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Adaptation

Technical Report 6

**Briefing Papers Reviewing Current Sectoral Plans and Policies
and their Coverage of Climate Change**

AUGUST 2012



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Report prepared by:



LTS International
Pentlands Science Park, Bush Loan, Penicuik,
EH26 0PL, UK
Tel: +44.131.440.5500
Fax: +44.131.440.5501
Skype: LTSInternational
Website: www.ltsi.co.uk



Acclimatise
Hexgreave Hall, Farnsfield, Newark,
Nottinghamshire
NG22 8LS, UK
Tel: +44 (0) 1623 884347
Website: www.acclimatise.uk.com

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1. Building Climate Change into the Agriculture Sector MTP – Achievements and Recommendations for Planning

1.1 Summary

This briefing paper is targeted at policy makers and planners who will be instrumental in the development of the new agriculture MTP from 2013-2017.

This note presents the findings of a review of the sector which: identifies the climate change risks associated with the sector; assesses what has been done so far to incorporate climate change issues into the sector in the current Medium Term Plan (MTP) 2008-2012; and gives recommendations to be considered in the next MTP process due to commence in July 2012.

Agriculture is the priority sector for Kenya, and is highly vulnerable to climate change. Consequently, a number of adaptation actions and initiatives are already in place through current programmes and projects. Future policy and the next MTP will need to learn from experience and consider a number of issues and recommendations, which are offered here.

1.2 Setting the scene – the importance of agriculture to Kenya and climate change

The Agriculture and Rural Development Sector (ARD) is very important in Kenya. It directly contributes twenty six per cent of the GDP annually (valued at Kshs three hundred and forty two billion), and another twenty seven per cent indirectly (valued at Kshs three hundred and eighty five billion) through linkages with manufacturing, distribution and other services related sectors. The sector accounts for sixty five per cent of Kenya's total exports, eighteen per cent and sixty per cent of the formal and total employment respectively, and has been identified as one of the six sectors aimed at delivering the ten per cent economic growth rate under the Vision 2030¹.

The sector's main objective is to address food insecurity and poverty challenges. It therefore focuses on activities aimed at improving crops, livestock and fisheries in a bid to safeguard real farm incomes in order to ensure availability and access to quality food. The current trend in Kenya is to transform subsistence agriculture into commercial production through value addition while ensuring environmental conservation and the balance of the ecosystem².

At the same time, agriculture is recognised as having real linkages with climate change. It contributes a significant amount of the greenhouse gas (GHG) emissions which contribute to climate change, either through agronomic practices that release sequestered carbon, livestock keeping, or the use of nitrogen-based inputs and fossil fuel powered equipment. The resilience of agriculture to climate change, particularly for rural small-scale farmers, is often compromised by the variability, uneven distribution and unpredictability of rainfall. Therefore, in agriculture, farmers are faced with increasing variability and unpredictability in the climatic conditions they rely on, and therefore their livelihoods are threatened.

Kenya is undertaking a National Climate Change Action Planning process that seeks to operationalise the National Climate Change Strategy that was launched during COP16 in Durban. This focuses on a low carbon, climate resilient development pathway, which means that all sectors of the economy need to be "climate proofed". This paper assesses what has been done so far to incorporate climate change issues into the sector (in the current Medium Term Plan (MTP) 2008-2012) and recommends how this can be better done in the next MTP process due to commence in July 2012.

1.3 The Agriculture Sector – challenges and goals

The agriculture sector has a total of seven subsectors (Crops, Livestock, Fisheries, Co-operatives, Northern Kenya and Arid Lands, Regional Development and Private Sector).

1.3.1 Challenges

These subsectors are facing challenges which are recognised to include: unfavourable climatic changes, poor planning and inadequate warning systems, low production and productivity, poor marketing and marketing infrastructure, low value addition and competitiveness, inadequate physical infrastructure, unfavourable legal and policy frameworks, low access to financial services and affordable credit and limited resources for implementation of programmes³.

1.3.2 Policy goals

The key policy goals of the sector include:

- raising agricultural productivity through generation and promotion of technologies and increased resource allocations;
- exploiting irrigation potential;
- increased commercialisation of agriculture;
- undertaking a comprehensive review of the legal and policy framework for the sector;
- improving governance of sector institutions;
- land development; and
- promotion of sustainable management of fisheries, forestry and wildlife resources.

The key programmes in the sector include: policy regulation and coordination, strategy and management of agriculture; crop development and management; agribusiness and information management; fisheries development; cooperative development and management; cooperative marketing; land policy and planning; livestock resources management and development; forestry and wildlife development; and research and development.

1.3.3 Climate change challenges recognised

The sector is ahead of most other sectors as it recognises climate change as a challenge in its current sector plans. The Medium Term Expenditure Framework (MTEF) review report acknowledges that to enhance productivity of the sector the potentially devastating effects of climate change is one of the key issues (along with volatile food prices, population growth, low agricultural productivity) that will need to be addressed. The sector has therefore committed to continue to explore new approaches and invest heavily in projects that address climate change, such as public-private partnerships (PPP), for example the crop and livestock insurance schemes. The current MTP identifies a number of flagship projects to address the challenges, which are currently being implemented:

- Fertiliser flagship project, under the crop sub-sector.
- Disease free flagship project, under the livestock sector.
- Arid and Semi-Arid Lands development project and water harvesting and supply for irrigation and livestock use, under the Northern Kenya and Arid Areas subsector.

1.4 Climate change - risks and impacts for the Agriculture sector

The agriculture sector is one of the economic sectors in Kenya most vulnerable to climate change, as shown in a recent risk assessment⁴.

The main climate change predictions for Kenya include:

1.4.1 Sea levels rise

According to a risk assessment report⁵ in the twentieth century, sea levels rose by an estimated 17 cm; the global mean projections for sea level rise by the turn of the twenty first century range from 17 cm to 59 cm. An associated rise in the coastal zone ground water table is expected.

1.4.2 Storms, rains and flooding

Some areas of Kenya, such as Coast Province, are already prone to torrential rains and flooding which cause problems, but the probability (i.e. likely frequency) and severity of such storm events will increase.

1.4.3 Higher temperatures

The Kenya Meteorological Department (KMD) has provided data of temperature and rainfall changes in Kenya over the last fifty years. From the early 1960s, Kenya has generally experienced increasing temperatures over vast areas. Over inland areas, the trends in both minimum (night-time/early morning) and maximum (daytime) temperatures depict a general warming through time⁶. In addition, rising temperatures are expected to strengthen coastal winds and storms.

The climate predictions for Kenya raise a number of risks and impacts for the agriculture sector. Some crops are expected to experience more favourable growing conditions as a result of climate change, whereas others will find future climatic conditions intolerable. Equally, some regions (namely the mixed rain-fed temperate and tropical highlands) are projected to experience an increase in crop yield, whereas others (namely the Arid and Semi-Arid Lands (ASALs) are projected to witness a significant decline in crop yields and livestock numbers, as water resources become increasingly scarce. These patterns are largely driven by regional variability in future precipitation and geographic exposure to extreme events, particularly drought frequency⁷.

A number of specific livelihood risks have been identified and are summarised below⁸:

1.4.4 Less days for crop growth

Both incremental (gradual) climate change and more frequent extreme events such as flooding and prolonged drought will cause a decrease in reliable cropping days, making crop failure more likely.

