limited to, those relating to the potential yet-to-be-identified linkages between ENSO and climate change.
- Developing a preliminary set of guidelines for national and regional preparedness for ENSO.
- Designing a capacity-building program for fellowship and training of mid-level resource and sector managers, post-graduate education, and outreach to the international academic and scientific community.

Through an improved understanding of early warning, the project ultimately contributes to the safety and welfare of people and the environment by enhancing preparedness for the impacts of future ENSO events.

This review and assessment study in Kenya, was carried out between the months of September 1999 and February 2000. Data and reports from Government Ministries and especially from the National Disaster Co-ordination Center, related to the 1997-98 El Niño were available to the

working Group. A national workshop was held on February 4<sup>th</sup>, 2000 where members of the technical working group presented their findings. Representatives from the various Government Ministries and Non-Governmental Organizations (NGOs) were invited to this workshop. Their contributions and suggestions have, as much as possible, been taken into consideration in this final report.

## 2 THE EL NIÑO PHENOMENON

### 2.1 Introduction

“El Niño” is the term used to refer to an oceanographic phenomenon in which there is extensive warming of the upper ocean in the tropical eastern Pacific lasting three or more seasons accompanied by changes in the atmospheric pressure over the western and central regions of the Pacific Ocean. These changes in the atmospheric pressure alternate periodically and are referred to as the Southern Oscillation (SO). El Niño and Southern Oscillation are related events and are normally referred to as ENSO. An El Niño event results from interaction between the surface layers of the ocean and the overlying atmosphere in the tropical Pacific. The ENSO system oscillates between warm (El Niño), and the cold (La Nina) phases, within a period ranging between 3 to 5 years.

Several El Niño events have been recorded in the past. Whilst these events share some similar characteristics, every one is somewhat different in magnitude, duration, and the resulting global climatic impacts. Wetter than normal conditions are usually observed during warm episodes, while drier than normal conditions are experienced during cold episodes in Kenya. El Niño events effectively disrupt normal seasonal patterns. Recent Strong El Niño events include those of 1957/58, 1965/66, 1972/73, 1982-83, 1986/87, 1991/92 and 1997-98. Figure 2.1 shows the temporal patterns of both the El Niño/La Nina and the weighted monthly rainfall in some parts of Kenya.

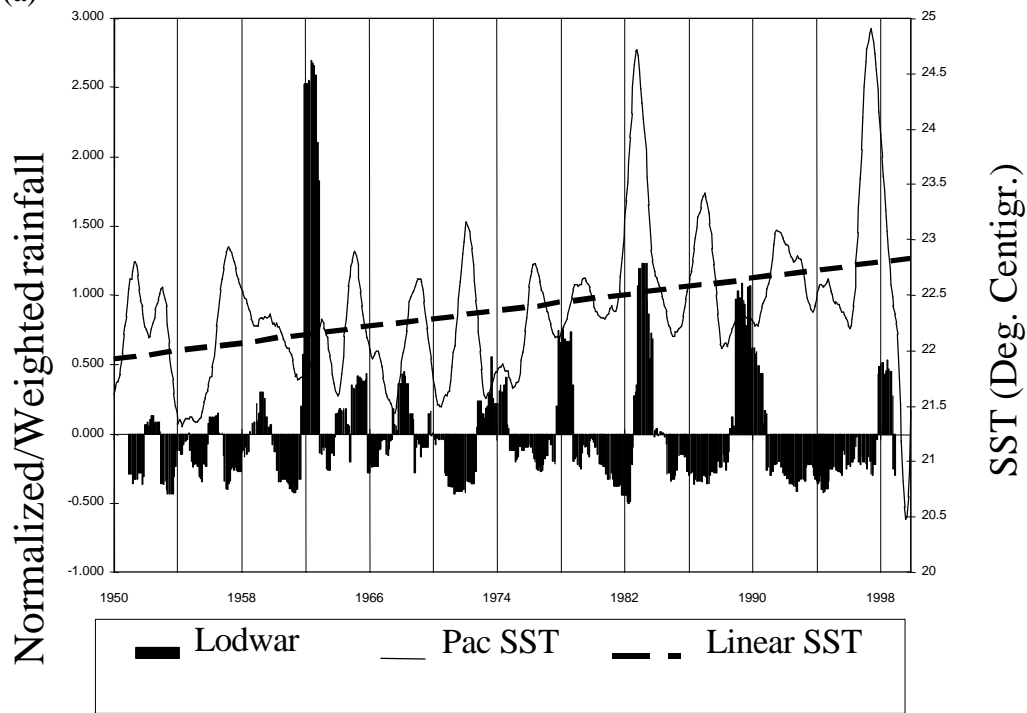
Undoubtedly, the ENSO phenomenon has a strong influence on rainfall over Kenya. The El Niño, the warm phase of ENSO, tends to enhance rainfall over most parts of the country, while La Niña, the cold phase, tends to suppress rainfall over the country. However, neither all parts of the country nor all the seasons have the same response to ENSO events. The season with the highest relationships, and hence the best predictability, is the October to December short rains, which are enhanced by the El Niño phenomenon and depressed by La Niña conditions. The “Long Rains” of March to May have the weakest association with the ENSO phenomenon. However, the nature of evolution and the response of the neighboring Atlantic and Indian Oceans are crucial to determine the degree of enhancement or suppression.

Generally, the phenomenon tends to enhance rainfall over the eastern parts of Kenya more than it does the other parts of the country. The response of the eastern parts of the country is associated with the warming of the Indian Ocean, which may in turn be associated with more moisture influx into these areas. On the other hand, La Niña tends to cool the Equatorial Indian Ocean leading to reduced moisture influx. Consequently, La Niña tends to depress rainfall over the eastern parts than for the western areas.

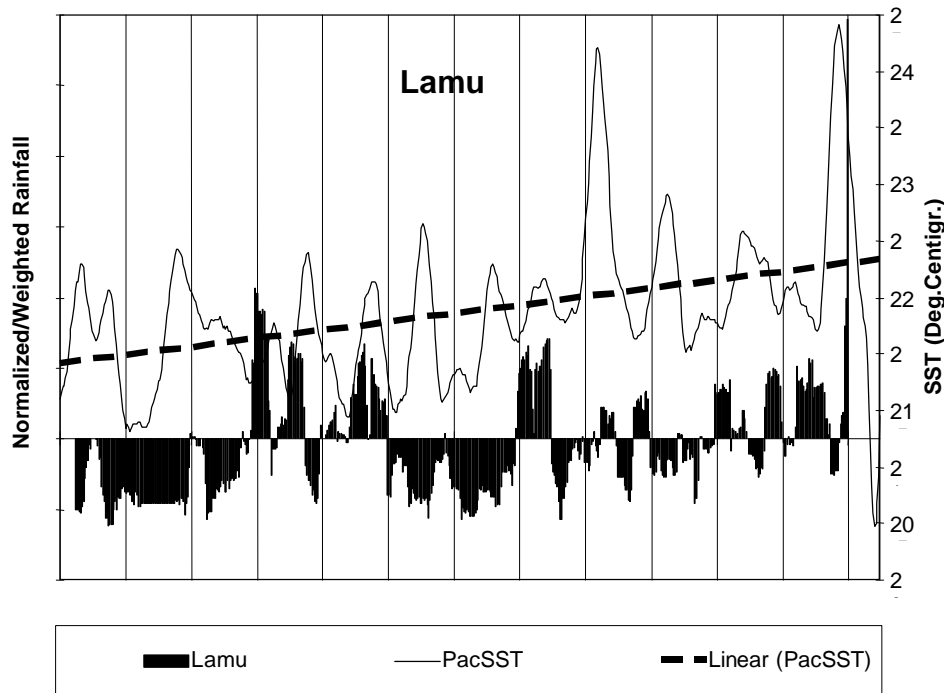
**Figure 2.1:** The Normalized and Weighted Monthly Rainfall with the corresponding El Niño Patterns for Lodwar (a), Lamu (b), Kisumu (c) and Narok (d) stations in Kenya. The figure shows the temporal patterns of the

central Pacific Ocean SSTs (PacSST). The El Niño episodes coincide, roughly, with the above normal PacSSTs (positive spikes above the LinearSST curve), while the La Niña episodes coincide with the below normal PacSSTs.

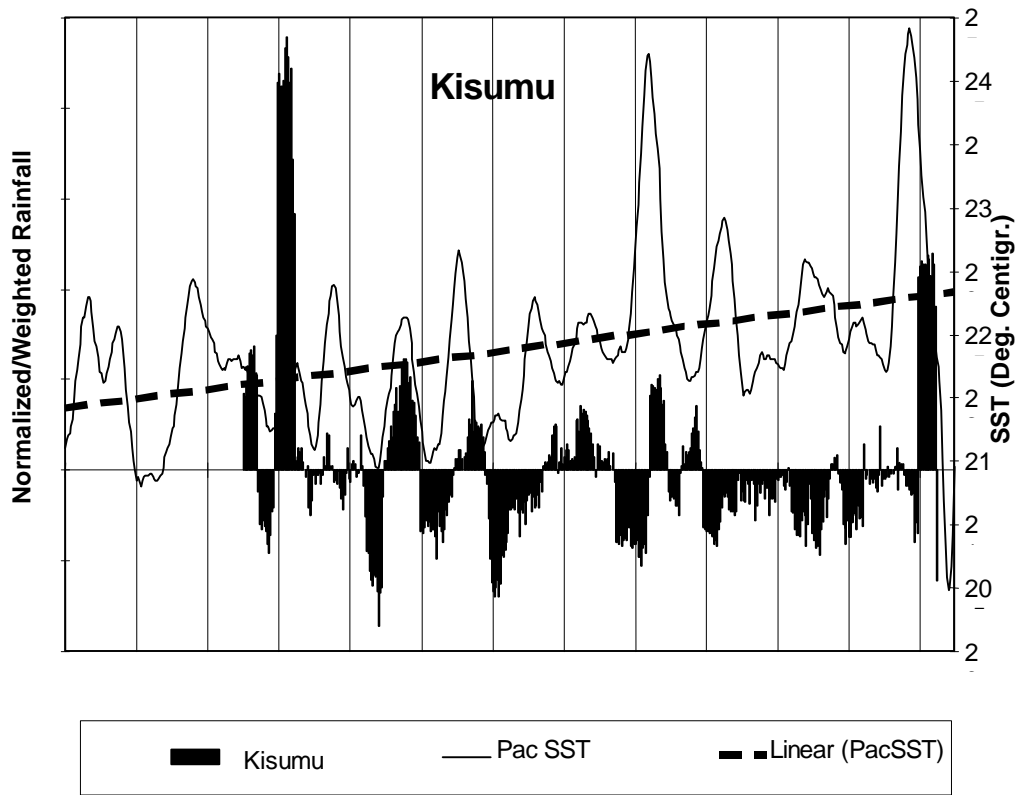
(a)



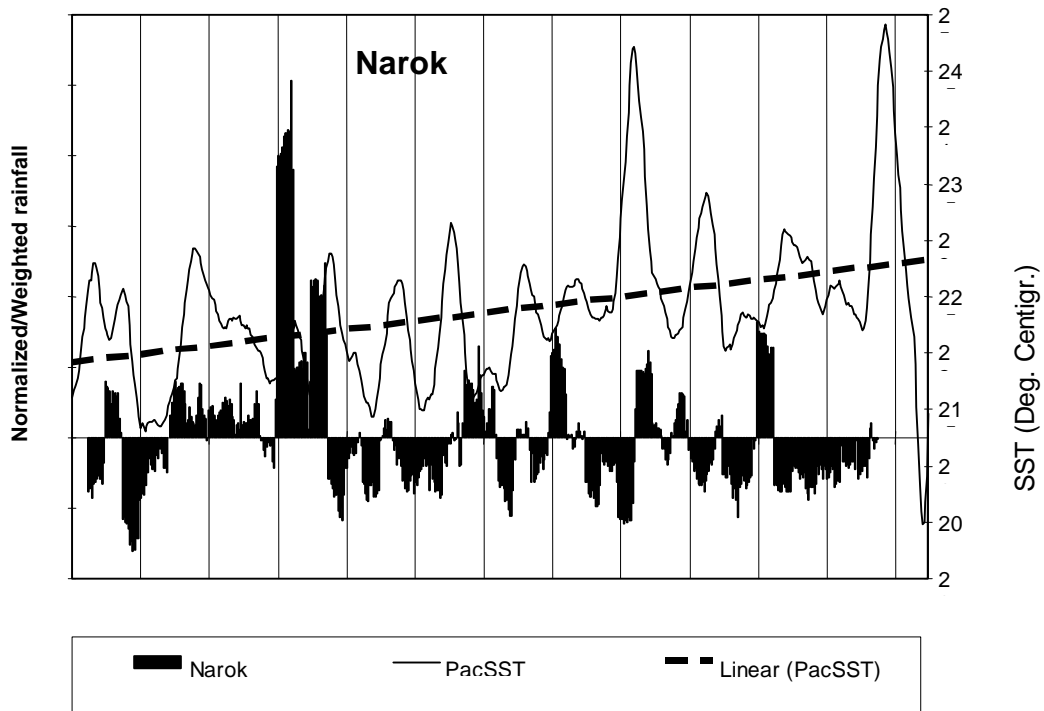
(b)



(c)



(d)





November and continued at high levels into January the following year. The rains thereafter subsided slowly and ended by mid February 1998 in most parts of the country.

