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Kenya Adaptation to Climate Change in the Arid Lands:

Anticipating, Adapting to and Coping with Climate Risks in Kenya – Operational Recommendations for KACCAL

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Acronyms and abbreviations

A-AARNET	ASARECA-Animal Agriculture Research Network
ALRMP	Arid Lands Resource Management Project
AMREF	African Medical Research Foundation
ASAL	Arid and semi-arid lands
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CB LEWS	Community Based Livestock Early Warning System
CBO	Community based organization
CDC	Community Development Coordinator
CDD	Community driven development
CDO	Community Development Officer
CDPO	Community Development Project Officer
CF	Contingency funds
COP	Conference of Parties
CRM	Climate Risk Management
DCU	District Coordinating Unit
DDO	District Development Officer
DFID	United Kingdom Department for International Development
DLPO	District Livestock Production Officer
DMC	Drought Management Coordinator
DMO	Drought Management Officer
DMP	Drought Management Programme
DOP	Director of Programmes
DPIRP	Drought Preparedness Intervention and Recovery Project
DRP	Drought Management Project
DSC	District Steering Committee
DSG	District Steering Group
DVO	District Veterinary Officer
EDRP	Emergency Drought Recovery Project
ENSO	El Niño Southern Oscillation
EWS	Early Warning System
EWTO	Early Warning Training Officer
FA	Finance Assistant
F&AC	Finance and Administration Coordinator
FAO	Food and Agriculture Organization of the United Nations
FC	Finance Clerk
FEWSNET	Famine Early Warning System Network
FFO	Federal Foreign Office
FFS	Farmers Field Schools
FGD	Focus group discussion
FI	Food insecure
FO	Finance Officer
FS&CC	Field Support and Community Coordinator
FSDMS	Food Security and Drought Management Secretariat
GCM	General Circulation Mode

GDP	Gross domestic product
GEF	Global Environment Facility
GIS	Geographic information system
GL-CRSP	Global Livestock-Collaborative Research Support Program
GoK	Government of Kenya
GPS	Global Positioning System
GSM	General Circulation Models
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HRO	Human Resources Officer
ICPAC	IGAD Climate Prediction and Application Centre
ICRAF	World Agroforestry Centre
IGAD	Intergovernmental Authority on Development
ILRI	International Livestock Research Institute
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate and Society
ISDR	International Strategy for Disaster Reduction
KACCAL	Kenya Adaptation to Climate Change in Arid Lands
KACE	Kenya Agricultural Commodities Exchange
KARI	Kenya Agricultural Research Institute
KEFRI	Kenya Forestry Research Institute
KFSM	Kenya Food Security Meeting
KFSSG	Kenya Food Security Steering Group
KMD	Kenya Meteorological Department
KNMI	Royal Dutch Meteorological Institute (Koninklijk Nederlands Meteorologisch Instituut)
KTDB	Kenya Tourism Development Board
KWS	Kenya Wildlife Service
LEWS	Livestock Early Warning System
LGP	Length of growing period
LINKS	Livestock Information Network and Knowledge System
M&E	Monitoring and evaluation
M&EC	Monitoring and Evaluation Coordinator
M&EO	Monitoring and Evaluation Officer
MET	Mobile Extension Team
MFO	Micro Finance Officer
MoLFD	Ministry of Livestock and Fisheries Development
MSF	Médecins sans Frontières
NASA	National Aeronautics and Space Administration (USA)
NARS	National agricultural research systems
NEMA	National Environment Management Authority
NGARA	National Gums and Resins Association
NGO	Non-governmental organization
NFSEC	National Food Security Executive Committee
NFSCC	National Food Security Coordination Committee
NOAA	National Oceans and Atmospheric Administration

NPC	National Programme Coordinator
NRM	Natural resource management
NRMO	Natural Resource Management Officer
OP	Office of the President
PARIMA CRSP	Pastoral Risk Management Collaborative Research Support Program
PC EWS	People-Centred Early Warning Systems
PCU	Project Coordinating Unit
PFS	Pastoralists Field Schools
PMU	Project Management Unit
PS	Permanent Secretary
SACCO	Savings and Credit Cooperative Society
SCF	Seasonal climate forecasts
SLD	Support to Local Development
SLDC	Support to Local Development Coordinator
SLDO	Support to Local Development Officer
SMS	Short message service
S&PO	Supplies and Procurement Officer
TARDA	Tana and Athi Rivers Development Authority
TOFNET	Trees on Farm Network
TEP	Trans-boundary Environmental Project, Terra Nuova
ToR	Terms of Reference
TPDC	Turkana Peace and Development Committee
TTF/TDF	Tourism Trust Fund/Tourism Development Fund
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USGS	United States Geographical Society
VAM	Vulnerability Assessment Mapping
VHF	Very High Frequency
VJDF	Vanilla-Jathropha Development Foundation
WFP	World Food Programme