1.4.5 Less water availability for crop growth

An increase in average annual temperature and increase in evapotranspiration will decrease water availability and cause a decrease in agricultural productivity, particularly in the arid and semi areas which are already experiencing prolonged drought.

1.4.6 More droughts

The increased frequency of droughts causes water shortages for domestic use, crop and livestock agriculture.

1.4.7 Unpredictable climate patterns disrupt agricultural planning

Unpredictable precipitation during both the short and long rains, together with extreme events, particularly increased frequency of droughts, causes a decline in agricultural productivity, including livestock-based (particularly a problem in the ASALs). Changes in the timing of long and short rains make it difficult to plan sowing and harvest times, causing lower maize yields and greater food insecurity.

1.4.8 Increased flooding of agricultural land

Extreme events, particularly the El Niño rains, cause flooding of agricultural land and destruction of crops.

1.4.9 Temperature changes affect crop potentials

Increase in average annual temperature causes shifts in tolerable limits for some crops (e.g. tea and coffee), and causes decline in fish stocks in lakes and rivers. Also, extreme temperature changes cause frostbite in the tea estates resulting in low tea productivity negatively affecting the private sector and livelihoods of local communities.

1.4.10 More pests

Incremental climate change causes biodiversity loss and emergence of new pests.

1.5 Current status of Climate Change in Agriculture Sector

A look at the risk assessment conducted for this sector shows that more integration of climate change issues into planning and implementation is taking place in this sector compared to other government sectors. This can be attributed to the sector being the main priority for the country and being the most vulnerable to climate change impacts. The Agriculture Sector Development Strategy (ASDS) 2010-2020 specifically outlines the implementation of the National Climate Change Response Strategy (NCCRS), noting in part that

“Climate fluctuations have a bearing on the way the environment and natural resources are managed ... and the effect has been unpredictable weather that in turn has affected agricultural activities.”⁹

Under the Northern Kenya and Arid Lands sub-sector the main challenge cited is the high impact of drought on local communities which causes food insecurity and contributes to the increase of poverty in the arid areas. The unpredictability of the weather, long dry spells, and flash flooding (all attributes of climate change), along with weak natural resource management systems, have led to the destruction of property and loss of human life and livestock.

These climate issues are all mentioned in the MTP as issues that need to be addressed in the sector. The MTP also recognises that climate-related destruction of the natural environment is causing concern in the sector, as increased flooding and occurrence of landslides have resulted in loss of agricultural land. In addition, human-wildlife conflict, which may or may not be attributed to climate change and drought in particular, is a major threat to agricultural productivity. It is recognised that temperature rises may also affect fish stocks which means the fisheries sector needs to adapt. Under the fisheries sub sector diminishing fish stocks are cited as an impediment in realising the potential of the sector¹⁰.

The MTEF (2011) report clearly states that emerging concerns such as the effects of climate change, adaptation and mitigation measures will need to be mainstreamed in the sector's programmes and projects. To this end the Ministry of Agriculture has established a climate change unit to monitor and mitigate against the effects of climate change. The Ministry of Agriculture is in the process of developing a policy of how to mainstream climate change within the sector and various climate change adaptation pilot projects are being implemented in various parts of the country.

Examples of climate change adaptation pilot projects:

- In collaboration with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) the Ministry of Agriculture is piloting ‘Adaptation to Climate Change and Insurance’ (ACCI) in Homa Bay and Busia counties. The objective of the programme is that *‘Farmers as well as stakeholders along selected value chains increase their adaptive capacity to adapt to climate change by making use of climate risk measures’*¹¹.
- The Kenya Agricultural Research Institute (KARI) under the Ministry is also implementing climate change adaptation programmes and projects under the Kenya Agricultural Productivity the Agribusiness Programme, the East Africa Productivity Project and research through the KARI Climate Change Research Fund amongst others.

1.6 Recommendations for future policy and planning

It is clear from the above sections that the ARD sector is already responding to the effects of climate change, and a lot of effort has gone into integrating climate change impacts into agricultural programmes and projects. Climate change still has to be integrated at the sector policy level and it is expected that climate change mainstreaming will feature even more prominently when the new agriculture sector MTP (2013-2017) is developed. In particular, adaptation efforts should focus on implementing measures that help build rural livelihoods that are more resilient to climate variability and disaster¹².

Based on the learning from these previous and ongoing efforts, the review of the current MTP has identified a number of opportunities for enhancing integration of climate change issues. Any forthcoming policy revisions and the new MTP will need to consider a number of additional points.

1.6.1 Risk/vulnerability assessments and climate change modelling

Plans should emphasise the importance of investing in risk/vulnerability assessments and climate change modelling in the different agro-ecological zones. The information generated will give an indication of how different crops/livestock breeds will perform under different climate conditions in the short, medium and long term so that relevant programmes and projects are developed.

1.6.2 Climate change research outputs

The research institutions in the sector (e.g. Kenya Agricultural Research Institute (KARI), the Tea Research Foundation of Kenya (TRFK), Coffee Research Foundation (CRF), International Livestock Research Institute (ILRI), International Center for Insect Physiology and Ecology (ICIPE), National Horticulture Research Centre (NHRC) amongst others) should be utilised to inform the development of agricultural programmes and projects at national and county levels. These institutions are conducting relevant climate change research and also testing different varieties of crops and livestock breeds for suitability to a changing climate (including changes in precipitation, temperature, pest prevalence, amongst other risks).

1.6.3 Product value chain

Planners should consider climate change impacts not only on agricultural production but on the entire value chain of various agricultural products so that relevant adaptation decisions are made with respect to enhancing resilience of the value chains. This will include close collaboration with the trade, industry and physical infrastructure sectors and the Kenya Private Sector Alliance (KEPSA).

1.6.4 Insurance mechanism

Integrate the establishment of an insurance mechanism that cushions both small and large scale farmers against the negative impacts of climate risks into planning especially at county level. Projects such as the UAP Syngenta and the GIZ adaptation to climate change and insurance (ACCI) are already piloting this and their experiences and lessons learnt can be used for planning purposes.

1.6.5 Long-term impacts of irrigation projects

Ensure when planning for small and large scale irrigation projects that their long term impacts on vulnerabilities has been determined as a decrease in available water for irrigation due to climate change can enhance vulnerabilities in the long term.

1.6.6 Screening against maladaptation

Provisions for screening the Vision 2030 flagship projects and other projects under the sector should be incorporated into the MTP to ensure that they do not lead to maladaptation in the long term.

1.6.7 Avoiding additional GHG emissions

Future plans should put in place policies which will ensure that large scale agricultural programmes are designed with appropriate measures that mitigate against the addition of GHGs into the atmosphere through land emissions.

2. Reinforcing Climate Change Planning in the Environment, Water and Sanitation Sector

2.1 Summary

This briefing note is targeted at policy makers and planners who will be instrumental in developing the new Water and Sanitation Medium Term Plan (MTP) for 2013-2017.

The note highlights the significant risks to the environment, water and sanitation sectors when climate change is not considered in planning. It makes recommendations for enhancing climate change issues within the sector's next MTP. The recommendations are based on evidence from a review of the current (2008-2012) environment, water and sanitation sector MTP.