During the period January to September 1997, the rainfall received over most parts of the country was below normal, although there were a few pockets in the country, which received normal and enhanced rainfall. The fifteen homogeneous zones, in Kenya, shown on figure 2.2 and described earlier in section 2.1 were affected in different ways as explained below.

In October 1997 zones 1, 2, 3, 4, 5, 6, 7 and 9 received 3 to 12 times of the expected rainfall. In November 1997, zones 1, 2, 3, 4, 5, 6 and 7 received 3 to 10 times of the expected rainfall. Most parts of the country received more than 100% of the expected rainfall.

In December 1997, zones 2, 3, 4, 5, 6 and 7 continued to receive three to ten times the expected long-term means. There was a marked increase over zones 12, 13, 14 and 15 located over Mt Kenya and western areas of the country. Zones 2, 3, 4, 5, 6 and 7 were the most hit by flooding (GOK/UNDP, 1998 - Food Emergency Assessment Report, 1998). Landslides associated with excess water and raised water table affected zone 12. Zone 13 experienced flooding related to the swelling of Lake Victoria and the River Nzoia.

In January 1998, zones 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11 received five to over ten times the monthly long-term mean rainfall. Generally most locations received more than twice the respective long-term means.

In the month of February 1998 rainfall was more enhanced in zone 6, 7, 8, 9, 10, 11 and 12. Most locations received more than four times the long-term mean. All locations, however, received above normal rainfall.

The month of March 1998 indicated a marked decrease in the percentage of rainfall received. However, all parts of the country realized normal to above normal rainfall. The decline in March 1998 was sustained in April and May. The enhanced rainfall in October 1997 to April 1998 was followed with a marked rainfall decline in the period October – December 1998 when most locations received less than 50% of long-term mean. The most depressed areas were zones 1, 2, 3, 4, 8, 10 and 13.

During the period January 1996 to December 1998 the rainfall in zone 4, as represented by Wajir Meteorological Station, was characterized mainly by rainfall deficits up to January 1998 when El Niño associated rainfall was able to offset the deficits and create excess. The excess was, however, cancelled by the deficits in March-May and October-December 1998. Similar patterns are observed for zones 5, 6, 7 and 9. Zones 4, 5 and 6 were severely hit by floods and by December 1997, most land had been flooded and there was no road access. Zones 7 and 9 had bridges and roads damaged by the third week of December 1997. The areas that faced severe flooding were also hit by contamination of wells and watering points. Such contamination led to outbreaks of water related diseases such as cholera and malaria. Zone 13, however, rarely realizes water stress. Any decline in a few months is quickly offset in the following months.

Table 2.1 below gives a comparison between the extent of the influence of the 1982-83 and 1997-98 El Niño events on the October-November-December (OND) rainfall season, which is most affected by the El Niño phenomenon, in some parts of the country. In 1982, the OND rainfall was

only slightly enhanced. Most locations received two times or less than their respective long-term means. In 1997 the rainfall over most parts of the country was very enhanced as compared to 1982. The areas with very marked differences were Zone 4 (Wajir), Zone 3 (Mandera) and Zone 7 (Mombasa). The marked difference in rainfall amounts translates to the difference in climate impacts associated with the 1982-83 and 1997-98 El Niño events.

**Table 2.1: A Comparison Between the Extent of the Influence of the 1982-83 and 1997-98 El Niño Events**

<b><u>Station</u></b>	1982-83	1997-98
<b>Moyale (2)</b>	1.2	5.0
<b>Voi (9)</b>	2.3	1.3
<b>Mombasa (7)</b>	1.0	5.0
<b>Lamu (6)</b>	0.4	2.5
<b>Makindu (10)</b>	2.0	0.5
<b>Wajir (4)</b>	1.5	4.5
<b>Mandera (3)</b>	2.0	8.2

In general rainfall was more enhanced in 1997-98 than in 1982-83 except for a few locations. The suffering associated with El Niño impacts was hence less severe in 1982-83 than was experienced in 1997-98.

### ***2.3 Forecast of the 1997-98 El Niño Event***

The National Meteorological Service (Kenya Meteorological Department - KMD), in the Ministry of Transport and Communications forecast the heavy rainfall associated with the 1997-98 El Niño as early as July 1997. According to KMD, this forecast was sent to various Ministries for use in planning and decision making. The Ministries, which received this forecast included the Office of the President, Ministry of Agriculture, Ministry of Information, and the Ministry of Transport and Communications, which are usually on their mailing list. The information was also sent to the Kenya Power and Lighting Company who use the KMD's monthly and seasonal forecasts for planning. These agencies are the ones, which are most impacted on by climate anomalies and therefore benefit greatly from these forecasts.

It was, however, not until September that the interest in El Niño was enhanced, following a report in the media (*The East African Standard* of 9 September 1997) that an El Niño was imminent. Strangely, this report was not based on the KMD forecast but was attributed to the Southern Africa Climate Forum held in Zimbabwe in July/August 1997. Nevertheless, this newspaper report led to some institutions getting in touch with KMD so as to get a forecast. Even those institutions that had been provided with the information requested a fresh forecast. As the period progressed, the KMD recorded various articles and programs, which appeared in the print media and the electronic media to create more awareness and to advice the public to use the rains



productively and safely. As the rains started to cause suffering to people in the eastern parts of the country, more interest developed and the general public and various private and government institutions were in constant contact with KMD to establish when the rains would come to an end. The Department participated in various committees instituted by the government to address El Niño-related issues.

#### **2.4 *Attributions***

As the heavy rains hit the country and continued into December 1997, almost everybody realized that the warnings from KMD were real and immediately thereafter, almost anything that happened to the water resources in the country was attributed to the El Niño. It was common understanding (although wrong!) that this phenomenon occurs rarely, but when it does, it causes very heavy rains throughout the country.

It is noteworthy that, before the 1997-98 El Niño forecast and impact, the phenomenon was only a subject for scientists engaged in understanding the influence of the phenomenon on rainfall variability over the country. The interest in and awareness of El Niño was enhanced when its devastating impacts were seen throughout the country. The various articles and presentations in the print and electronic media created such interest and awareness. It is important to mention that following the 1997-98 rains El Niño became a household word. The word could be seen printed on commercial vehicles and casual clothes. The name was also used liberally in most casual conversations. Due to its uniqueness, intensity and destructive power, the 1997-98 El Niño event was an intriguing phenomenon to many in the country, even to those who are involved in the ENSO research. It was therefore not surprising that the 1997-98 El Niño was blamed for almost all the problems, that individuals, groups and the Kenyan population as a whole were facing, be they the worsening national economy, social ills and diseases, retarded national development or even domestic hardships. This blame was made even stronger in the face of the fact that the government kept quiet about most of the disturbing issues at that time.

In reality, most of the attributes of the 1997-98 El Niño event in the country were true. However, some of the negative impacts of the extended and heavy 'short rains' of 1997 are attributable to poor design, planning and management of the major sectors in the country.

#### **2.5 *Impacts of the 1997-98 El Niño Floods***

The government of Kenya often has to cope with various forms of disasters. The most common and recurrent have been persistent meteorological droughts, which often have negative impacts on the sources of livelihood of a significant proportion of the country's population. The other types of natural disasters, though not as common, are also experienced in various parts of the country. The severity of the impacts of natural disasters in Kenya in the order of national ranking is as follows:

1. Drought
2. Floods
3. Lightening/storms and hailstorms
4. Disease epidemics
5. Environmental degradation

6. Earthquakes
7. Pest infestation, conflicts, fire and livestock diseases

Flood disaster is not common in Kenya, though a few areas in the country are prone to frequent flooding mainly because of their location in the flood plains. The most important areas, which are most frequently affected by floods, are the low lands of Nzoia River as it meanders into Lake Victoria and the Kano plains where the Nyando River also meanders into Lake Victoria. Most of the flooding in these areas results from the high runoff originating from the western highlands' intense precipitation. Floods also have significant impacts near the Athi/Galana River just before it flows into the Indian Ocean near the town of Malindi where the river is locally known as the Sabaki. Other areas prone to flooding are the urban areas of some major towns like Nairobi, where mainly poor drainage systems and poor planning policies frequently result in flash floods whenever a heavy rainfall storm episode occurs in the vicinity of the city.

KMD issued flood warnings related to the El Niño phenomenon in July 1997, before the devastating floods of November and December 1997 came, in both the print and electronic media. To many, these warnings were perceived as based on inaccurate forecasts from the Department and were therefore not taken with the seriousness they deserved. To others, especially those in the drier areas of the country, a forecast of heavy rains would have been more of a welcome relief than a threat. This was due to the fact that most parts of the country, especially those in the dry parts, had been experiencing serious impacts of an extended drought in the previous few seasons. Thus, a sizable percentage of the Kenyan population were aware of the forthcoming flooding due to the heavy rains of the El Niño well in advance, but did very little if anything to combat or mitigate the consequences of the rains when they occurred in the country. Consequently, the floods had wide-ranging positive and negative impacts on the various sectors of the national economy.

In the following subsections, the impacts of the 1997-98 El Niño are discussed for the following sectors:

- Water resources
- Agriculture
- Health
- Transport
- Socio-economic

### **2.5.1 Water Resources Sector**

Rarely does Kenya experience countrywide flooding problems. However, extreme floods were recorded during the 1951 El Niño rains, the 1961/62 floods caused by an above normal warming of the Indian Ocean, the 1982-83 El Niño rains and more recently during the 1997-98 El Niño induced rains. The 1997-98 El Niño induced floods had both negative and positive impacts on the water resources in Kenya.

#### **2.5.1.1 Negative Impacts of the 1997-98 El Niño on the Water Resources**

Kenya experienced a wide range of negative impacts of the 1997-98 El Niño rains on the water resources sector. These mainly included:

- a) Widespread and extensive flooding which destroyed property in several sections of the country.
  - Very many homes were destroyed during the flooding period of the 1997-98 El Niño rains.
  - Very many lives were lost through drowning during the floods. The loss of lives specifically due to drowning, and not connected to other epidemics that were related to the El Niño rains, has not been authentically specified. The local daily newspapers quoted about 300 deaths due to drowning.
  - Damage to roads and bridges in the country.
- b) Increased soil erosion in areas with poor land use and management practices.
  - Kenya experiences a wide range of climates. Generally, due the poor land-use and management practices in most parts of the country, widespread land degradation has been experienced in the past decades. This problem was extremely amplified during the flooding period of the 1997-98 El Niño rains especially through soil erosion. Most of the sediments and silt from the increased erosion of the El Niño rains were washed into the major water storage dams, reducing their storage capacities considerably.
- c) Increased frequency of mud/landslides especially in the sloping areas.
  - These were generally associated with an increase of the soil moisture, which often reached saturation levels.
- d) Increased surface water pollution due to extensive water logged soils in areas of poorly drained soils.
- e) Increased ground water pollution due to the rise of the ground water table to near surface levels especially in the low-lying areas.
- f) Increased water pollution in the rivers and other water storage bodies, which are located in the vicinity of agricultural areas where both organic and mineral fertilizers are extensively used.
- g) Breakage of many of the small water storage earth-dams, which provide cheap but vital surface water resource for domestic, livestock farming and other farming practices for most communities in the country.
- h) Increased sedimentation and siltation in the rivers and streams and consequently in the major water storage reservoirs which are important for national development.
- i) Most urban centers experienced flooding due to blocked storm drainage systems that were obviously not maintained or serviced. This affected not only the municipal road transport systems but also the educational, health, recreation, business and residential facilities in the urban centers.

Table 2.2 show the official reports on the extent of the damage of the 1997-98 El Niño floods to the water resources related infrastructure.