Executive Summary

Years of concerted activism to bring awareness of climate change and its consequences to the fore of global concerns are finally yielding dividends. Until recently, most climate change activity focused on medium- to long-term projections regarding the nature and trajectory of change processes. With the uncertainties inherent in long-term climate projections and the difficulty of building political and economic momentum from hypothetical future scenarios, progress was slow. The recent past has, however, resulted in a drastic increase in extreme climate events across the globe that has wreaked untold humanitarian and economic havoc.

The costly present day manifestations of climate change have catapulted climate concerns to the forefront of the global arena. The recent high-level event convened by the Secretary General of the United Nations to address the leadership challenge of climate change and build momentum for climate change talks (Bali, Indonesia, December 2007) is a clear indication that the urgency of climate change has fostered the degree of serious commitment it requires from the global agenda.

Whatever its impacts, it is widely acknowledged that poor communities, already vulnerable to a suite of existing risks and endowed with meagre resources, will be the most adversely affected as climate change is superimposed on their already tenuous situation. In recognition of the need to help vulnerable populations in developing countries adapt to the adverse impacts of climate change, the Global Environment Facility (GEF), in conjunction with its partners, funds programmes aimed at reducing the vulnerability of countries to the impacts of climate change and helps them build adaptive capacity.

The Kenya Adaptation to Climate Change in the Arid Lands (KACCAL) project is one such initiative supported in conjunction with the World Bank and the United Nations Development Programme (UNDP). About 80% of Kenya is arid or semi-arid and the main livelihood activities in these areas are pastoral, agropastoral and subsistence agriculture. Currently, these populations are among the poorest in Kenya, suffer from a weak natural resource base, are negatively affected by socio-economic and demographic trends that see a growing population depending on diminishing rangelands, and are relatively marginalized from the growing economy. Add to this the impacts of climate change, of which the recent severe and extended droughts of 2001, 2004–06 and the widespread flooding in 2007 are an early signal, and the livelihood threats to the communities of Kenya's arid and semi-arid lands (ASAL) are clear and present.

The Government of Kenya (GoK), in several key policy documents including the Economic Recovery Strategy, the Poverty Reduction Strategy Paper, the Kenya Rural Development Strategy and the newly published Vision 2030, recognizes the substantial needs of the ASAL population and has committed itself to prioritizing the alleviation of the key problems they face. These include food insecurity, water scarcity, increasing banditry and more generally, increasing poverty and vulnerability. The government's acknowledgement of the risks climate change poses and its commitment to addressing

them is set out in their national contribution to the Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCC). Here they lay out the importance of identifying adaptation options in agriculture, water and rangeland management for reducing the impacts of climate vagaries and efforts to increase the resilience of affected populations.

KACCAL represents an effort of the World Bank and UNDP to assist the GoK to meet its climate adaptation objectives. KACCAL is designed to help embed climate change perspectives in the activities carried out by the Arid Lands Resource Management Project (ALRMP). ALRMP is a well established collaboration between the World Bank and the GoK that serves as the government's main vehicle for responding to climate related emergencies in the ASAL, building community resilience to climate shocks and directing the government's community development agenda for the ASALs. KACCAL aims to complement the efforts of ALRMP by providing the necessary resources and capacity to realign ALRMP activities to more effectively handle the additional set of challenges that climate change poses for development efforts in the ASAL.

This report represents the outcome of a KACCAL pre-activity designed to inform and recommend various programmes, policies and processes to help KACCAL meet its objectives. Specifically, the World Bank KACCAL project team and its colleagues in ALRMP commissioned the International Livestock Research Institute (ILRI) to conduct reviews, surveys and analyses that would inform two interrelated KACCAL activity lines: *Coping and adaptation strategies in arid and semi-arid lands of Kenya* and *Early warning, seasonal climate forecasts and information dissemination*. Among the 28 districts covered by ALRMP, the following 5 were chosen as pilot beneficiaries of KACCAL interventions: Garissa, Malindi, Marsabit, Mwingi and Turkana. These districts were chosen to achieve variation across geographic distribution, agro-ecologies, livelihood zones and market accessibility.