Key recommendations for the sector planners include:

- Ensuring that the climate change policy, environment policy and climate change bill are all synchronised.
- Ensuring that the National Climate Change Action Plan is integrated in the next MTP process beginning July 2012.
- Ensuring that an appropriate climate change institution is established with the mandate of coordinating climate change issues across all ministries at national and county levels.
- Ensuring that risk and vulnerability assessments are factored into the sector's programmes.
- Capacity development of the Kenya Meteorological Department and the National Environmental Management Authority is prioritised.
- Resources allocated to public awareness programmes on climate change are increased.
- The domestication of the Africa Plan of Action in Public Health Adaptation to Climate Change is fast tracked.

2.2 Introduction

The environment, water, health and sanitation sectors are crucial to the overall social and economic aspects of human living. Kenya Vision 2030, which is Kenya's national planning and development strategy for the years 2008 to 2030 recognizes social and economic factors as two of the three "pillars" forming the basis of the Vision. The social aspect, significantly affected by water, sanitation and health sectors, recognises that for Kenya to prosper, a just and cohesive society has to be built; one where equitable social development in a clean and secure environment are available to all¹³.

The sector includes four sub-sectors represented by five ministries, namely; Environment and Mineral Resources, Public Health and Sanitation, Special Programmes, and Development of Northern Kenya and Other Arid Lands¹⁴. The mission of the sector overall is "to promote, conserve and protect the environment and natural resources sustainably for national development."

2.3 Climate Change Risks and Impacts on the Environment, Water and Sanitation Sector

Climate change risks have already had an effect on the sector, and further impacts are predictable.

- Extreme weather conditions characterised by a rise in temperature and irregular or increased rainfall have affected the environment and sporadic rainfall which have led to droughts and floods in various parts of the country¹⁵.
- With prolonged droughts and the variability of rainfall, water bodies such as rivers and lakes and their associated biological systems are bound to be affected¹⁶ with the consequence that the integrity of these ecosystems and the services they provide being reduced.
- A decrease in annual mean and seasonal precipitation will cause a decline in deciduous and semi-deciduous closed-canopy forests, with the consequence that environmental degradation occurs.
- The increased frequency of droughts will cause negative impacts on wetlands, with the consequence that environmental degradation occurs¹⁷.
- Climate change is likely to cause changes in water availability in terms of quantity and quality. This will result in extreme competition of the resource¹⁸. This can lead to increased water resource conflicts between upstream and downstream users and between agriculturalists and pastoralists. Migration of people is also likely to increase during water scarcity periods, which also affects human health¹⁹.
- At the coast a rise in sea water levels is likely to contaminate coastal aquifers and render ground water resources therein unavailable for domestic, agricultural and industrial use due to saline intrusion. This will also affect the integrity of the ecosystem services provided by estuaries and wetlands²⁰.
- An increase in average annual temperature and increased evapotranspiration rates will also cause water losses from open water bodies, with the consequence that environmental degradation occurs, including declines in fish stocks²¹.
- With respect to gender, particularly increased frequency of droughts and flooding, causes unsuitable living and working conditions (e.g. in internally displaced people's camps) with the consequence that gender inequality increases, with the disempowerment of women²².
- In the health and sanitation sub-sector, increased temperature and rainfall may lead to an increased spread of various diseases in Kenya, such as malaria, yellow fever, ebola and tuberculosis²³. In addition the reduction of surface water will increase the exploitation of ground water which will lead to more people suffering from diseases such as fluorosis, diabetes and hypertension. This is because ground water in some areas such as the Rift Valley in Kenya has been shown to contain specific compounds such as high fluoride levels, high sodium level and low chromium levels which are directly associated with the increased emergence of these diseases²⁴.
- Water scarcity, due to increased temperatures, has also been linked to an increase in the incidence of diarrheal diseases, such as cholera, where sanitation facilities are poor.
- Increased precipitation may accelerate the spread of these diseases by overflow of sewage from latrines and run-off into water sources causing contamination²⁵.
- Pollution of fresh water, mainly from agricultural farms, industrial establishments and inadequate waste water conveyance and treatment systems in urban centres will be exacerbated²⁶.

2.4 Current status of Climate Change in the Environment, Water, and Sanitation Sector Plan

The current 2008-2012 MTP acknowledges that, in order to achieve goals set out in the Vision 2030, challenges facing the sector need to be addressed. These include: pollution and waste management, water scarcity, catchment degradation, poor physical planning in urban centres, low water resource monitoring and climate change.

It also acknowledges that, with global changes in climate and weather patterns, planning for adequate water resources is becoming increasingly difficult - rainfall patterns become unreliable and more complex to forecast. Thus rain-fed agriculture is no longer reliable, which means there is a need for an increase in the use of water harvesting technologies and storage.

The plan also spells out the impacts that recurring drought has had on the economy. For example droughts have resulted in the loss of vegetation cover that reduces available forage that supports human and animal life. The consequence has been high animal mortality, famine and lack of drinking water. In addition, droughts have led to power and water rationing in major urban centres and pastoralist communities have suffered loss of livelihoods as a result of prolonged and recurring droughts. However whilst significant progress has been made in drought management, efforts to address drought-related problems have not yet fully succeeded, thus the need for institutionalizing a well-established drought management strategy²⁷.

The sector's MTP (2008-2012) therefore outlines strategies that need to be taken in order to address the above challenges. These include:

- The need to modernise the detection and prediction monitoring infrastructure that will help in strengthening attribution and develop scenarios for developing appropriate adaptation and mitigation strategies to reduce the negative impact of the adverse effects.
- The formulation of an environment and climate change response policy and related, laws and national strategy.
- The increase of irrigated land to one million three hundred hectares from five hundred and thirty thousand hectares through enhanced water storage capacity.
- Increasing the conservation of the water towers by strengthening of forest governance structures such as Community Forest Associations, Water User Associations and communities so that forest cover can be increased to ten per cent from the current one decimal point seven per cent
- Establishment of databases for natural resources e.g. water, forests, wildlife, biodiversity and minerals, pollution status on chemical waste chemical stockpiles and obsolete pesticides.
- Establishment of a Green House Gas inventory for informed decision making.
- Harmonisation of policies and regulations in the sector. Under this action the Ministry of Environment and Mineral Resources (MEMR) developed a draft Environment Policy. This however is yet to be finalised. Currently a new Climate Change Policy is being considered and there is a draft Climate Change bill that was developed by a Member of Parliament which does not link to the environment and climate policies. All these processes are not synchronised.
- Rehabilitation of degraded land through youth programmes.
- Environmental awareness and education. This is currently on-going through the Wildlife Clubs of Kenya and other non-governmental organisations. However the levels of climate change knowledge are still low in the general public. Information from the county consultations held on climate change by the MEMR show that the more resources need to be directed to public education and awareness programmes.

- Development of Payment for Ecosystem services amongst others.

The Ministry of Environment and Mineral Resources (MEMR) has made great strides in the delivery of some of its plans. For example in 2010 the National Climate Change Response Strategy (NCCRS) was launched in Copenhagen during COP 15. In 2011 the National Climate Change Action Planning process began and will be finalised in 2012. The action plan will outline Kenya's low carbon climate resilient pathway through the implementation of a climate change policy, a national adaptation plan, a national appropriate mitigation plan, a national technology plan, a national performance and benefits measurements framework, a knowledge management and capacity building plan and a finance strategy. All these components are meant to be delivered under a suitable institutional framework. However it is unclear how the National Action Plan is going to be implemented especially under the decentralised government which will be operationalised after the next general elections.