**Table 2.2: Cost (US Dollars) of Chemicals for Water Treatment and Rehabilitation of Damaged Water Supply Facilities.**

Province	Rehabilitation of water supply facilities	Chemicals to improve water quality	Total
Rift Valley	199,504	179,973	379,477

Province	Rehabilitation of water supply facilities	Chemicals to improve water quality	Total
North Eastern	1,045,930	113,271	1,159,201
Coast	5,189,402	35,251	5,224,653
Western	190,323	159,009	349,332
Nyanza	635,164	128,550	763,714
Central	180,823	186,763	367,586
Eastern	493,568	135,016	628,584
<b>Total</b>	<b>7,934,662</b>	<b>937,832</b>	<b>8,872,494</b>

### 2.5.1.2 Positive Impacts Of The 1997-98 El Niño on the water resources

While it is generally accepted that the 1997-98 El Niño phenomenon had a lot of devastating impacts as shown above, the event had some positive impacts such as:

- a) Reduction of pollution loads which are not related to sedimentation and siltation, in some rivers through washout.
- b) Increased resources in the:
  - i). Ground water due to increased aquifer recharge
  - ii). Surface water in reservoirs and river channels due to the heavy rains and high runoff.
  - iii). Soil water (green water) for crop production in the well-drained soils.
- c) When the El Niño rains hit the country, they came at a time when most parts of the country, especially those in the dry areas where all the major hydro-electric power dams in the country are located, were experiencing serious impacts of an extended drought in the past seasons. As such, the water levels in all these dams were boosted from dangerously low levels to full capacity levels in most of the dams. The Kenya power generation institutions have therefore benefited greatly from this El Niño water dam storage. This is particularly significant because the post El Niño rains in these areas where the major dams are located have been below normal up to date and therefore most of these dams would not be in operation today if it were not for the El Niño rains.

### 2.5.2 Agricultural Sector

The USAID report on “Kenya’s Vulnerability Update” estimated that the El Niño rains threatened 65% of the unharvested maize crop in the Rift Valley and Trans Nzoia. These areas, being “the hub of Kenya’s food supply”, are extremely important to the country. The negative impacts of the 1997-98 El Niño event in these regions were correctly analyzed in the *Daily Nation* newspaper editorial of 18<sup>th</sup> January 1998. Similarly, a USAID/WMO/DMC (Nairobi) funded conference with the theme “The Greater Horn of Africa Climate Outlook Forum for 1998 and the Implications for Regional Food Security”, was held in Nairobi commencing 9<sup>th</sup> February 1998 (*Daily Nation* newspaper of 9<sup>th</sup> February 1998) and mainly deliberated on the adverse effects of the 1997-98 El Niño Event. Another notable event, which is related to the 1997-98 El Niño devastation, was that the Government of Kenya waived taxes on imported grains and foodstuff to

encourage investors and to facilitate the entry of food into the country in order to minimize the effects of food shortage. Notwithstanding the negative aspects of the 1997-98 El Niño event, these rains were a blessing to the pastoral communities of Kenya.

In this section, some major impacts of the El Niño rains in the agricultural sector, mainly livestock and crop production sub-sectors are, highlighted.

### 2.5.2.1 Negative Impact on the Agricultural Sector

The negative impacts on the agriculture sector included the following:

- Loss of livestock due to increased disease infection. Such diseases included east coast fever, pneumonia in calves and lambs, diarrhea, foot rot, Contagious Bovine Pleura-pneumonia (CBPP) in cattle and Contagious Caprine Pleura-pneumonia (CCPP) in goats. The diseases increased the cost of veterinary services and claimed lives of a lot of animals. Table 2.3 shows the mortality rates of livestock in the country as a result of the 1997-98 El Niño flooding.

**Table 2.3: Summary of estimated countrywide livestock mortality due to El Niño weather phenomenon**

Livestock species	Mortality No.	Mortality No. as % of total	Total value (\$US.)	Remarks: Highest mortality
<b>Cattle</b>	167,609	1.4	31,127,386	Eastern province (0.5 %), Northeastern province (0.2 %)
<b>Sheep</b>	795,119	10.7	43,076,529	Eastern province (5 %), Northeastern province (2 %)
<b>Goats</b>	1,120,635	9.9	32,018,143	Eastern province (5 %), Northeastern province (3 %)
<b>Camel</b>	63,710	5.2	7,281,143	Northeastern province (4.6 %)
<b>Donkeys</b>	1,120	0.1	80,000	Northeastern province (0.1 %)
<b>Poultry</b>	68,680	0.3	196,229	Coast Province (0.2 %), Western and central provinces. (0.04 % each)
<b>Rabbits</b>	2,324	1.3	9,960	Central province (1%), Western province (0.3 %)
<b>Pigs</b>	1,307	0.9	4,574,500	Central province (0.9 %)
<b>Total</b>			113,593,161	

Source: Ministry of Agriculture and Rural Development reports, 1997 and 1998

- Loss of livestock, particularly small stock, due to drowning and starvation resulting from animals getting stuck in mud.
- Damage to livestock water facilities (dams, pans, bore-holes, water troughs, crashes, etc).
- Loss of kids and calves due to chilling effects.
- Decline in body condition of livestock due to increased incidences of disease.

- Disruption of livestock marketing services due to destroyed livestock marketing facilities (mainly holding ground) and destroyed road network.
- Damage to food crops and some industrial crops, particularly coffee, occurred at different stages of crop growth and in different regions of the country, due to different cropping calendars for western and eastern regions. In some parts of the western region of the country, especially in Rift Valley province, maize and wheat crops, which were already at maturity and harvesting stages, suffered due to rotting, molding and lack of proper sunshine.
- In some parts of the eastern region of the country, for example in Central and Eastern provinces, food crops which were at relatively younger stages of growth, suffered because of loss of nutrients. This resulted from flooding, reduced soil temperatures, reduced sunshine hours, difficult weeding conditions, accelerated disease attack particularly in legumes, and at much later stage, poor harvesting conditions.
- In some cases, especially in Coast province, El Niño rains continued into the long rains season of 1998, causing problems of land preparation. Farms were wet and overgrown with weeds, necessitating more operations than is usually the case.
- Tree crops such as mangoes and citrus performed poorly as they either died due to water logging or failed to flower.
- As far as coffee is concerned, such excess rainfall was a disadvantage. The rains caused leaching of nutrients, especially nitrogen. It also caused soil erosion and made drying of harvested coffee very difficult, which to some extent resulted to loss of quality. Excess rainfall resulted in abortion and abnormality in coffee flowers. Some flowers opened prematurely while in some the corolla and stems rotted. In both abnormalities fruit set failed to take place.
- Periods of continuous wetness characterized by high humidity and cool temperatures were conducive to diseases such as Coffee Berry Disease (CBD) and to insect pests such as Leaf Miner (*Leucoptera Spp.*) and antestia bugs.
- Overall, production of clean Coffee declined by about 22 percent from 68,000 metric tonnes in the 1996/97 season to 53,000 metric tonnes in the 1997-98-crop season. The El Niño phenomenon, among other factors led to the observed decline in production.
- Several irrigation infrastructures, for example, pumps, intake structures, canals, etc, were destroyed (washed away). This damage countrywide was estimated to be approximately US\$ 1,142,857
- During and following the El Niño period, there were high incidences of crop pests and diseases, adding to the already high cost of farming.
- During field visits after the El Niño rains, it was observed that a lot of erosion of productive topsoil took place – both within and outside farms. Most of erosion was in form of sheet and rill erosion, although the other forms of erosion including gullies and landslides also contributed.

Table 2.4 shows the extent of the damage to some major food crops as a result of the 1997-98 El Niño floods in the country.

Table 2.4: Countrywide damage to some major food crops due to El Niño rains of 1997-98

<b>Crop</b>	<b>Hectares damaged</b>	<b>Equivalent No. of bags</b>	<b>Value/bag (ton) Kshs.</b>	<b>Total value \$US.</b>
<b>Maize</b>	115,000	2,500,000 (90 kg bags)	800	285,714
<b>Millets</b>	20,000	160,000 (90 kg bags)	2,700	6,171,429
<b>Rice</b>	10,000	200,000 (90 kg bags)	5,400	15,428,571
<b>Wheat</b>	20,000	400,000 (90 kg bags)	1,600	9,628,571
<b>Beans</b>	150,000	750,000 (90 kg bags)	2,700	28,928,571
<b>Irish potatoes</b>	16,000	160,000 tons	8,000	18,285,714
<b>Clean coffee</b>	-	15,000 tons	200,000	42,857,143
<b>Total</b>				121,585,713

*Source: Ministry of Agriculture and Rural Development*

### **2.5.2.2 Positive Impacts of El Niño on the Agricultural Sector**

After the El Niño rains, and in early 1998, the following were generally observed:

- In the ASALs, most pastureland flourished with vigor and production of both fodder shrubs and pasture grasses improved tremendously. This resulted in improved livestock performance: livestock conditions improved as pasture growth increased to above average levels. Livestock prices went up due to favorable conditions. Water shortages, which are usually a major problem in ASAL, were for quite some time solved, as water was available in excess quantities in most locations.
- In Medium and High Agricultural Potential Zones, there was increased availability of pasture and other forage foodstuff, which resulted in high milk production and improved livestock condition.
- It was noted that production of some industrial crops improved during and immediately after El Niño rains. For example, tea output in most of tea growing regions went up by about 20 percent in 1997-98 year. In some agriculturally marginal areas of Eastern Province, production of cereals, tubers and root crops was above average.
- El Niño rains enhanced and prolonged the time and moisture availability for the biological soil and water conservation structures to take up. Tree planting and survival rates were generally increased by nearly 100 percent.

### **2.5.3 Transport Sector**

This section discusses the various types of impacts associated with the 1997-98 El Niño on the transport sector. The major factors were disruption of infrastructure such as roads, bridges, rails, telecommunications, aviation and shipping through floods and landslides and the disruption of public transport and general loss in business in the transport sector. The impacts on this sector were generally negative.

#### **2.5.3.1 Impacts on Roads and transport system**

- The heavy downpour in the areas around the coastal region that included Mombasa, Malindi, Kilifi, Lamu, Kwale, Garsen, Hola and Tana River districts left a trail of destruction on roads and the whole transport system of the area. The flood waters that paralyzed road services,

washed away buildings, residential houses and other infrastructure was the highest in recent times.

- The road linking Kenya to Tanzania was completely cut off, halting traffic flow to and from Tanzania. Hundreds of travelers were left stranded as the public transport system ground to a halt. This included a cabinet minister who had to be airlifted by helicopter after his vehicle got stuck in muddy waters.
- The Marsabit - Moyale road became impassable after the rains washed away a section.
- All roads leading to Wajir from Isiolo, Moyale, Garissa and Mandera were impassable with vehicles getting stuck along the way.
- A Landslide in Nyeri Town partially blocked the Nyeri - Kigonyo road near Chania Bridge.
- In Mombasa, shippers, transporters and the business community complained of the poor state of roads that was causing them massive losses on vehicle maintenance, fuel and working hours.
- Illegal and poor farming practices along the sprawling Chania Valley in Nyeri's Tetu Division (Forest-Land) triggered a chain of landslides in the area, destroying hundreds of acres of farmland on the slopes of the River Chania and blocking the main road to Gathuthi Tea Factory, thus adversely affecting tea farmers.
- The heavy rains that fell in the coastal area of Mombasa had an impact on the railway line in which a section of the line between Mariakani and Mazaras was washed away by the raging floodwaters. The passenger train to Mombasa had to be delayed for several hours at Mariakani while repairs were being done on the damaged line.
- The El Niño toll on roads in Central Meru District was dramatized by the 100km detour of the Nairobi-Nyeri-Nanyuki-Meru route following the closure of the Meru-Chuka-Embu Highway. This was closed as a result of massive landslide in the area.
- The closure of Nairobi-Mombasa highway after the swollen River Kambu swept away a bridge near Kibwezi was a serious blow to the heavy cargo from the Mombasa port. This implied that the only means of transport from Mombasa was by air.
- Shipping activities in Mombasa almost ground to a halt since no cargo discharged was being transported, as trucks destined to land-locked countries were held up at various points along the Mombasa Highway.
- The Mombasa Branch Chairman of the Kenya National Chambers of Commerce and Industry estimated that the Chamber's members from Mombasa lost close to US\$500 million in three days due to the closure of the Mombasa highway, and appealed to the Government to take urgent steps to restore the road infrastructure.
- The Chairman of the Kenya Clearing, Forwarding and Warehousing Association estimated that its members were losing close to US\$ 714million daily from delays caused by the closure of the highway.
- An estimated 100,000km of road network covering both the urban and rural areas was adversely affected. Ten percent of these roads were paved. As at February 1998, an estimated US\$ 51million were required as emergency funds to repair both the rural and urban road network and 13 major bridges in the country. Table 2.5 shows the estimates of the damage to Kenyan roads.
- Torrential rains destroyed essential bridges in different parts of the country, leading to millions spent in repair costs. For example, in Kwale and Kilifi districts alone, the following bridges were completely destroyed by the raging floodwaters:
  - Bando and Ramisi bridges on Mombasa - Lunga-Lunga Road
  - Mbogolo bridge on Mombasa - Malindi Road



- Marere bridge on Kwale - Kinango Road
  - Mwatsuma bridge on Mariakani - Kilindini Road
  - Part of Makupa Causeway on Mombasa - Nairobi Highway
  - Mtwapa Bridge connecting Mombasa with Kilifi threatened with collapse. (Depression at center).
  - Ndi Bridge near Kibwezi on Mombasa highway.
- The following bridges in Murang'a and Mbeere Districts were destroyed:
- Ngumo Bridge on Thika - Nairobi Highway
  - Ivoro/Ikia Bridge connecting Mbeere district and Kian'gombe location.
  - Thingitho Bridge in Tharaka-Nithi district damaged by raging waters cutting off Marimanti with Meru.
- Athi-River Bridge connecting Kibwezi and Kitui and the Sofia Bridge connecting Thika with Garissa were washed away.
  - In Hola district, the Lagabuna Bridge was washed away cutting off the Hola - Garsen road in the area.
  - Torrential rains in North Eastern province destroyed the Torubi, Walda and Damballa Fachana bridges that are essential in the area.