The National Environment Management Authority under the Ministry has also compiled a GHG inventory which will be useful in the reporting of GHG emissions as per international obligations under the United Nations Framework Convention on Climate Change in order to ensure a low carbon pathway.

Other institutions such as the Water Resource Management Authority (WRMA) under the Ministry of Water and Irrigation are developing a Water Resources Information Management System (WRIMS) for water modelling and forecasting. When fully operational, water allocation will be fully automated. It will also help forecast future water scenarios and hence effectively equip WRMA in addressing water scarcity related conflicts²⁸. Climate change is also meant to be integrated into the Water Resource Users Association Development Cycle training manual by WRMA.

The capacity of the Kenya Meteorological Department under MEMR is also being built through various programmes so that they are able to disseminate timely climate data and information to various stakeholders who can then use the information to make decisions on climate change adaptation and mitigation actions²⁹.

In 2011, the Ministry of Northern Kenya and other Arid Lands developed an addendum to Vision 2030 and a sessional paper that detailed a development strategy for Northern Kenya and other arid and semi-arid areas (ASALs). In this addendum climate change impacts and measures to address them were identified. The Ministry has already begun the implementation of some of the actions such as the establishment of a National Drought Management Authority. This authority will implement disaster risk reduction measures especially in the ASALs which make up about eighty per cent of Kenya's landmass.

In the health sector, Kenya has already adopted a Public Health Adaptation Strategy for Africa³⁰ and therefore the Ministry of Health is required to formulate its national strategy from this document. The health sector adaptation actions that have been developed under the National Adaptation Plan³¹ will contribute to health sector's national strategy.

The environment, water, health and sanitation sectors are interconnected and climate change impacts in the environment and water sector also impacts the health and sanitation sector in various ways and thus actions in these sectors need to be looked at holistically in order to avoid maladaptation.

2.5 Summary Recommendations

- The overall environment, water and sanitation sector has already begun integrating climate change into its planning processes and programmes and the momentum needs to continue. The MEMR needs to ensure that the National Climate Change Action Plan is integrated in the next MTP process beginning July 2012 by ensuring buy in from key stakeholders within the Ministry of Planning and the Ministry of Finance. Once these two ministries integrate and budget for the proposed climate adaptation and mitigation actions, Kenya will begin its journey on the low carbon climate resilient pathway.

- The MEMR needs to take leadership in the development of the institutional framework that will coordinate the delivery of the National Climate Change Action Plan and its component. Needless to say, climate change is **NOT** an environment issue only as it affects all sectors of the economy. Thus the housing of the climate change function/institution will be of utmost importance if Kenya is to attain a low carbon climate resilient Vision 2030. The institution will need to be resourced appropriately and adequately and have a coordinating mandate across all ministries both at national and county levels.
- Risk and vulnerability assessments of various sub-sectors within the sector will need to be factored into the next environment, water and sanitation MTP plan so that the relevant ministries can make informed decisions regarding impacts of climate change in their respective programmes.
- Enhanced capacity building of the institutions that generate climate change information (KMD) and enforce environment laws (NEMA) will need to be prioritised in the next MTP. These institutions lack adequate technical, human and financial resources, yet decision making on climate change by all sectors of the economy requires accurate and timely information from them.
- Synchronisation of relevant laws and policies is urgently required.
- Public awareness and education on climate change impacts will also need to be enhanced because when the general public has the relevant knowledge on how climate change is affecting their lives, they are able to make appropriate decisions thus building their adaptive capacities.
- The Ministry of Public Health needs to fast track the domestication of the The African Plan of Action for Public Health Adaptation to Climate Change that was published in 2012.

3. Building climate change planning for the TTI sector

3.1 Summary

This briefing note is targeted at policy makers and planners who will be instrumental in developing the new infrastructure Medium Term Plan (MTPs) for 2013-2017.

The note highlights the significant risks to the Tourism, Trade and Industry sectors when climate change is not considered in planning. It makes recommendations for enhancing climate change issues within the Tourism, Trade and Industry sector's next MTP. The recommendations are based on evidence from a review of the current (2008-2012) sector MTP.

Key recommendations for the sector planners include:

- Recognise and better understand climate impacts on the sector through research in order to effectively inform policy and planning.
- Generate data to inform decision-making from risk/vulnerability assessments and scenario modelling in different bio-geographical regions.
- Screen projects for climate adaptation: The flagship projects under this sector will also need to be screened for climate change adaptation so as to ensure that they are climate proofed.
- Take a holistic, multi-sector approach by considering climate change impacts in other natural resource sectors
- Improve education and awareness on the climate change impacts on the sector by factoring it into the forthcoming MTP for 2013-2017

Kenya is undertaking a National Climate Change Action Planning process that seeks to operationalize the National Climate Change Strategy that was launched during COP16 in Durban. This focuses on a low carbon, climate resilient development pathway, which means that all sectors of the economy need to be "climate proofed". This paper assesses what has been done so far to incorporate climate change issues into the TTI sector (in the current Medium Term Plan (MTP) 2008-2012) and recommends how this can be better done in the next MTP process due to commence in July 2012.

3.2 The importance of the TTI sector

The Trade, Tourism and Industry (TTI) sector overall contributes significantly to the overall national development agenda as envisioned by the Kenya Vision 2030, by overseeing the fast tracking of the East African Community (EAC) regional integration initiatives, poverty reduction and creation of employment opportunities. The Sector also plays a significant role towards achievement of the Millennium Development Goals (MDGs)³². The Trade, Tourism and Industry (TTI) sector comprises the sub-sectors of Trade, East African Community, National Heritage & Culture, Tourism, and Industrialization. This paper focuses on Tourism and on Trade and Industry.

The current MTP provides data that shows the importance of the TTI sector. The Tourism sub-sector alone currently accounts for about 10% Kenya's Gross Domestic Product (GDP), making it the third largest contributor to the Gross Domestic Product (GDP) after agriculture and manufacturing. It is also Kenya's leading foreign exchange earner and major (and growing) source of employment. It generated about KSh sixty five billion in 2007, up from KSh twenty one decimal point seven billion in 2002. Between 2003 and 2007, the sector's

contribution to employment generation grew at rate of three per cent annually, while earnings per employee rose by eighteen per cent³³.

The Trade and Industry sub-sector (including informal and formal trade) accounts for approximately ten per cent of GDP and ten per cent of formal employment. However, most of the employment in trade is in the informal sector, providing about ninety eight per cent of total employment in Kenya and contributing about eighty seven per cent of new jobs in 2005/06. Kenya's external (foreign) trade is primarily in the services, agriculture and manufacturing sectors. In 2006, trade in these sectors made up 61.3% of the Trade & Industry sub-sector's GDP (ie 61.35 of the 10%), with exports accounting for 25.5% of that and imports 35.9%. In 2007, merchandise trade contributed about 60.6% of total exports, while services share of exports was about 38.8%. Overall, the services sector in 2007 accounted for about 60% of Kenya's GDP, with leading contributors being transport and communication (23.3%), postal and telecommunication (17.3%), and wholesale and retail trade (15.6%)³⁴.

3.3 Climate change risks and their impact on TTI sector

The main climate change predictions for Kenya include:

3.3.1 Sea levels rise

According to a risk assessment report³⁵ in the 20th century, sea levels rose by an estimated 17 cm; the global mean projections for sea level rise by the turn of the twenty first century range from 17 cm to 59 cm. An associated rise in the coastal zone ground water table is expected.