**Table 2.5: El Niño damage estimates on the roads in Kenya by Province/District**

<u>Name of Province/District</u>	<u>Estimate (US\$)</u>	<u>Province/District</u>	<u>Estimate (US\$)</u>
<b>NAIROBI</b>	15,000.00	<b>R. VALLEY PROVINCE</b>	
<b>COAST PROVINCE</b>		<b>Turkana</b>	54,167.00
<b>Nairobi -Mombasa</b>	4,66,667.00	<b>West Pokot</b>	4,167.00
<b>Kwale</b>	93,334.00	<b>Samburu</b>	25,000.00
<b>Kilifi</b>	61,834.00	<b>Trans Nzoia</b>	75,000.00
<b>Malindi</b>	23,334.00	<b>Uasin Gishu</b>	13,334.00
<b>Lamu</b>	25,000.00	<b>Marakwet</b>	31,667.00
<b>Taita Taveta</b>	38,334.00	<b>Keiyo</b>	6,667.00
<b>N. EASTERN PROVINCE</b>		<b>Nandi</b>	12,500.00
<b>Garissa</b>	641,667.00	<b>Baringo</b>	39,167.00
<b>Wajir</b>	73,334.00	<b>Koibatek</b>	14,167.00
<b>Mandera</b>	44,334.00	<b>Laikipia</b>	15,000.00
<b>EASTERN</b>		<b>Nakuru</b>	64,167.00
<b>Moyale</b>	50,000.00	<b>Trans Mara</b>	23,334.00
<b>Marsabit</b>	50,000.00	<b>Narok</b>	8,334.00
<b>Isiolo</b>	20,000.00	<b>Kajiado</b>	145,000.00
<b>Nyambene</b>	36,667.00	<b>Bomet</b>	35,834.00
<b>Meru</b>	21,667.00	<b>Kericho</b>	18,334.00
<b>Tharaka Nithi</b>	31,667.00	<b>WESTERN PROVINCE</b>	
<b>Embu</b>	8,334.00	<b>Malava/Lugari</b>	1,667.00
<b>Mbeere</b>	27,500.00	<b>Kakamega</b>	7,250.00
<b>Mwingi</b>	16,667.00	<b>Vihiga</b>	10,000.00
<b>Kitui</b>	185,000.00	<b>Mt. Elgon</b>	10,834.00
<b>Makueni</b>	15,667.00	<b>Teso</b>	25,000.00
<b>Paved Roads</b>	66,667.00	<b>Busia</b>	15,000.00
<b>CENTRAL PROVINCE</b>		<b>NYANZA PROVINCE</b>	
<b>Nyandarua</b>	59,078.00	<b>Siaya</b>	76,667.00
<b>Nyeri</b>	30,000.00	<b>Kisumu</b>	30,000.00
<b>Kirinyaga</b>	20,000.00	<b>Rachuonyo</b>	65,567.00
<b>Murang'a</b>	1,667.00	<b>Homa Bay</b>	30,000.00
<b>Maragua</b>	316,000.00	<b>Migori</b>	57,334.00
<b>Thika</b>	10,834.00	<b>Suba</b>	33,334.00
<b>Kiambu</b>	50,000.00	<b>Kuria</b>	50,000.00
<b>R. VALLEY PROVINCE</b>		<b>Kisii /Gucha</b>	50,000.00
<b>Turkana</b>	54,167.000	<b>Nyamira</b>	20,667.00
<b>West Pokot</b>	4,167.00	<b>TOTAL</b>	7,725,926.00

- In Embu district, heavy rains destroyed Mwara Bridge on the Rupangazi River that connects Nginda and Ngandori locations, which is mainly used by coffee, tea and horticultural farmers.

- A major landslide in Central Province destroyed the Chania Bridge.
- Before the El Niño phenomenon, an estimated US\$ 27.4 million was required to rehabilitate and maintain the road network and this rose to US\$ 670 million after El Niño.

The Table 2.6 below shows the damage caused by the El Niño rains on the bridges and some other structures along the road.

Table 2.6: Summary of El Niño Damaged Bridges by Province and District

<u>Province/ District</u>	<u>Concrete Bridges</u>	<u>Wooden Bridges</u>	<u>Box Culverts</u>	<u>Armco Culverts</u>	<u>Drift Bridges</u>	<u>Total</u>	<u>Remarks</u>
<b>COAST</b>							
<b>Mombasa</b>			2			2	
<b>Kwale</b>	3		3		1	7	
<b>Kilifi</b>	2		2	2	1	7	1 Bridge reinstated
<b>Malindi</b>	2		2			4	
<b>Tana River</b>						-	
<b>Lamu</b>			3			3	
<b>Taita Taveta</b>			5			5	
<b>N. EASTERN</b>							
<b>Garissa</b>						-	
<b>Wajir</b>							Habaswein bridge under water
<b>Mandera</b>	1						
<b>EASTERN</b>							
<b>Moyale</b>			2	3		5	6 pipe concrete culverts destroyed
<b>Marsabit</b>	2					2	
<b>Isiolo</b>	1		2			3	
<b>Nyambene</b>	1		3	2		6	More culverts required on roads
<b>Meru</b>	1		1			2	
<b>Tharaka Nithi</b>	2					2	
<b>Embu</b>			1			1	
<b>Mbeere</b>			4			4	
<b>Mwingi</b>						-	
<b>Kitui</b>	2					2	
<b>Machakos</b>	2		3	1	2	8	
<b>Makueni</b>						-	
<b>CENTRAL</b>							

<u>Province/ District</u>	<u>Concrete Bridges</u>	<u>Wooden Bridges</u>	<u>Box Culverts</u>	<u>Armco Culverts</u>	<u>Drift Bridges</u>	<u>Total</u>	<u>Remarks</u>
Nyandarua	11					11	
Nyeri	3		4	150	1	158	
Kirinyaga	4	1	1			6	
Murang'a	2		1		1	4	
Maragua	2		1	3		6	
Thika						-	
Kiambu						-	
<b>R. VALLEY</b>							
Turkana						-	
West Pokot						-	
Samburu						-	
Trans Nzoia	3		2	1	1	7	1 bridge threatened
Uasin Gishu						-	
Marakwet		1	4		3	8	
Keiyo						-	
Nandi	6	1	1	1	1	10	
Baringo	1		1	1	1	4	Massive Landslide.
Koibatek	1		1			2	
Laikipia	1					1	
Nakuru						-	
Trans Mara	1					1	
Narok	8					8	
Kajiado	2		6			8	
Bomet		1				1	
Kericho	3		3			6	
<b>WESTERN</b>							
Malava	1					1	
Kakamega	2					2	
Vihiga	2	1		2		5	
Mt. Elgon	1		1			2	
Bungoma						-	
Teso				1		1	
Busia						-	
<b>NYANZA</b>							
Siaya			4			4	
Kisumu	11		8	2	14	35	
Rachuonyo	1					1	
Homa Bay						-	
Migori	1			1		2	
Suba			10	3	4	17	
Kuria						-	
Kisii						-	

<u>Province/ District</u>	<u>Concrete Bridges</u>	<u>Wooden Bridges</u>	<u>Box Culverts</u>	<u>Armco Culverts</u>	<u>Drift Bridges</u>	<u>Total</u>	<u>Remarks</u>
<b>Nyamira</b>			3			3	
<b>Gucha</b>						-	

### ***2.5.2.2 Impacts on Aviation Industry***

- The heavy downpour in the country had a major impact on the aviation industry. For example, the operations at Moi International Airport in Mombasa were disrupted following a heavy downpour in the area, with aircraft finding it difficult to land or take off.
- The navigation equipment at several airports and airstrips were submerged while other equipment was partially interfered with by the rain.
- Chartered flights were delayed for several hours while others were cancelled due to poor visibility.
- Airplanes were grounded in flooded airstrips as pools of water submerged the runways.

### ***2.5.3.3 Impacts on the Shipping Industry***

- The heavy downpour in the Mombasa area left more than 300 containers full of imported merchandise submerged in floodwaters at the Kenya Ports Authority container terminal. The floodwaters also paralyzed activities at other sections of the port.
- In the process, the Kenya Ports Authority, Kenya Railways, Kenya Airport Authority and other multinational companies registered huge losses running into millions of shillings.

### ***2.5.3.4 Impacts on the Telecommunications Sector***

- The heavy rains and falling trees often brought down telephone cables. The situation was made worse by the already congested telephone exchanges in Kenya.
- Heavy rains in Nairobi broke down the main telephone cable system in the central part of the city cutting off communication links with the Central Bank, Electricity House and the Treasury Building, affecting nearly 1200 subscribers. This occurred on the night of 18 November 1997.

### ***2.5.3.5 Negative Impacts on the Energy Sector.***

Kenya produces 753.6 MW of electricity against a total installed capacity of 815 MW and peak demand of 805 MW. Of the effective production as at June 1997, 588.2 MW was harnessed from hydropower, 103 MW from thermal and geothermal sources, 42 MW from gas turbines, 20.1 MW from diesel engines and 0.4 MW from wind power. Table 2.7 compares the installed and generation capacities of the various hydroelectric power stations in Kenya before and after the 1997-98 El Niño.

**Table 2.7: Gross Generation of Electricity in 1997 and 1998**

<b>Hydro Power</b>	<b>Capacity Installed (MW) 1997</b>	<b>Capacity Installed (MW) 1998</b>	<b>Effective Production (MW) 1997</b>	<b>Effective Production (MW) 1998</b>
<b>Tana</b>	14.4	14.4	12.4	14.4
<b>Wanjii</b>	7.4	7.4	7.4	7.4
<b>Kamburu</b>	91.5	91.5	84	91.5
<b>Gitaru</b>	145	145	145	145
<b>Kindaruma</b>	44	44	44	44
<b>Small Hydro</b>	6.2	6.2	5.4	6.2
<b>Masinga</b>	40	40	40	40
<b>Kiambere</b>	144	144	144	144
<b>Turkwel</b>	106	106	106	106
<b>TOTAL HYDRO</b>	598.2	598.2	588.2	598.2

In discussing the impacts of 1997-98 El Niño event on the energy sector, it is important to note the following:

- The power supply in the coastal area was intermittent following the heavy rains there. The worst hit areas were Nyali and Kisauni, which went without power for 72 hours. To access the worst flood hit areas on the coast, the KPLC engineers had to hire canoes to navigate a road stretch to Miritini. In some cases, the company had to use aircraft to patrol the worst hit areas, pinpointing fallen electricity poles and, hence, alerting the ground crews.
- The Power Company faced huge costs in airlifting diesel to isolated areas of Wajir, Garissa, Mandera and Moyale, which rely on diesel power plants. These areas were completely marooned by floodwaters and the roads made impassable.
- In Nairobi, most areas went without power as heavy rains wreaked havoc on the electricity supply system. The power failures were mostly a result of trees falling on power lines, flood waters uprooting the power poles and vehicles knocking down power lines as a result of poor visibility.
- It was reported that all hydropower stations given in the above table (except Masinga Dam) overflowed within 15 days from the onset of the El Niño rains. No damages were however reported as a result of the overflow. This was a huge boost to the ability of the plants to operate at full capacity.
- Masinga Dam filled up in a record 30 days moving from 1045.89m to 1056m giving a record steep rise in dam levels in the recent past. The critical level for Masinga dam that can trigger power rationing is 1036m. The Turkwel Dam, considered to be the largest in the country, also recorded a significant rise in dam levels from 1105m to 1112m.
- Kenya Petroleum Refineries suspended its operations partially as a result of heavy rains in Mombasa that resulted in landslides, power failure and flooding disrupting the normal production of both cooking gas and fuel. Shortages of LPG cooking gas were experienced in Nairobi, Nakuru, Eldoret as well as other urban centers.
- It was reported (*Daily Nation*, 19 November 1997) that more than 50 lorries carrying fuel, food and other essential commodities worth more than \$US100 million destined for the North Eastern towns of Marsabit and Moyale were stuck in the mud for several days between Serolevi and Merrill.

## 2.5.4 Human Health Sector

The El Niño phenomenon affected more than 300,000 families in Kenya. The health resources in the affected parts of the country were stretched beyond manageable levels. The general effects of the El Niño phenomenon were:

- Destruction of health facilities
- Contamination of water sources
- Increased stagnant water ponds
- Increased morbidity and mortality due to epidemics
- Increased overgrowth around homesteads and market centers
- Frequent blockage of sewers due to siltation and open drains
- Raised ground water table causing collapse and overflow of pit latrines
- Silting of clean water sources, for example shallow wells, springs, etc.
- Increased fly breeding due to decomposition of refuse.