3.3.2 Storms, rains and flooding

Some areas of Kenya, such as Coast Province, are already prone to torrential rains and flooding which cause problems, but the probability (i.e. likely frequency) and severity of such storm events will increase.

3.3.3 Higher temperatures

The Kenya Meteorological Department (KMD) has provided data of temperature and rainfall changes in Kenya over the last fifty years. From the early 1960s, Kenya has generally experienced increasing temperatures over vast areas. Over inland areas, the trends in both minimum (night-time/early morning) and maximum (daytime) temperatures depict a general warming through time³⁶. In addition, rising temperatures are expected to strengthen coastal winds and storms.

Recent, and largely anecdotal, evidence shows that the TTI sector is being affected by climate change in a number of ways, as shown in the examples below.

3.4 Tourism sub-sector risks

- The National Climate Change Response Strategy (NCCRS) showed that climate change affects a wide range of the environmental resources that are critical attractions for tourism, such as wildlife productivity and biodiversity, and water levels and quality. Climate also has an important influence on environmental conditions that can deter tourists, including infectious disease, wildfires, insect or water-borne pests (e.g., jellyfish, algae blooms).
- Extreme events such as flash floods have at times rendered some tourist destinations (e.g. Masai Mara in 2011) inaccessible due to the destruction of the road infrastructure.

- Cases of wildlife deaths have increased in the recent past³⁷. Lately, the reduction in the volume of the Mara River (due to climatic variations and the destruction of the Mau catchment) has taken a toll on the eighth wonder of the world – the migration of wildebeests between the Serengeti National Park (Tanzania) and the Maasai Mara Reserve (Kenya) across the Mara River³⁸.
- According to the Kenya Wildlife Service (KWS), drought has also pushed lions closer to waterholes near human settlements, thereby exacerbating human-wildlife conflicts.
- Temperature rises are likely to disrupt and even destroy some of the tourist attractions such as the snow-caps of Mt. Kenya, the coastal rainforests and fragile marine ecosystems. For instance ‘coral bleaching’ of the Kenya coral reef has been observed.
- The NCCRS projects that some wildlife diseases will increase with climate change and these include *babesiosis* and *trypanosomiasis*, as well as a host of intestinal and external parasites. In 2007, drought-induced anthrax in Northern Kenya plains infested Grevy’s zebras living in and near Samburu National Reserve, and almost wiped them out.

3.5 Trade and Industry subsector risks

- According to a recent risk assessment report³⁹ an increase in average annual temperature and humidity causes heat stress for workers, with the consequence that business continuity and productivity is affected.
- Extreme events can cause real problems. For example, increased frequency of droughts have caused water scarcity with the consequence that hydro-electric power generation is compromised. This means that businesses face disruption (through lack of electricity) and additional operational costs of running generators or having to pay more for electricity due to increased use of thermal-based sources. Furthermore, in cases where there is a shortfall in thermal power supply, the result is often loaded shedding. The higher cost and intermittent supply of the energy has clear negative implications on the operational costs and business continuity, ultimately affecting the competitiveness of the trade and industry sector on a global stage.
- According to an analysis by the Africa Development Forum⁴⁰ one of the clearest impacts of climate change will be on trade infrastructure and routes. Port facilities, as well as buildings, roads, railways, airports and bridges, are at risk of damage from rising sea levels and the increased occurrence of extreme weather, floods and storms. In addition, fuel prices are likely to change significantly in the future, making some existing trade uneconomic, but also opening up new possibilities such as alternative sources of energy. A separate briefing note deals with how climate change can be built into the infrastructure sector.
- Greater seasonal climate variability and long- term decline in crop productivity in a hotter African climate will likely result in reduced exports and greater dependency on food imports - in a world of more volatile prices. Capture fisheries are in decline due to CC and aquaculture also offers growing opportunity as an alternative⁴¹.
- Some industries, such as mining and agro-processing, are major consumers (and polluters) of water. Water resources are generally scarce and are likely to become more so with climate change – an important factor for selecting and locating industrial developments without disadvantaging water-dependent communities⁴².

However, research has not been done on these areas of risk, and as yet the scale and magnitude of the impacts of climate change on the TTI sector is not clear.

3.6 Current status of climate change in the TTI Sector planning process

According to a legal working paper by IDLO⁴³ on the trade and industry sector, despite the clear significance of the sector's strategic and future socio-economic development, and despite a growing bank of anecdotal evidence, little is scientifically known about how climate change will impact these crucial sectors. Without this research, climate change is not being built into policy and planning in the sector. Neither the National Climate Change Response Strategy (NCCRS) nor the State of Environment Report (SoE) 2006/7⁴⁴ contain an analysis of how climate change will impact the trade and industry sectors.

In analysing the emerging issues and challenges in the trade and industry sector, the First Medium Term Plan (2008-2012) identified post-election violence; weak business regulatory framework evidenced by high cost of doing business; centralized business registration and influx of counterfeits; poor infrastructure; numerous constraints to market access; lack of sound business management skills; low levels of ICT utilization; low market development capacity; limited access to finance and credit; and HIV/Aids; inadequate, costly and unstable energy supply; institutional ambiguity and overlap of mandates; low technology, innovation, research and development uptake; weak legal, regulatory and institutional frameworks; inadequate capacity to meet quality and standards requirements; limited access to financial services; and limited production and managerial skills as the main challenges. Climate change impacts on the sector were not identified as challenges or opportunities.

In the tourism sub-sector the Tourism Policy does not identify climate change as a challenge that needs to be addressed⁴⁵. However in the most recent MTEF report⁴⁶ the sector acknowledges that *“climatic change and unsustainable human activities have led to negative environmental effects including global warming and environmental degradation. This has led to mitigation strategies which affect the sector operations and global competitiveness of the sector products and services. These include control of carbon emission through carbon tax, call for use of clean and safe energy mechanisms and carbon trading programmes”*. However, it does not give clear guidelines as to how these issues will be mainstreamed into the sector's planning processes.

According to IDLO⁴⁷, none of the policies and legislations analysed under the TTI sector identify climate change as a challenge or issue that they should attempt to address. In addition, no framework exists in any of the policies and legislations to harness necessary financial support to ensure that the sub-sectors of tourism, trade and industry adequately adapt to climate change.

The impacts of climate change have also not been considered in the development of the flagship projects in the sector (such as the creation of a free trade port, and the development of industrial and manufacturing zones based on agriculture) which are meant to increase the economic growth and assist in the attainment of Vision 2030.

3.7 Recommendations

The TTI sector has the potential to lift people out of poverty through the employment, entrepreneurial and income generating opportunities it provides. This, however, demands that the sector strategically considers the growing evidence about and adapts to climate change impacts and, and reduces both its contribution to climate change (through emissions of greenhouse gas) and its overall environmental footprint⁴⁸. Below are suggestions as to how this can be mainstreamed in forthcoming planning processes.

- Recognise and better understand climate impacts on the sector: The sector first needs to recognise in all its planning documents (MTP and strategic plans for the sub-sectors) that climate change is having an impact on the sector, whether positive or negative. The scale and magnitude of this is unknown and needs to be determined through research in order to effectively inform policy and planning.