The eight most affected districts in Kenya were Mandera, Wajir, Garissa, Marsabit, Moyale, Isiolo, Tana River and Busia. There was an upsurge in cases of vector-borne and water-borne diseases. The main diseases that showed an upsurge were cholera, malaria, Rift Valley fever (enzootic hepatitis), typhoid and dysentery (Impact, 1998). It was assumed that Rift Valley Fever had been eradicated in human beings and hence only a cattle disease at the moment. Diagnosis of the disease in man, therefore, took a long time resulting in more than 400 deaths in man and several deaths in cattle in the N.E. province (*Weekly Review*, 23 January 1998). There was starvation and related ailments such as malnutrition and susceptibility to infection in some of the affected areas. By the middle of July 1998, 472, 528 cases of malaria with 2,705 deaths and 44,833 cases of cholera with 2,525 deaths had been reported. The breakdown of these figures per province is shown in the table 2.8 (National Disaster Office).

Table 2.8: Table showing the status of malaria/cholera epidemics during May-July 1998.

No.	Province	Malaria		Cholera	
		Cases	Deaths	Cases	Deaths
1.	East Province	78,588	580	8,721	245
2.	Central Province	-	-	1,376	66
3.	Rift Valley Province	313,026	1,266	1,140	131
4.	Nyanza Province	77,134	628	11,208	637
5.	Coast Province	290	9	18,574	1,204
6.	Western Province	-	-	1,523	198
7.	North Eastern	3,500	22	29	-
8.	Nairobi Province	-	-	2,262	44

By mid-March 1998, the El Niño related rains had displaced 77,679 people, caused 1,385 deaths and injured 15 people. There are four main refugee camps in northern Kenya with a population of over 178,000 people (*Weekly review*, May 1998). Three are located in Dadaab area in Garissa district with a population of 123,000 of predominantly Somali refugees whereas the fourth is located in Kakuma (Turkana district) and hosts 55,000 mainly Sudanese refugees. The doctors without borders estimated that 50,000 people were displaced from these refugee camps in the

N.E. province (*Weekly Review*, 12 December 1997). Camps were without clean water and sanitation facilities. Floods displaced 25,000 people in Tana River District.

In Wajir town, a large number of the 40,000 inhabitants were without clean water or a latrine system because floods contaminated the wells for drinking water and washed away the lavatories (*Weekly Review*, 12 December 1997). Food supplies were low as the road from Isiolo to Wajir was cut off for several weeks. A village known as Dadashjiboula (with 500 people) was completely surrounded by water for more than the three weeks and could not be accessed. People had neither food nor shelter.

### **2.5.3 Socio-economic Sector**

There were many and varied impacts of the 1997-98 El Niño event, on the socio-economic sector in Kenya. Some of the most important of these impacts are outlined below:

- The school education system was adversely affected
  - School attendance diminished due to either the inconveniences of heavy rains or inaccessibility of the schools as a result of damaged bridges or flooding in streams and rivers
  - Schools were closed due to flooding which either made the schools' facilities uninhabitable or created complications in the schools' sanitation. When deciding to close the schools, the authorities feared that general flooding, which often led to poor sanitation, could trigger some of the related health epidemics.
  - End-of-year examinations were adversely affected in terms of delivery and collection. This promoted many cases of examinations leaks, which were reported during that time.
- The General Elections, which were scheduled for 29 December 1997, were adversely affected. In many places, the election dates had to be extended due the difficulties of accessibility to the polling stations and the inconveniences due to general flooding and damaged bridges.
- Most social activities and gatherings were adversely affected. The most affected of the social functions included:
  - Weddings
  - Funerals
  - Fund-raising gatherings
  - Church services
- Businesses and office operations were also adversely affected by the 1997-98 El Niño event.

The factors which were pertinent to the impacts were:

- Lateness in reporting to places of work due to malfunctioning private and public transport system
- Reduced business volumes due to below-capacity employee output and poor transportation facilities
- Reduced number of customers due to declining purchasing power of individuals, groups and institutions which was caused by the declining economy
- Depression, stress and apathy in the general public which were mainly caused by:
  - Monotony of the heavy rains
  - Widespread suffering through sickness, poor public services and road network
  - Limitations of time, opportunities and convenience to relax.
- Poor road transportation services which affected:
  - Businesses



- Public movement
- Hospital attendance for treatment and checkups
- Office operations
- Movement of relief personnel, facilities/equipment and supplies

### **3. THE RESPONSE TO THE IMPACTS OF THE 1997-98 EL NIÑO FLOODS**

Due to the low frequency of widespread flooding problems in the country, the Kenya Government had neither a flood disaster management policy nor the institutional framework to monitor and manage flood disasters prior to the 1997-98 El Niño floods. The only disaster management institution that was in operation during the early periods of the 1997-98 El Niño-related floods was The National Famine Relief Program, whose mandate is almost exclusively related to monitoring and management of the negative impacts of drought. This program was not well equipped to manage the heavy rains.

Further, an attempt by the government to mitigate the effects of the negative impacts of the 1997-98 El Niño floods was hampered by the diversity of the impacts, which could not, therefore, be handled by any one government Ministry on its own in isolation. However, the government took some measures to try and combat the impacts, as may be seen below.

#### **3.1 *The Government Response:***

The following are some of the measures undertaken by the government in trying to combat the impacts of the 1997-98 El Niño event.

- The government through the Department of Meteorology in the Ministry of Transport and Communications, issued several statements to warn the public and other concerned Ministries on the impacts of flooding due to the impending El Niño, well in advance of the beginning of the 1997 'short rains'.
- At the height of the flooding, the negative impacts became more serious and widespread and the government was forced to set up various committees and a center (National Disaster Operations Center in the Office of the President), to address these impacts. The Government issued statements to declare the floods a disaster in some parts of the country. Such statements were aired in the electronic media. Besides the television news, other TV and radio programs that were used included *Radio Press Conference, Radio Contact, Yaliyotokea, TV Professional View, TV Good Morning Kenya* and *TV Mambleo*.
- The Government strengthened the existing District Disaster Committees and charged them with the responsibility of managing disaster situations in their respective districts. A 24-hour Operational Center in the Office of the President was also set up to strengthen the National Disaster Coordinating Committee. The Sub Committees would then link up with the Operational Center regularly. At a National Disaster Committee meeting chaired by H.E the President, the worsening situation related to the El Niño rains, which caused extensive damage to roads, infrastructure, crops, livestock as well as loss of life, was reviewed (E.A. Standard 21<sup>st</sup> January).
- Despite the limitations of the existing economic and financial constraints, the government spent large amounts of money to purchase and transport emergency food, water treatment

chemicals and medical supplies for the worst affected communities. Table 3.1 gives an example of the government's response in the livestock sub-sector.

**Table 3.1: Summary of estimated countrywide cost of livestock infrastructure repairs in US dollars as a result of damage caused by El Niño weather phenomenon**

<b>Item description</b>	<b>Cost of repairs</b>	<b>Remarks</b>
<b>Repair of livestock watering facilities</b>	220,000,000	Most of the damage occurred in Eastern and North-eastern provinces
<b>Repair of fire breaks for control of incidental fires</b>	30,000,000	
<b>Provision of emergency livestock purchase fund for the operations of Kenya Meat Commission (KMC) to enable it purchase livestock during drought period</b>	240,000,000	
<b>Repair of livestock routes and access roads to markets</b>	50,000,000	Most of the damage occurred in Eastern and North-eastern provinces
<b>Repair of crashes</b>	5,000,000	
<b>Total</b>	<b>545,000,000</b>	

*Source: Ministry of Agriculture and Rural Development reports, 1997 and 1998*

- Following interruption of electricity supplies to certain areas due to heavy rains, on 17<sup>th</sup> January 1998, the Kenya Power & Lighting Company convened an Emergency Team specifically to restore supply systems to areas affected by El Niño rains.
- Deployment of military personnel to assist in emergency operations, especially in the rehabilitation of the damaged roads and bridges in the worst affected areas.
- The Government of Kenya waived taxes on imported grains and foodstuff to encourage investors and to facilitate the entry of food into the country in order to minimize the effects of food shortage.
- Deployment of medical personnel to assist in emergency operations in the worst affected areas, especially in the management of the spread of communicable diseases related to flooding.
  - The government responded to the effects on health by offering emergency medical supplies. As the rains persisted, the government put in place measures to alleviate the problem, for example, by waiver of duty on essential medical imports. It also provided two fixed wing planes, six helicopters and two naval craft for air/sea lifting of foodstuff, both human and veterinary drugs and also the 2,500 stranded passengers (mainly students, teachers, civil servants, security detachments and paramedics). Shelter, blankets and mosquito nets were also provided to displaced persons. The relief and humanitarian operation cost the government Department of Defense to transport them at a total cost of US\$863,000.

- The following human medicine and other drugs were also distributed:
  - Anti-cholera drugs
  - Anti-malaria drugs
  - Antiseptics
  - Vitamin supplements
  - Unmixed (UNICEF)
  - IV fluids, gloves, etc.
  - General medicines
- The Ministry of Health also deployed more officers to the epidemic areas to monitor and help alleviate the effects by focussing on health education. During outbreaks, the Ministry of Health mobilized staff from areas not affected to assist during the epidemics depending on the magnitude of the surveillance. These officers were drawn from national, provincial or district levels to the affected areas. Their role was to emphasize health education, treatment and environmental sanitation for as long as the epidemics persisted.
- The government response also included appeals to the donor communities for assistance. Various donor communities responded by providing resources and support. A committee comprising the Government and diplomats representing institutions and foreign governments met regularly to assess the situation of the disaster and laid a strategy. The Kenya Meteorological Department kept the Committee informed of the trend in the El Niño rains.
  - Medecins Sans Frontieres (Doctors without Borders) embarked on a 3 months mission to provide relief food, mainly consisting of high protein biscuits, shelter (plastic sheeting) and medical assistance to people in the area between Hola and Kipini (*Weekly Review*, 12 Dec. 1997). The aid agency also set up a mobile medical clinic on a boat to deal with incidences of cholera, malaria, diarrhea and skin diseases. The doctors also provided technical assistance to the Ministry of Health for the entire coast region. In Nyanza province, the doctors worked with government health officials in 6 districts to combat the spread of cholera.
  - In Wajir district, the doctors without borders treated water and distributed chlorinated solutions and drugs. The agency also set up one hospital and three dispensaries in each of the three refugee camps at Dabaad.
  - Following the appeal by the Kenyan government, the friendly governments responded by donating money and material essential to the health sector such as human medicines, chemicals, fuel for transportation and aircraft in excess of US\$5,000,000 as shown in table 3.2.

Table 3.2: Friendly governments and donors/NGOs response

<b>Donor</b>	<b>Contribution</b>	<b>Purpose</b>
<b>USA</b>	US\$3,315,000	Relief operations for fuel and hire of aircraft and cholera kits
<b>United Kingdom</b>	US\$500,000	Fuel and hire aircraft
<b>Japan</b>	US\$250,000	Fuel
<b>Germany</b>	DM200,000	Essential supplies
<b>Belgium</b>	Aircraft, 16MT capacity for one month at US\$900,000	On hire basis

<b>Donor</b>	<b>Contribution</b>	<b>Purpose</b>
<b>Spain</b>	US\$100,000	General expenses
<b>UNDP</b>	US\$40,000	Fuel
<b>UNICEF</b>	US\$190,000	Medicines, water chemicals and other expenses
<b>Red Cross</b>	Medicines	_____
<b>African Inland Church</b>	To hire two boats of 10 and 12 MT capacity	_____
<b>Catholic Relief Services (CRS)</b>	366 MT per month of drugs to the Tana River District	_____
<b>MSF-Belgium</b>	Distributing various medicines and chlorine to the North Eastern Province (NEP)	_____
<b>Supreme Council of Muslims - Kenya (SUPKEM)</b>	Distributing human and veterinary drugs to the North Eastern Province	_____
<b>Al-Ibrahim foundation</b>	Distribution drugs to NEP	_____
<b>European Union</b>	Aircraft hire and support costs and cholera intervention	
<b>WHO</b>	US\$30,000	Epidemiological surveillance to characterize the Rift Valley Fever virus, Cholera kits

Table 3.3 lists some of the non-governmental agencies that responded to the government's appeals for assistance.