- Generate data to inform decision-making: Measures to ensure that climate change data is used to inform decision making and planning need to be put into place within the next MTP process. This data should be generated from risk/vulnerability assessments and scenario modelling in different bio-geographical regions. Information from these assessments will then feed into the decision making process with respect to adaptation options.
- Screen projects for climate adaptation: The flagship projects under this sector will also need to be screened for climate change adaptation so as to ensure that they are climate proofed.
- Take a holistic, multi-sector approach: Planning for adaptation in the TTI sector cannot be undertaken in isolation and needs to consider impacts and adaptations in other sectors which may have knock on effects. Other relevant sectors include water, environment, energy, health, agriculture, land, physical infrastructure (e.g. roads and housing). This is applied in other countries, and Box 1 below offers an example of a holistic approach in adaptation for the tourism sub-sector in Egypt.

Box 1: Adaption Best Practice in Egypt: The Green Sharm Initiative

Egypt started, the “Green Sharm Initiative”, launched by the Ministry of Tourism and designed to position Egypt as a global pioneer in the holistic greening of tourist destinations. The main rationale behind Green Sharm is to make this destination environmentally sustainable and to capitalize on ecotourism trends. The initiative focuses mainly on golf, diving tourism and safari (squad) tourism. It aims to reduce emissions, but also to address coastal erosion and degradation of coral reefs (diving). Sharm’s energy supply is entirely based on fossil fuels. Transport emissions per passenger km in Sharm are above benchmark levels, mainly because of taxis and local dive boats. Emissions related to hotel energy consumption are also high relative to benchmarks, and rising per guest per night. Water desalinization in Sharm is energy intensive, while water wastage and water consumption per guest per night are relatively high. Waste management practices in Sharm are significantly below acceptable standards. The Ministry of Tourism has identified seven key targets in Sharm under the umbrella of the Realistic Green Programme, as well as the reduction of GHG emission in the period 2015-2020. These key targets are; i) Reduce destination-related emission by thirty per cent compared to business as usual, ii) Reduce hotel energy consumption per guest night by thirteen per cent, iii) Reduce water consumption per guest night for existing hotels by thirteen per cent and for new hotels by twenty eight per cent, iv) Achieve level three in solid waste management best practice (Where level five is the highest standard). With regard to threats, the Ministry of Tourism is aware of financial constraints on retrofitting and restructuring, as well as the limited technical potential to reduce emission from aviation.

Source: OECD, Climate Change and Tourism Policy in OECD Countries, 2010

- Improve education and awareness on the climate change impacts on the sector: Education and awareness of the impacts of CC for the sector’s stakeholder needs to be factored into the forthcoming MTP for 2013-2017. The messages need to target all the TTI sector players involved in the production of goods and services. This is because a recent study⁴⁹ showed that CC adaption was not well understood by the private sector which plays a big role in this sector. For example whilst the sector players have experienced high costs of electricity due to the use of thermal power as opposed to hydro-electric power due to low water levels, they are unable to make the link between this and CC. They also have little knowledge on how the reduction of wildlife or a change in wildlife species due to CC impacts will have an impact on their businesses. These links will need to be made clearly for the stakeholders through a comprehensive CC information and dissemination programme where stakeholders appreciate the participatory approaches to adaptation in the sector.

4. Climate Proofing the Infrastructure Sector - Some Recommendations for Planning

4.1 Summary

This briefing note is targeted at policy makers and planners who will be instrumental in developing the new infrastructure Medium term Plans (MTPs) for 2013-2017.

The note highlights the significant costs and risks to infrastructure investments when climate change is not considered in planning. It makes recommendations for building climate change issues into infrastructure sector MTPs in Kenya, with a focus on the transport sector. The recommendations are based on evidence from a review of the current (2008-2012) transport sector MTP, which has highlighted opportunities for building climate change issues into the next MTP process.

Key recommendations include for transport sector planners to:

- Build climate change and related national commitments into sectoral policies and laws
- Coordinate beyond their sector to consider ecosystem protection, private investment, and community needs.
- Adopt a risk assessment approach to considering climate change in their planning
- Set aside a fund to deal with climate change impacts on infrastructure
- Research alternative techniques to climate-proof infrastructure developments.

4.2 Setting the scene

Physical infrastructure is an important and necessary enabler of socio-economic development in any country. An improved, expanded, effective and reliable national infrastructure - to lower the cost of doing business and increase the competitiveness of the country - is a crucial cog in Kenya's wheel of development. Recognising this, Kenya's *Vision 2030*, the country's long-term development blueprint, aspires to deploy world class infrastructure facilities and services⁵⁰. The target is increased investments in the road network, water and sanitation services, energy supply services, and in rail, sea and air transport.

Significant developments have been made in some of these areas in recent years but Kenya still lags behind the middle income countries (Indonesia, Malaysia and Vietnam) to which it aspires, and remains closer to the average in sub-Saharan Africa in terms of infrastructure stock and services⁵¹.

New Medium Term Plans (MTPS) for 2013-2017 are to be developed across the infrastructure sectors, covering roads, housing, and electricity and communication infrastructure amongst others. MTPs include investment plans and budgets. Climate change presents a risk to any investments in Kenya, and as such should be considered in MTPS. Also, Kenya is undertaking a National Climate Change Action Planning process which seeks to operationalize the National Climate Change Strategy. This focuses on a low carbon, climate resilient development pathway which means that all sectors of the economy need to be "climate proofed".

What does that mean? “Climate-proofing” refers to the explicit consideration and internalisation of the risks and opportunities that alternative climate change scenarios are likely to imply for infrastructure. In other words, it is about integrating climate change risks and opportunities into the design, operation, and management of infrastructure⁵². Climate-proofing infrastructure is thus a way of advancing towards climate change adaptation and strategic risk management, and ensuring that current investments are not compromised in future.

4.3 The transport sector – challenges and achievements

The goal of the transport sector MTP is the provision of adequate, efficient, affordable, safe and reliable transport services to all parts of the country to support the economic and social activities necessary for the realisation of Vision 2030. Transport subsectors include road, marine, rail and air transport.

Challenges noted in the MTP 2008-2012 Transport⁵³ sector include:

- over-reliance on one transport corridor;
- poor management of *matatu* and bus routes and stages leading to emergence of cartels and touts;
- a fragmented transport system that does not allow for convenient interchanges between the different modes of transport;
- low investment in the transport infrastructure largely limited to government sources;
- inadequate institutional framework;
- Outdated parts of legislation, and lack of standardised curriculum for driving schools.

In response to these challenges, the long-term, strategic objectives of the MTP included a strong focus on improving infrastructure facilities and services and developed flagship projects.

Flagship projects earmarked during the current MTP for the transport sector as a whole include:

- The finalisation and implementation of the National Integrated Transport Policy by 2008;
- Development of the National Spatial Plan to guide physical development by 2008/9;
- Development of the fifty year National Integrated Master Plan by 2008/9, and;
- The development of the second Transport Corridor to South Sudan and Ethiopia (2008-2012).
- Implementing the National Road Safety Programme to enhance road safety on Kenyan roads with the expected outcomes of reduced road fatalities, crash rates and the impact on the economy.

The National Integrated Transport Policy has been approved by cabinet, and there have been some major achievements in the roads subsector , including

- The second generation driving licenses are being finalised.
- The Thika super Highway which is almost complete,
- The northern corridor roads where substantial progress has been in bituminising the murrum sections.
- Nairobi bypasses construction

Results are being felt all over the country, with real impact on social and economic activities. In areas opened up by the new roads (including on the Nairobi bypasses, Mombasa Road to Machakos, and on Athi River to Kajiado on the way to Namanga on the Tanzania border) the prices of land have sky-rocketed and major settlements are mushrooming. However, the question is, with extreme events linked to climate change occurring frequently in Kenya, how resilient is this new infrastructure?

What does that mean? Resilience is about how resistant the infrastructure is to damage. Will it stand up to the increasingly severe and frequent storms that are predicted? Will it get washed away by floods or landslides just as easily as in the past? Or will the investment simply go down the drain?

4.4 Climate change – risks and impacts for the transport sector

The transport sector is one of the most vulnerable sectors when it comes to climate risks and impacts. The main climate change risks include:

4.4.1 Sea levels rise

According to a risk assessment report⁵⁴ in the 20th century, sea levels rose by an estimated 17 cm; the global mean projections for sea level rise by the turn of the twenty first century range from 17 cm to 59 cm. An associated rise in the coastal zone ground water table is expected.

4.4.2 Storms, rains and flooding

Some areas of Kenya, such as Coast Province, are already prone to torrential rains and flooding which cause problems, but the probability (i.e. likely frequency) and severity of such storm events will increase.

4.4.3 Higher temperatures

The Kenya Meteorological Department (KMD) has provided data of temperature and rainfall changes in Kenya over the last fifty years. From the early 1960s, Kenya has generally experienced increasing temperatures over vast areas. Over inland areas, the trends in both minimum (night-time/early morning) and maximum (daytime) temperatures depict a general warming through time⁵⁵. In addition, rising temperatures are expected to strengthen coastal winds and storms.

These risks raise the potential of a wide range of impacts on all elements of the transport sector:

4.5 Urban infrastructure problems

Sea level rise will lead to the inundation and erosion of low-lying, coastal zones including coastal cities and infrastructure. A sea level rise of 0.3 m could submerge seventeen per cent of Mombasa, which is very low-lying (only 45 m above sea level at its highest points). Larger areas of Mombasa would be rendered unusable, thereby affecting the maritime transport system including the Mombasa Port facilities which would be submerged. Urban areas are also vulnerable to flooding due to poorly maintained drainage systems, which frequently surcharge during heavy rainfall events⁵⁶.

4.6 Damage to port facilities

Port facilities are at risk of damage from increasingly severe storm events. Higher temperatures and ocean acidification (both associated with the increasing greenhouse gas

(GHG) concentrations which cause climate change) will also exacerbate the corrosion of port facilities constructed from steel. In addition, rising temperatures are expected to strengthen coastal winds and storms, which will affect ship navigation and other port operations.

4.7 Damage to road infrastructure

Roads are particularly vulnerable to all aspects of climate change. A rise in the coastal zone ground water table would introduce a weakening in the underlying foundation upon which coastal roads are built. This could eventually lead to widespread structural instability and therefore affecting transportation of goods to and from the harbours.

The destruction of infrastructure including roads and bridges during storms is increasingly becoming a common phenomenon during the El Nino-Southern Oscillation events and causes untold economic loss to the country. Flooding has the potential to cause significant damage to physical infrastructure, which results in widespread disruption, a requirement for additional capital expenditure and wider environmental damage. Major infrastructure that supports the national economy, such as roads, bridges and water pipelines are prone to flood damage. Rising temperatures may also have an impact on the roads in Kenya⁵⁷.

Lessons from other countries

Other countries such as Canada have predicted that an increase in the frequency and severity of hot days could have a negative impact on roads with more problems related to pavement softening and traffic-related rutting, as well as the migration of liquid asphalt (flushing and bleeding) to pavement surfaces from older or poorly constructed pavements being experienced. Asphalt rutting may become a greater problem during extended periods of heat on roads with heavy truck traffic, whereas some flushing could occur with older pavements and/or those with excess asphalt content. These problems should be avoidable with proper design and construction, but at a cost⁵⁸.

4.8 Damage to rail network

Kenya's already dilapidated railway network is likely to be further damaged by floods and extreme heat. The high temperatures are likely to cause warping of the rail track, thereby exacerbating the chances of derailment of trains, while flooding will wash away bridges. Such was the case in 1993 when one hundred and fourteen people perished in a train that plunged into a river after floods washed away a bridge at Ngai Ndethya National Reserve near Voi in Coast Province.

4.9 Impact on infrastructure maintenance and development

Experiences from other countries have shown that warming temperatures may require changes in materials, maintenance, and operations. The combined effects of an increase in mean and extreme high temperatures affect the construction, maintenance, and operations of transportation infrastructure and vehicles. Higher temperatures may also suggest areas for materials and technology innovation to develop new, more heat tolerant materials. Some types of infrastructure deteriorate more quickly at temperatures above 32.2°C (90°F). As the number of very hot days increase, different materials may be required. Further, restrictions on work crews may lengthen construction times. Rail lines may be affected by more frequent rail buckling due to an increase in daily high temperatures. Ports, maintenance facilities, and terminals are expected to require increased refrigeration and cooling. The impacts of warming on the fuel efficiency of motorized transport can also lead to slight increases in fuel consumption for both road vehicles and aircraft. For cars and trucks, this is due to an anticipated increase in air conditioner use. For aircraft, increased fuel consumption is

expected because warmer temperatures translate into lower engine efficiency⁵⁹. The effects of increases in average temperatures and in the number of very hot days will have to be addressed in designing and planning for vehicles, facilities, and operations⁶⁰.

4.10 Economic impacts

Economically, the infrastructure loss and damage due to damage caused by climate change impacts is immense – it is very expensive to repair or replace roads, bridges and other infrastructure. The damage caused to the country's transport and telecommunication infrastructure by the eight-month 1997/1998 El-Niño rains was estimated at one billion US Dollars⁶¹. It caused Kenya's worst-ever flood-related casualties, including the instant death of thirty six passengers travelling in a seventy seat bus that plunged into a deep river near the slopes of Mount Kenya following the destruction of three kilometres of the Meru-Embu road. In October 2006, torrential rains pounded the eastern part of Kenya causing massive damage to roads, cutting off several of them and washing away bridges. In 2007, brief but also intense rains caused the collapse of the Kainuk Bridge in Rift Valley Province cutting off the supply of crucial goods including foodstuff to the agriculturally unproductive Turkana and Samburu districts. Recent rains have been estimated by the Government to have caused around Ksh ten billion of damage, a significant proportion of the total budget for Kenya of Ksh one trillion.

4.11 Options for ameliorating climate change impacts

Ecosystem management is an important complementary activity to minimise risks to infrastructure. For example, protection and restoration of forests will reduce runoff and landslides, which are a major cause of destruction to roads. The restoration of ecosystems and their capacity to regulate the impacts of climate change will reduce risks and slow down the deterioration of infrastructure, which will also result in the private sector being more motivated to invest in the area⁶².

4.12 Climate change and the transport sector MTP

From the foregoing overview it is apparent that the adverse impacts on the economy and on society in general are colossal and should be urgently addressed⁶³. One way to do so is through the climate-proofing of infrastructure – building climate change considerations into all planning and implementation. Building the climate resiliency of infrastructure requires a multidimensional approach, integrating consideration of the need to develop the economic and social infrastructure of the country and the necessity to protect the country's ecosystems to reduce risks to infrastructure.

In the transport 2008-2012 MTP, none of the identified challenges to the sector mention the risks of extreme climate change events. Most of the challenges relate to transport systems which are not efficient, or to inadequate capacity. Consequently, none of the programmes/projects suggested in the MTP relate to addressing climate change challenges.