**Table 3.3: Activities of some NGOs/Agencies and their operational areas in the country during the 1997-98 El Niño rains**

<b>NGO/AGENCY</b>	<b>AREA COVERED</b>	<b>ACTIVITY</b>
<b>UNICEF</b>	Busia, Garissa, Isiolo, Mandera, Wajir, Marsabit, Tana River and Moyale	Provision of humanitarian assistance
<b>World Food Programme</b>	-do-	-do-
<b>Action Nur Sud</b>	Garissa	Livestock health service
<b>Rural Development Organisation</b>	-do-	Livestock Health service delivery
<b>Catholic Relief service</b>	-do-	Immunization, health and nutrition
<b>Red Cross</b>	-do-	Food relief, health care
<b>Christian Children Fund</b>	Isiolo	Humanitarian assistance
<b>Council of</b>	-do-	-do-

<u>NGO/AGENCY</u>	<u>AREA COVERED</u>	<u>ACTIVITY</u>
<b>human ecology</b>		
<b>Isiolo Catholic Mission</b>	-do-	-do-
<b>Isiolo home foundation</b>	Wajir	Health issues
<b>World Vision</b>	Wajir	Water issues
<b>MSF-Belgium</b>	Wajir	Water issues
<b>Catholic mission</b>	Wajir	Food aid
<b>OXFAM</b>	Wajir	Health and Water

The main concern to the government and its partners in the implementation of the prioritized activities was the targeting of the scarce resources to the deserving individuals, households or prioritized clusters, which required urgent support. Thus an objective criterion, which was verifiable, was required in order to replicate it to all the areas targeted, without causing disparities in response action. Some of the specific actions taken by the Kenya government, foreign governments, non-governmental organizations and other donors were as follows:

- i) The Office of the President together with representatives of donor aid agencies was involved in organizing relief operations for flood victims. They flew over parts of the Tana River and Garissa to assess the food situation (*Daily Nation* 26 November 1997)
- ii) Kenya Red Cross relief workers, the District Commissioner's office and the Kenya Army were involved in a massive evacuation exercise along Tana River banks. The residents of the area were stranded as the river burst its banks and flooded their homes (*Daily Nation* 30 November 1997).
- iii) Environmental experts from Africa and the UN had a meeting in Nairobi in November 1997 to deliberate on the El Niño weather phenomenon. The meeting aimed at seeking ways to improve chances for environmentally sustainable development in Africa in light of the serious dangers of climatic change, among other issues (*East African Standard* 9 November 1997)
- iv) The US government gave a grant of US\$900,000 for flood victims. The US Ambassador to Kenya, H.E. Prudence Bushnell, made the announcement (*East African Standard* 17 December 1997).
- v) Kenya Red Cross donated 22 metric tonnes of food to flood victims in the Tana River area (*Nation and Standard* 14 December 1997).
- vi) Kenya Red Cross, Red Crescent, Supreme Council of Muslims, Northern Aid and Muslim Consultative Council distributed 180 tonnes of maize and other relief supplies to flooded areas especially in Tana District (*Daily Nation* 17 December 1997).
- vii) The WFP, the UN and the Kenya Government teamed up to airlift relief supplies to North Eastern province worth Ksh. 450 million (*Daily Nation* 24 December 1997)
- viii) In January 1998, Britain gave assistance worth US\$600,000 to some 175,000 flood victims in Wajir and Mandera districts. Britain had previously given US\$457,143 through the WFP toward relief operations in 1997 to the flood-hit areas (*East African Standard* 7 January 1998).
- ix) In February, the Iranian Embassy donated US\$71,429 and 5 metric tonnes of dates to flood victims in various parts of the country.

- x) The Democratic Party set up a National Disaster Fund (*East African Standard* 18 February 1998)
- xi) Britain funded an anti malaria program in Wajir town to the tune of US\$ 50,000 (*East African Standard* 19 February 1998).
- xii) The European Commission launched a US\$10 million maintenance project in Eastern Province (*East African Standard* 19 February 1998).

### **3.2 Media Response**

The National Meteorological Service, KMD, forecast the heavy rainfall associated with the 1997-98 El Niño as early as July 1997. A report to this effect appeared in all the press facilities but was not given prominence. However, on 9 September 1997 a report appeared in *The East African Standard* about the imminence of an El Niño event. Strangely, this report was not based on the KMD forecast but was attributed to the Southern Africa Climate Forum held in Zimbabwe in July/August 1997. From this time on, the interest of the media was heightened and they gave daily coverage of the effects of the El Niño and generally created awareness about this event. For example there was a convincing editorial in the *Daily Nation* (10 December 1997), which pleaded with the government and Kenyans to alleviate flood victims' plight in North Eastern Province, and in Kano plains. These reports continued until the end of June 1998, when, for example, a report appeared in the *Daily Nation* about the vegetable prices being affected due to the state of the roads (*Daily Nation* 23 June). Although the rains reduced in intensity, the country continued to receive rainfall to the end of June. Annex 1 gives some of these reports as they appeared in only two of the local dailies, the *East African Standard (EAS)* and the *Daily Nation (DN)*. There were many other reports in all of the international as well as the local news media regarding the 1997-98 El Niño. The *EAS* and the *DN* were chosen in this only for the sake of illustration.

### **3.3 Response by Private Companies and the Public**

- In some areas the private companies undertook to repair roads in order to facilitate the flow of traffic. For example, on 17 June 1998, the Eastleigh public vehicle owners agreed to assist with road repairs in the Eastleigh section of Nairobi. Similar initiatives were seen in parts of Nairobi's industrial area.
- Some bus transport companies, especially those using the Mombasa highway, suspended night trips to reduce road traffic accidents.
- Following the flooding of the Sondu/Miriu River, stranded villagers in Kano and Nyakach areas were evacuated by boat operators (*Daily Nation* 15<sup>th</sup> December 1997).
- The country has in the past experienced disruptions in electricity supply, mostly during the drought season when the water levels are low and KPLC are forced to ration power. This forced the private companies to find alternative power sources, for example standby generators. These alternatives helped these companies during disruptions caused by El Niño rain
- Some private firms located in Nairobi and Mombasa industrial areas experienced flooding on the premises. The firms located alongside riverbanks, for example, the Nairobi River that burst its banks, were affected. Some entrepreneurs constructed stone walls to stave off waters, and some used sandbags. The entrepreneurs along the Nairobi River near Mukuru

area commenced a clean up of the drainage system in order to ease flow of the river to minimize flooding.

#### 4. NATIONAL AND INTERNATIONAL RESEARCH ON IMPACTS OF EL NIÑO

The El Niño phenomenon is better understood today than it was several years ago. The predictability of the phenomenon has improved significantly. This is mainly because research on the El Niño phenomenon has intensified in the last few years. The list below gives some of the research that has so far been carried out both nationally and internationally.

International Seminar On The 1997-1998 El Niño Phenomenon: Evaluation And Projections. The first Intergovernmental Meeting of Experts on El Niño concluded successfully on 13<sup>th</sup> November 1998 in Guayaquil, Ecuador. The meeting was held in accordance with UN General Assembly Resolution 52/200 of 18 December 1997 on international cooperation to reduce the impact of the El Niño phenomenon, and in line with the report to the UN Secretary-General on its implementation by the Inter-Agency Task Force on El Niño. As part of an ongoing United Nations System strategy, the first intergovernmental meeting provided a unique scientific and technical understanding of the latest El Niño/Southern Oscillation, for all the regions affected worldwide. In addition to providing a global insight into the climate anomalies and their socio-economic impacts associated with the latest event, emphasizing both the positives in addition to the negative impacts, experts presented a first overview of the predictability of such climate extremes. The principal decisions taken at the meeting are laid out in the Declaration of Guayaquil. The Declaration calls for an increased synergy between science and technology, decision-makers and planners at all levels, as well as the public at large. It calls for the development of regional networks and implementation of proven operational systems to improve monitoring of the climate system. It also pinpoints the need for an interdisciplinary approach to prevention and risk reduction in order to diminish the impact of future climatic extreme events. In addition, the Declaration calls for improved early warning for the prevention of natural disasters through capacity building at local and regional levels.

The Fifth UNESCO/WMO International Conference on Hydrology closed in Geneva on 12 February 1999. The current status of climate prediction and its application to water resources management was presented to experts in hydrology and water resources.

White, L. D., M. Tewari, and T. N. Krishnamurti, 1998: Application of a GCM to study the surface hydrological budget of Amazonia. *Journal of Applied Meteorology*, 37, 1321-1331. [Abstract Online]

Tiscareño-Lopez, M., N. J. Rosenberg, D. M. Legler, A. R. Corral, R. Shrinivasan, R. A. Brown, G. G. Medina, M. A. V. Valle, and R. C. Izaurralde, 1998: Algunos efectos del fenomeno climatico El Niño en la agricultura Mexicana. *Ciencia y Desarrollo*, 24, 4-14.

Izaurralde, R. C., N. J. Rosenberg, R. A. Brown, D. M. Legler, M. Tiscareño-Lopez, R. Shrinivasan, and R. D. Sands, (1998): Modeled effects of strong Los Niños on crop productivity in North America. *Ag. Forest Meteor.*, submitted.

- Effect of El Niño rains on soil and water conservation structures: *Ministry of Agriculture and Rural Development, June 1998.*
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## 5. LOCAL REPORTS ISSUED AFTER IMPACT APPEARED

Table 4.1 shows some of the reports, which were compiled after the 1997-98 El Niño event.

**Table 4.1:** Some reports on the 1997-98 El Niño event

<b><u>Title of report</u></b>	<b><u>Date when report was compiled</u></b>
<b>Monthly food and crop situation reports</b>	October 1997 to March 1998
<b>Impact of El Niño phenomenon on livestock production</b>	April 1998
<b>Impact of El Niño on Coffee sub-sector</b>	May 1998
<b>Impact of El Niño rains on Soil and water Conservation</b>	June 1998
<b>Flood Emergency Assessment report (UNICEF)</b>	March 1998

## 6. LESSONS LEARNED FROM THE 1997-98 EL NIÑO EVENT

The 1997-98 El Niño, though not the strongest in the last 100 years or so, had the strongest impacts on the rainfall systems in Kenya, during the recorded rainfall period in the country. The El Niño event hit the country when the government had no plans or policies in place to deal with the associated flood hazards.

The country had neither a national plan nor policy for responding to flood disasters that can impact negatively on national economic sectors. The government has learned that such a plan or policy should be developed or added to either the National Disaster Plans or to the National Water Policy, with clear flood warning and management mechanisms. There is already a national plan to establish an Early Warning System Unit in the Ministry of Agriculture and Rural Development.

In addition, there are many uncoordinated efforts among different Early Warning Units in various Departments/Ministries such as the Kenya Meteorological Department (KMD), the Central Bureau of Statistics (CBS), the Department of Resource Survey and Remote Sensing (DRSRS), and the Arid Lands Resource Management Project (Office of the President), among others. It has therefore been proposed that co-ordination among these departments/ ministries be strengthened and an early warning unit be established and be well equipped to enable it effectively to monitor the situation on the ground and collect reliable data, which would enable the ministries to respond appropriately to disaster in their sector.

The scientific community, which is involved with the ENSO and rainfall characteristics in the region, as well as the Kenya government, has learned that the warming (or cooling) of the oceans

adversely affects the rainfall patterns in Kenya considerably. However, research has not as yet revealed clearly the quantitative association between the ENSO phenomenon and the rainfall in this region. A lot of effort is therefore being made to understand the frequency and occurrence of extreme rainfall events, and how these are related to the ENSO phenomenon.

The government and the general public have also learned that:

- The weather forecast period should if possible be for longer periods than 3 months.
- The storm drainage systems in the urban areas should be maintained and serviced regularly.
- The government should educate the public through active awareness campaigns regarding disasters well in advance.
- The Kenya Meteorological Department weather forecasts should be as accurate as possible.
- Settlement in potential disaster areas, especially those in the flood plains, should be discouraged through a clear government policy.
- In future the planners should always incorporate climate and weather information in their planning.
- The government should institute a policy or plan that supports flood prevention through integrated watershed development programs in eroded mountainous regions and also support design and management of strategic food security reserves.
- There is need to find a lasting solution to future disasters through intervention by capacity building for early warning and disaster preparedness.

With the experiences gained, the pertinent questions related to the 1997-98 El Niño event can therefore be answered as follows:

#### **A. Is El Niño explicitly considered to be a disaster in Kenya?**

El Niño is explicitly considered to be a disaster in Kenya. This is mainly because of the negative impacts it had on virtually all sectors in Kenya. The negative impacts were valued at billions of Kenya shillings. Some areas that were severely affected included:

- Agriculture (livestock and crops)
- Water resources
- Loss of human life
- Displacement of certain communities from their homes by floods
- Landslides
- Damage to road network and bridges
- Disruption of food supply to some parts of the country, etc.

With the above kind of negative impacts and related huge costs, El Niño cannot be ignored – it has to be taken seriously as a disaster.

#### **B. If A Perfect Forecast had been available, what could have been differently done from what was done?**

- About Information Flow:  
Information flow to the field, through different channels, e.g. radio, television, printed media, verbal, etc would have been intensified in the entire country. Reasonable awareness about the impending impact would have been created among most of the Kenyan population.