In addition, policies and laws governing infrastructural development and management in several sectors do not recognise climate change as a serious threat or put in place measures to adapt existing and proposed infrastructure developments to climate change⁶⁴. This becomes a challenge because the sector plans are derived from mandates stipulated in legislation and Vision 2030. Thus if climate change is not identified in policies, laws and in Kenya's Vision 2030, then the sector plans are unlikely to pick up, plan, budget and implement climate change adaptation actions. Given the climate change impacts noted above, this holds real risks of investments in infrastructure being compromised in future as climate and weather patterns shift.

4.13 Potential benefits of building climate change into infrastructure sector planning

Adapting infrastructure to the risks of climate change, within a broader low-emission climate-resilient development strategy, is effectively protecting that infrastructure. It will not only help to reduce the loss of lives, physical damages and interruptions in critical socio-economic services related directly to the infrastructure, it will also yield additional benefits, for example:

- More balanced regional development- reducing the need to spend money on infrastructure damage releases budget for other purposes
- Reduced poverty – avoiding the destruction of homes through floods can make people homeless, increasing poverty and vulnerability
- Greater energy security – electricity lines and hydroelectric supplies will be more secure
- Reduction of greenhouse gas (GHG) emissions- less traffic jams due to bad roads and flooding, and more efficient transport.
- Increased economic development – encouraging investment (for example in housing or industry) that would otherwise be constrained by poor infrastructure.⁶⁵

4.14 Recommendations for building climate change into infrastructure sector planning

There is increasing evidence of how climate change affects the transport sector in Kenya, and the costs of dealing with the damage to infrastructure are often colossal and can run into billions of shillings. Recommendations for addressing this in future planning are as follows:

- Infrastructure policies and laws need to be reviewed and climate change adaptation considerations and strategies incorporated therein, so that technical ministries dealing with infrastructure are mandated to integrate climate change into their planning processes.
- The technical ministries in the sector need to work in partnership with natural resource agencies, communities, businesses, and others as they develop programmes and projects which will meet the enhancement of mobility, economic development, community safety and environmental objectives.
- The ministries need to adopt a risk assessment approach to considering climate change in their planning. A conceptual framework and taxonomy for consideration of climate factors has been used in some countries⁶⁶ and incorporates four key factors that are critical to understanding how climate change may impact transportation and other types of infrastructure:
 - *Exposure*: What is the magnitude of stress associated with a climate factor (sea level rise, temperature change, severe storms, precipitation, flooding etc.) and the probability that this stress will affect infrastructure?
 - *Vulnerability*: Based on the structural strength and integrity of the infrastructure, what is the potential for damage and disruption in transportation services from this exposure?
 - *Resilience*: What is the current capacity of a system to absorb disturbances and retain transportation performance?
 - *Adaptation*: What response(s) can be taken to increase resilience at both the facility (e.g., a specific bridge) and system levels?

Ultimately, the purpose of a risk assessment approach is to enhance the resilience of the transportation network. Analysis of these factors can help the transport sector ministries, identify those facilities most at risk and adopt adaptation strategies to improve the resilience of facilities or systems. Structures can be hardened, raised, or even relocated as need be and – where critical to safety and mobility – expanded redundant systems may be considered as well.

- Research into building designs and materials that assist in enhancing the resilience of roads, bridges and other associated infrastructure to climate impacts (such as floods, strong winds, high temperatures) should be prioritised.
- A fund needs to be set aside to deal with climate change impacts on infrastructure, as when the damage is done rehabilitation is very costly.

¹ Republic of Kenya 2011. Medium Term Expenditure Framework 2012/13 – 2014/15. Report for the Agriculture and Rural Development Sector

² Government of Kenya 2009. Kenya Vision 2030. Sector Plan Agriculture 2008-2012.

³ Republic of Kenya 2011. Medium Term Expenditure Framework 2012/13 – 2014/15. Report for the Agriculture and Rural Development Sector

⁴ LTS & Acclimatise Risk Assessment Report 2012.

⁵ LTS & Acclimatise (2012). Risk Assessment Report for the Kenya National Adaptation Plan

⁶ *ibid*

⁷ *ibid*

⁸ *ibid*

⁹ Kenya (2010) Agriculture Sector Development Strategy p 68.

¹⁰ Government of Kenya 2009. Kenya Vision 2030. Sector Plan Agriculture 2008-2012.

¹¹ *ibid*

¹² Gerald C. Nelson, Mark W. Rosegrant, Jawoo Koo, Richard Robertson (et al) 2009 Climate Change Impact on Agriculture and Costs of Adaptation (IFPRI Food Policy Report), p13

¹³ Kenya Vision 2030, The Popular Version. The Government of The Republic of Kenya, 2007. Page 16.

¹⁴ REPUBLIC OF KENYA (2008-2012) SECTOR PLAN FOR ENVIRONMENT, WATER AND SANITATION

¹⁵ National Climate Change Response Strategy, Executive Brief. Government of Kenya, April 2010. Page 9.

¹⁶ NCCRS, page 10.

¹⁷ LTS & Acclimatise (2012). Risk Assessment Report.

¹⁸ *ibid*

¹⁹ LTS & Acclimatise (2012). Risk Assessment Report.

²⁰ WRMA Climate Change Response Strategy. Draft concept note.

²¹ LTS & Acclimatise (2012). Risk Assessment Report.

²² *ibid*

²³ NCCRS, page 9.

²⁴ Common Wealth Medical Association (2009). International Symposium on Climate Change and Health held in Dar-Es-Salaam, Tanzania. Pages 32-37. Paper Presented by Dr. S. Mwangi. Convenor, Public Health Committee, Kenya Medical Association

²⁵ NCCRS page 5.

²⁶ WRMA Climate Change Response Strategy. Draft concept note.

²⁷ Republic of Kenya (2008-2012). Sector Plan for Environment, Water and Sanitation

²⁸ WRMA Climate Change Response Strategy. Draft concept note.

²⁹ LTS 2012. Accessibility and Availability of Climate Data in Kenya. A technical report for the National Adaptation Plan.

³⁰ The African Plan of Action for Public Health Adaptation to Climate Change (2012-2016).

³¹ The National Climate Change Adaptation Plan is part of the National Climate Change Action Plan 2012.

³² Republic of Kenya (2011). Trade Tourism and Industry Sector Report for the Medium Term Expenditure Framework 2011/12-2013/14.

³³ Republic of Kenya (2008-2011). Ministry of Tourism Strategic Plan.

³⁴ IDLO (2012). Scoping of the Legal and Institutional Framework in Kenya for Climate Change Adaptation in Trade and Industry Sector. Legal Working Paper.

³⁵ LTS & Acclimatise (2012). Risk Assessment Report for the Kenya National Adaptation Plan

³⁶ *ibid*

³⁷ According to the Kenya Wildlife Services, 14 elephants died in 2007, 28 in 2008 and 37 already in 2009, all due to what the organization calls “extraordinary and prolonged dry seasons”.

³⁸ Government of Kenya; NCCRS, April 2010, p. 27.

³⁹ LTS & Acclimatise (2012). Risk Assessment Report.

⁴⁰ Africa Development Forum VII (2010). Acting for Climate change and Sustainable Development in Africa. Climate Change, Trade and Industrial Development. Issues Paper. No.5.

⁴¹ *ibid*

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- ⁴² ibid
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