- About Preparing for the Forecasted Anomalies:

The following, among other activities, would have been undertaken in order to prepare for the forecast:

- Advising pastoralists on livestock de-stocking (selling) to avoid huge losses during floods.
- Storage, by the Government, NGOs and Donors, of relief food, drugs and other necessary items in strategic areas in order to avoid transportation problems during floods.
- Early renovation of bad or weak sections of major roads and bridges in order to ensure that they remain stable during floods.
- Advising farmers to avoid planting crops in swampy or flat areas where drainage is usually a problem during excessive rains.
- Putting in place some contingency planning and funds for an emergency.
- Establishing a disaster or a rescue team of experts and standby equipment like vehicles, helicopters, etc, which would be necessary during an emergency.

The above-mentioned points would have ensured good preparation and would have gone a long way toward minimizing impacts.

**C. What were the realistic obstacles that might have prevented the above theoretical actions from being taken?**

Several constraints affected the execution of relief operations in the disaster areas. Among them were:

- Lack of disaster preparedness partly due to lack of early warning systems.
- Lack of training in new techniques of handling humanitarian relief.
- Poor coordination of disaster response bodies.
- Lack of sufficient time to prepare for disasters that are associated with the climatic impacts, such as the El Niño event.
- Lack of sufficient information regarding the magnitude of the climatic impacts of the El Niño event.
- Cynical attitudes towards weather and climate forecasts.
- Lack of adequate medical supplies at district level.
- Lack of adequate financial resources due to the poor state of the national economy.
- Inadequate community participation due to mistrust of government coordination.

The private sector seemed to be most hit by what was perceived as unexpected sudden rainfall and in such high magnitude. Below are the limitations experienced by the private firms whilst attempting to control damage:

- Due to cost constraints, some firms were not able to construct stonewalls to stave off water from their premises, especially those using rented premises.
- Lack of time to prepare for the climatic impacts of the El Niño event. Most entrepreneurs learned about the rains after they had commenced. However most entrepreneurs felt that whilst psychological preparation was necessary, the preventive measures they could have put in place would have been on a very minor scale.
- Like every other citizen of this country, there is a level of skepticism among the business community regarding weather forecast reports. There have been a few

incidents in the past when weather forecast information was found to be conflicting and unreliable.

#### **D. Can El Niño considerations be added explicitly to national disaster plans?**

The El Niño phenomenon is better understood today than it was in 1997-98. The country now has a Disaster Management Office, which is operational. Consequently, the El Niño considerations can be added explicitly to national disaster plans.

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## 8.0 APPENDICES

### Annex 1: Some of the Local Media Reports of the 1997-98 El Niño in Kenya.

There were also numerous reports of the impacts of the 1997-98 El Niño. Table 1.2 below gives some of these reports as they appeared in the EAS and the *Daily Nation*.

**Table 1.3:**

<b>Paper and Date</b>	<b>Remarks</b>
<b>Standard: 9 Sept. 1997</b>	<ul style="list-style-type: none"> <li>- Meeting in Zimbabwe sensitizes public about El Niño.</li> <li>- El Niño blamed for drought over Eastern Australia.</li> <li>- Gives a report from London on El Niño.</li> </ul>
<b>Standard: 15 Sept. 1997</b>	<ul style="list-style-type: none"> <li>- Drought threatens Indonesia with famine.</li> </ul>
<b>Standard: 7 Oct. 1997</b>	<ul style="list-style-type: none"> <li>- Article on Pacific El Niño and how coral may be used to count the number of previous El Niños.</li> </ul>
<b>Standard: 20 Oct. 1997</b>  <b>Nation:</b>	<ul style="list-style-type: none"> <li>- 9 die in freak rains at Coast.</li> <li>- Bombolulu Handicraft Centre destroyed by floods.</li> <li>- Damage estimated at 2.5 million.</li> <li>- Nine Killed in Coast Flooding.</li> </ul>
<b>Standard: 21 Oct. 1997</b> <b>Nation:</b>	<ul style="list-style-type: none"> <li>- Papua New Guinea faces mass famine.</li> <li>- 9 people die in Coast Province due to floods.</li> <li>- 2 people died in Mlolongo slums due to heavy rains.</li> <li>- The main roads in Wajir town are flooded, forcing some businesses to close down.</li> <li>- A section of the Nairobi-Mombasa railway line is washed away by floods forcing disruption of transport by rail to and from Mombasa.</li> <li>- Nine more killed in Rain Tragedies.</li> <li>- Editorial: Boost Capacity to handle Disasters.</li> </ul>
<b>Standard: 22 Oct. 1997</b> <b>Nation:</b>	<ul style="list-style-type: none"> <li>- Floods in Nairobi.</li> <li>- Relentless Rain Kills Five Others.</li> </ul>



<p><b>Standard: 23 Oct. 1997</b></p> <p><b>Nation Report:</b></p>	<ul style="list-style-type: none"> <li>- Erratic Weather the easy excuse, Editorial.</li> <li>- The floods chaos.</li> <li>- Marooned: residents of Kombeni Village In Kilifi district stranded after Kombeni.</li> <li>- 25 people die. Mbogoli Bridge washed away (Mombasa/Malindi)</li> <li>- Kombeni Bridge is swept away by floods.</li> <li>- Kibao-Kiche Bridge is washed away.</li> <li>- Disruption of electricity supply in most parts of the Coast Province due to heavy rains.</li> <li>- Poor transport is reported in Malindi causing delays in the delivery of KCSE exam papers.</li> <li>- The main Mombasa water supply pipe is damaged by the heavy rains.</li> <li>- 100 people are left homeless in Coast after homes are flooded.</li> <li>- Kenya Meteorological Department Issues a statement on the rains in coast Province.</li> <li>- Rain Damage Requires Billions. Torrential rains have destroyed 5 essential bridges in the coast province. Mombasa water pipe destroyed by landslide.</li> </ul>
<p><b>Standard: 24 Oct. 1997</b></p> <p><b>Nation:</b></p>	<ul style="list-style-type: none"> <li>- Coast declared a National Disaster. El Niño team established by WFP</li> <li>- Two people died in Coast region due to floods.</li> <li>- Many bridges, roads and other infrastructure in Coast Province are destroyed by the heavy rains.</li> <li>- Repairs Start on Makupa Causeway</li> <li>- Flood Disaster Fund Launched for the coast flood victims.</li> </ul>
<p><b>Standard: 25 Oct. 1997</b></p>	<ul style="list-style-type: none"> <li>- More than 20 bridges washed away in Kwale and Kilifi.</li> <li>- El Niño blamed for floods.</li> </ul>
<p><b>Nation: 26 Oct. 1997</b></p>	<ul style="list-style-type: none"> <li>- Mbogolo Bridge reconstructed in 2 weeks at a cost of 2.0M.</li> </ul>
<p><b>Standard: 28 Oct. 1997</b></p> <p><b>Nation Report:</b></p>	<ul style="list-style-type: none"> <li>- Heavy rains at Coast with falls of more than 500mm in a week.</li> <li>- 45000 bags of maize distributed to flood victims.</li> <li>- Rains wash away Roads: Marsabit - Moyale road has become impassable.</li> </ul>
<p><b>Nation: 29 Oct. 1997</b></p>	<ul style="list-style-type: none"> <li>- Bridges are swept away in Marsabit.</li> <li>- Government sets aside 25M to reconstruct more than 6 bridges at coast province say PS Abdulahi Sharawe.</li> </ul>
<p><b>Nation: 30 Oct. 1997</b></p>	<ul style="list-style-type: none"> <li>- Marsabit-Moyale road is made impassable due torrential rains.</li> <li>- One Person dies in Moyale due to floods.</li> </ul>
<p><b>Nation: 1 Nov. 1997</b></p>	<ul style="list-style-type: none"> <li>- Four people die in Mandera due to floods.</li> <li>- Floods Kill 4 in Mandera.</li> <li>- Editorial: To expect disaster helps deal with it.</li> </ul>

<p><b>Standard: 3 Nov. 1997</b></p> <p><b>Nation Report:</b></p>	<ul style="list-style-type: none"> <li>- Leaders in North Eastern request government to declare Mandera a National Disaster after 5 people died through floods.</li> <li>- Four people and 15 camels die in Wajir due to heavy rains.</li> <li>- There are food shortages due to torrential rains in Wajir.</li> <li>- 57 people are killed and 4,000 people are left homeless in Ethiopia due to floods.</li> <li>- Four die as rains pound North Eastern Province.</li> </ul>
<p><b>Nation: 4<sup>th</sup> Nov. 1997</b></p>	<ul style="list-style-type: none"> <li>- More than 50 families are left homeless in Kasmir area of Lamu town due to flash floods.</li> <li>- The heavy rains damage Mwana Bridge in Embu.</li> <li>- 10 people died in Kalahari slums due to floods.</li> <li>- Torrential Rains return to coast.</li> <li>- Editorial: Flood victims need urgent help.</li> </ul>
<p><b>Standard: 5 Nov. 1997</b></p> <p><b>Nation Report:</b></p>	<ul style="list-style-type: none"> <li>- Rains pound Kenya.</li> <li>- 500 livestock drown in flooded Tana River.</li> <li>- One person and 500 cattle die due to floods in Northeastern Kenya.</li> <li>- More than 3,000 families are left homeless in various parts of the country due to floods.</li> <li>- Road transport is paralyzed in Kwale district after the heavy rains damage 16 roads.</li> <li>- 30 families are left homeless in Ruring`u Nyeri after their houses are flooded.</li> <li>- River Juba in Somalia is flooded causing extensive damage to infrastructure, farmlands and houses.</li> <li>- In southern Somalia famine is caused by floods, which have resulted to epidemics and food shortages.</li> </ul>
<p><b>Standard: 6 Nov. 1997</b></p> <p><b>Nation Report:</b></p>	<ul style="list-style-type: none"> <li>- The floods wash Msufini and Shibe bridges away.</li> <li>- There are disruptions of learning in schools in Nyeri after the Chania River burst its banks and floods extensive areas in the neighborhood.</li> <li>- There is interruption of wheat harvest in many parts of Nakuru district due to torrential rains</li> <li>- 100 families in Kirinyaga are rendered homeless due to floods.</li> <li>- Cows, goats and chicken are swept away in the floods when the Thiba River burst its banks.</li> <li>- Heavy rains kill 4 in central Kenya.</li> <li>- Rains continue to intensify at coast. Government is working on alternative routes to Kwale District as a short-term solution to the road crisis in the area.</li> </ul>
<p><b>Standard: 7 Nov. 1997</b></p> <p><b>Nation Report:</b></p>	<ul style="list-style-type: none"> <li>- UK soldier dies in floods in Mt Kenya forest.</li> <li>- Boy drowns in Mombasa. (Death toll in Mombasa 2).</li> <li>- 16 bridges are damaged in Kwale District due to floods.</li> <li>- One woman dies in Sagana River due to heavy rains.</li> <li>- Isiolo-Moyale road is damaged due to torrential rains.</li> </ul>
<p><b>Nation: 8 Nov. 1997</b></p>	<ul style="list-style-type: none"> <li>- A landslide occurred in Mathioya-Murang`a due to floods.</li> </ul>

<b>Standard: 9 Nov. 1997</b> <b>Nation Report:</b>	<ul style="list-style-type: none"> <li>- 40,000 peopled displaced in Mandera.</li> <li>- The floods damage Chania Bridge.</li> <li>- Landslide occurs at Muhoya due to heavy rains.</li> <li>- 16 bridges collapse in Coast due to heavy rains.</li> <li>- Heavy rains wreak Havoc in Central province.</li> </ul>
<b>Standard: 10 Nov. 1997</b>  <b>Nation Report:</b>	<ul style="list-style-type: none"> <li>- 15,000 marooned in Tana River.</li> <li>- More than 15,000 families in Garsen division of Tana River district are left homeless due to floods.</li> <li>- Bridges in Tana River District are swept away, roads cut and houses submerged in floodwaters.</li> <li>- There are shortages of fuel, food and other supplies in many parts of North Eastern Kenya due to floods causing poor road communication.</li> <li>- A 200m long stretch of the main Garissa-Thika road is severely damaged by the floods.</li> <li>- Bridge in Garissa is eroded and washed away by floods.</li> <li>- 5 people die in flood-related incidents countrywide.</li> <li>- Rain havoc leaves 5 more people dead in Makueni district.</li> </ul>
<b>Standard: 11 Nov. 1997</b>	<ul style="list-style-type: none"> <li>- Rains destroy wheat fields in Nyandarua and Laikipia.</li> </ul>
<b>Nation: 12 Nov. 1997</b>	<ul style="list-style-type: none"> <li>- 100 people in southern Somalia die due to heavy rains.</li> </ul>
<b>Nation: 13 Nov. 1997</b>	<ul style="list-style-type: none"> <li>- A landslide occurred in Murang`a due to torrential rains.</li> </ul>
<b>Standard: 14 Nov. 1997</b>  <b>Nation Report:</b>	<ul style="list-style-type: none"> <li>- 25,000 homeless due to floods in Tana River.</li> <li>- 25,000 people in Lamu are left homeless after extremely serious floods hit the area.</li> <li>- Floods wash more than 12,000 hectares of rice paddy in the Tana Delta rice irrigation scheme away.</li> <li>- Cholera epidemics break in Nyanza province due to floods.</li> <li>- Marsabit roads are left impassable after heavy rains.</li> </ul>
<b>Nation: 15 Nov 1997</b>	<ul style="list-style-type: none"> <li>- Another Landslide occurs in Muran`ga.</li> </ul>
<b>Nation: 16 Nov 1997</b>	<ul style="list-style-type: none"> <li>- People of Tana River District face starvation due to floods, which have adversely affected the road transportation systems.</li> </ul>
<b>Standard: 17 Nov. 97</b>	<ul style="list-style-type: none"> <li>- Malokote community is left homeless due to flood.</li> </ul>
<b>Standard: 18 Nov. 1997</b> <b>Nation Report:</b>	<ul style="list-style-type: none"> <li>- Soldier drowns in Mwingi.</li> <li>- Major City Roads now a nightmare.</li> </ul>
<b>Standard: 19 Nov. 1997</b> <b>Nation Report:</b>	<ul style="list-style-type: none"> <li>- Floods affect Mombasa, Nairobi and Kisumu.</li> <li>- Rain Havoc rises all round.</li> </ul>
<b>Standard: 20 Nov. 1997</b>  <b>Nation Report:</b>	<ul style="list-style-type: none"> <li>- Government declares NEP a flood disaster zone due to persistent heavy rains.</li> <li>- In Nairobi there are heavy traffic jams caused by heavy rains.</li> <li>- President declares North Eastern Province a disaster Zone.</li> <li>- Editorial: Set up committee to tackle rain disaster.</li> </ul>
<b>Standard: 21 Nov. 1997</b>	<ul style="list-style-type: none"> <li>- 12 people die of cholera in Mombasa due to poor sanitation as a result of widespread flooding.</li> </ul>
<b>Standard: 22 Nov. 1997</b>	<ul style="list-style-type: none"> <li>- 1 dies, 200 homeless, livestock drowned.</li> </ul>

<b>Nation: 24 Nov. 1997</b>	<ul style="list-style-type: none"> <li>- Rains cause more havoc: Refugee camps submerged in floodwaters.</li> <li>- Poor transport means in Tana River district, Garissa and some parts of Lamu districts due to floods causing exam papers to be delivered late in examination centers.</li> <li>- A section of refugee camp in Dadaab Garissa is submerged in water following heavy rains.</li> <li>- 20 people die in Eastern Uganda district of Mbale due to landslide, which is caused by the heavy rains.</li> <li>- 7 people die in different parts of the country due to floods.</li> </ul>
<b>Standard: 25 Nov. 1997</b>	<ul style="list-style-type: none"> <li>- 2 drown in Taita/Taveta as river bursts banks.</li> </ul>
<b>Nation: 27 Nov. 1997</b>	<ul style="list-style-type: none"> <li>- Grain farmers lose to rains.</li> <li>- There were losses of crops countrywide due to torrential rains.</li> </ul>
<b>Nation: 28 Nov. 1997</b>	<ul style="list-style-type: none"> <li>- Rains kill six in Wajir.</li> <li>- Six people died in Wajir due to floods.</li> </ul>
<b>Nation: 30 Nov. 1997</b>	<ul style="list-style-type: none"> <li>- 100 families in Garissa and Tana River district are left homeless due to the floods.</li> </ul>
<b>Standard: 1 Dec. 1997</b> <b>Nation Report:</b>	<ul style="list-style-type: none"> <li>- Floods in Tana River and Kendu Bay. Several feared dead.</li> <li>- Flooding Tana leaves 10 dead.</li> </ul>
<b>Nation: 2 Dec. 1997</b>	<ul style="list-style-type: none"> <li>- 29 people die of cholera in the city.</li> </ul>
<b>Nation: 2 Dec. 1997</b>	<ul style="list-style-type: none"> <li>- 10 people die in Garissa due to floods.</li> <li>- There are shortages of water in most parts of Nyeri after the floods pollute Chania and Muringato rivers.</li> </ul>
<b>Standard: 3 Dec. 1997</b> <b>Nation Report:</b>	<ul style="list-style-type: none"> <li>- El Niño drought looms over South Africa.</li> <li>- 5 more killed in floods since Tana River burst its banks 3 days ago.</li> </ul>
<b>Nation: 4 Dec. 1997</b>	<ul style="list-style-type: none"> <li>- The floods destroy 60,000 hectares of crops and farmland.</li> </ul>
<b>Standard: 5 Dec. 1997</b>	<ul style="list-style-type: none"> <li>- 3 die of cholera following floods in Garissa.</li> </ul>
<b>Standard: 6 Dec. 1997</b>	<ul style="list-style-type: none"> <li>- 100,00 rendered homeless in Tana River by floods. 4 people killed. 12000 acres of rice washed away.</li> <li>- More than 3,000 families are left homeless in Kibuyu and Chewele due to floods.</li> </ul>
<b>Standard: 8 Dec. 1997</b> <b>Nation Report:</b>	<ul style="list-style-type: none"> <li>- Over 1,500 people die in Somaliland due to floods.</li> <li>- 23,000 people are displaced in Somalia due to flood.</li> <li>- 6 people die of diarrhea in flood-hit Garissa district.</li> <li>- 40 families are left homeless after their houses are swept away by the floods.</li> </ul>
<b>Nation: 10 Dec. 1997</b>	<ul style="list-style-type: none"> <li>- 2,000 people are displaced in Kisumu due to floods.</li> </ul>
<b>Standard: 11 Dec. 1997</b> <b>Nation Report:</b>	<ul style="list-style-type: none"> <li>- El Niño rains cut down Ethiopia coffee output.</li> <li>- Floods displace hundreds of people in Kano and Nyakach area of Kisumu district.</li> <li>- 48,000 people are left homeless in Tana River district after their homes are flooded.</li> </ul>
<b>Standard: 12 Dec. 1997</b>	<ul style="list-style-type: none"> <li>- 1500 families rendered homeless in Rachuonyo due to flooding over River Miriu. Food airlifts to NEP.</li> </ul>
<b>Nation: 13 Dec. 1997</b>	<ul style="list-style-type: none"> <li>- 6 people are killed in Tana River district due to floods.</li> <li>- More than 65,000 people are displaced by the floods.</li> </ul>

<b>Standard: 14 Dec. 1997</b>	- El Niño floods render 1000,000 homeless in Tana River. Red Cross donates food. 20,000 assisted in NEP.
<b>Nation: 16 Dec. 1997</b>	- 5 people drown in Uwaso-Nyiro river and more than 5,000 people in the neighboring areas are displaced due to floods. - There is an increase of water-borne diseases in Isiolo District due to floods. - El Niño rainfall causes huge losses in unharvested maize and wheat in most parts of the country.
<b>Nation: 17 Dec. 1997</b>	- Flooding causes cholera outbreak in East Africa.
<b>Standard: 18 Dec. 1997</b>	- Supplement on "The fury of the climate child".
<b>Standard: 19 Dec. 1997 Nation Report:</b>	- 2000 trapped in homes due to floods in Nyando, Nyakach and Nakuru. El Niño hits coffee sales. - 300,000 Kenyans are facing hunger due to the destruction of their crops by the floods.
<b>Standard: 21 Dec. 1997</b>	- Floods wreak havoc in Teso rendering 2500 homeless.
<b>Standard: 22 Dec. 1997 Nation Report:</b>	- Landslides destroy property. - The floods leave 100 families in Busia homeless.
<b>Standard: 23 Dec. 1997 Nation Report:</b>	- Heavy rains cut off power on South Coast for a period of 3 days. - More than 40,300 refugees at Ifo camp in Dadaab Garissa were left homeless due to heavy rains. - Water-borne diseases break out in Ifo camp due to floods. - The Murang'a -Kabati bridge is damaged by flooding waters
<b>Standard: 29 Dec. 1997 Nation Report:</b>	- El Niño floods affect national polls. 5 people killed in Mombasa.  - 10 people die of cholera in Garsen Division due to floods.
<b>Standard: 31 Dec. 1997 Nation Report:</b>	- Man killed in Narok. Thousands unable to vote in Narok due to lack of bridge. - More than two million people countrywide are in need of food aid following the destruction of their crops by floods.
<b>Nation: 9 Jan. 1998</b>	- 21 people die in Kenya due to floods.
<b>Nation: 10 Jan. 1998</b>	- Nyeri roads a nightmare. - Floods sweep away 30 houses in Nyatike division of Migori district. - Bridge washed away in Meere district.
<b>Nation: 12 Jan. 1998</b>	- Deadly fever claims more than 350 lives in NE province. - Growing danger as roads collapse. - El Niño back with a Vengeance. Food shortages to follow in its wake.
<b>Nation, 13 Jan. 1998</b>	- Despair mounts in floods havoc. - Rains halt repair on Mombasa road.
<b>Nation, 14 Jan. 1998</b>	- Government moves as rains havoc grows.
<b>Nation: 15 Jan. 98</b>	- 5 people died in Nairobi due to floods. - The floods displace 60 families in Kisiiki village Machakos. - Floods: 5 drawn in the City.

<b>Nation: 16 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Editorial: El Niño weather danger not yet over.</li> <li>- Chaos, Agony in torrential rains: City gets 180mm, Kericho 49, Dry at Coast.</li> <li>- President says Government to start emergency food distribution to all areas under floods.</li> <li>- National Meteorological Centre update says situation is likely to continue.</li> <li>- Back page: Deadly disease strikes in Marsabit and kills 20 people.</li> </ul>
<b>Nation: 17 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Rains close off Mombasa Road.</li> <li>- Kenya Power and Lighting Company (KPLC) acts to restore affected supplies.</li> <li>- Heavy rains ground planes.</li> </ul>
<b>Nation: 18 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Nairobi-Mombasa highway temporarily reopened.</li> <li>- Kenyans count their losses as rains havoc continues.</li> <li>- Flooding claims 86 lives countrywide. Coast 38, Nairobi 8, Rest of Country 40.</li> </ul>
<b>Nation: 19 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Landslide displaces 20 Limuru families.</li> </ul>
<b>Nation: 20 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Driver dies in the 10km long Jam.</li> </ul>
<b>Standard: 21 Jan. 98 Nation:</b>	<ul style="list-style-type: none"> <li>- 7 people die of cholera in Siaya due to floods.</li> <li>- Leaders meet over El Niño Disaster. MPs from NE province, Diplomats and Donor Agencies met yesterday in Nairobi over the devastation that El Niño weather phenomenon continues to cause in the region.</li> <li>- Government moves on floods. President chairs a meeting of the National Disaster Committee in his office.</li> <li>- A 24 hr. Unit (National Operations Centre) is set up to strengthen and co-ordinate the operations of the NDC.</li> <li>- El Niño: Military involved. The military has identified 12 bridges countrywide where the army men and Public Works Department were ascertaining the extent of damage with a view to repairing them.</li> </ul>
<b>Nation: 22 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Experts predict dry spell in April.</li> </ul>
<b>Nation: 23 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Mombasa Road woes persist as snarl-up continues.</li> <li>- Back page: Disease kills 24 people in Marsabit.</li> </ul>
<b>Nation: 24 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Increase in Cholera linked to flooding.</li> </ul>
<b>Nation: 25 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- El Niño Damage - More than 8 Billion Required.</li> </ul>
<b>Nation: 26 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Turkwel and Kerio rivers are flooded.</li> </ul>
<b>Nation: 27 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Back page: World Bank in Roads pledge.</li> </ul>
<b>Nation: 28 Jan. 1998</b>	<ul style="list-style-type: none"> <li>- Floods affect over 300,000 families in Kenya.</li> </ul>
<b>Nation: 2 Feb. 1998</b>	<ul style="list-style-type: none"> <li>- Thange Bridge on the Nairobi-Mombasa highway is swept away by floods.</li> <li>- More than 30 people die of malaria in Kisii due to floodwaters.</li> </ul>
<b>Standard: 5 Feb. 1998</b>	<ul style="list-style-type: none"> <li>- Schools and Health centres in Garissa are closed due to impassable roads.</li> </ul>
<b>Standard: 13 Feb. 1998</b>	<ul style="list-style-type: none"> <li>- There is food shortage in most parts of Nyeri because of crop damage by heavy rains and breakdown of road communication due to road damages.</li> </ul>

<b>Standard: 18 Feb. 1998</b>	- 118 people die of malaria in Kericho due to the El Niño rains.
<b>Standard: 21 Feb. 1998</b>	- 200,000 children are suffering from the worst effects of El Niño.
<b>Standard: 10 Mar. 98</b>	- 9 people die of Malaria in Kisii due to extensive flooding
<b>Standard: 11 Mar. 98</b>	- 35 die of cholera in Mandera due to extensive flooding.
<b>Standard: 19 Mar. 98</b>	- 6 people die of cholera in Busia due to floods.
<b>Standard: 24 Mar. 98</b>	- Due to floods, people from Bundalagi constituency of Busiadistrict are suffering from kwashiorkor and typhoid.