The analyses and recommendations contained in this document are based on information gathered from literature reviews, extensive consultations with key informants, both in KACCAL pilot-districts and other knowledge sources, and most importantly from the wealth of information generated from a series of focus group surveys conducted in the pilot districts. Consistent with the emerging consensus on how best to reduce the climate-related vulnerability community members face and empower and equip them to effectively adapt to the current and expected consequences of climate change, our recommendations follow a two-pronged approach. Improving the provision of climate risk management services which comprises both traditional early warning services as well as community based risk mitigation though seasonal climate forecasts, contingency planning and training etc., defines one prong. Climate-robust development interventions, which includes introducing and supporting the adoption of enhanced livelihoods and development of an enabling economic infrastructure defines the other.

Throughout the report, we emphasize the complementarities of these two focal points for enhancing adaptation to climate change. As we have seen, climate change will bring with it more extreme climate events. This likely implies more emergencies and the need for

more external relief and recovery activities. Aid resources, already stretched thin, will become an ever more pressing constraint. Emergency response efforts, where necessary, will have to dramatically increase in effectiveness. This will mean improved early warning systems (EWS) for timely response and improved coordination among partners. Reliance on external relief, especially for mild climate catastrophes, will also have to decrease. This will mean capacitating communities to manage shocks better, improve their coping response and putting in place mechanisms to reduce their exposure to risk. Taking advantage of good climate conditions by investing in optimal agricultural production, possible with improved seasonal climate forecasts, can also help improve resilience to climate shocks when they hit.

On the flip side, and equally important, we emphasize the importance of enhancing livelihood productivity and choice in affected areas. As noted, individuals sufficiently endowed with assets, savings and opportunities are less vulnerable to climate shocks (and non-climate related shocks as well) and more able to recover after a period of considerable stress. As such, welfare improving development activities are equally important in reducing vulnerability. Certainly, we focus on enhancing and developing livelihood opportunities—such as supporting the commercialization of dryland commodities—that are less sensitive to the vagaries of the climate. However, we also note that simply improving the asset base, increasing the productivity of assets and expanding the space of income source opportunities that vulnerable communities have access to, even for assets or opportunities whose returns are correlated with climate outcomes, is similarly essential.

1. Introduction

1.1. Managing vulnerability in Kenya's ASAL

The inhabitants of the arid and semi-arid lands (ASAL) of Kenya are among the poorest and most vulnerable populations on the planet. They suffer from an increasing array of both natural and human-made shocks that serve as effective barriers to productive and sustainable livelihoods and relegate a majority of the population to a state of chronic poverty. The increasing frequency of droughts, floods and climate-related disease epidemics coupled with unfavourable socio-economic trends and underdeveloped infrastructure highlights the predicament facing Kenya's ASAL populations and institutions concerned with their welfare and development.

The hardships that ASAL inhabitants endure have not gone unnoticed. The Government of Kenya (GoK), international aid agencies and non-governmental organizations (NGOs) have over the past two decades channelled significant resources towards helping ASAL communities cope with the seemingly continuous string of catastrophes they face. One of the earliest substantial institutional efforts came in the form of a World Bank funded, GoK initiative dubbed the Emergency Drought Recovery Project (EDRP). EDRP, operational from 1991–96, covered drought recovery efforts in Mandera, Marsabit, Tana River, Turkana and Wajir which were the districts most affected by droughts during this period.

The lessons gained from the EDRP experience gave rise to the recognition that short-term emergency interventions were insufficient for reducing the vulnerabilities of ASAL communities and building their resilience to shocks. To register sustainable welfare gains and develop effective livelihood alternatives as a means to escape poverty, a more concerted longer-term effort was necessary. This led to the creation of the Arid Lands Resource Management Project (ALRMP), a 15-year, 3-phase project funded by the World Bank and implemented by the Office of the President (OP).

1.2. The Arid Lands Resource Management Project

The mandate of ALRMP was to take a more holistic approach to risk management in the ASAL, responding to emergency crises by providing the necessary short-term life-saving interventions but also encouraging and sponsoring community driven development efforts. The idea was to empower communities, promote development priorities that improve the resilience to the shocks they face, enhance their capacity to engage in productive livelihoods, and eventually to reduce the reliance of ASAL communities on external support.

While ALRMP has an impressive track record having implemented numerous successful development projects and been at the centre of disaster response efforts, the challenges they face are significant and the problems complex. The increasing frequency and severity of droughts in the past two decades have resulted in the deaths of millions of livestock and threatened the lives and livelihoods of hundreds of thousands of the

pastoralist and agropastoralist populations who comprise a large majority of the ASAL population. With a dearth of alternative productive livelihood strategies to pursue, scant risk management options to provide safety nets in the event of shock, diminished rangelands and increasing incidents of violent conflicts, these populations grow ever more vulnerable to the range of risks that afflict them.

Climate change threatens to further exacerbate matters. It is now largely accepted that climate change is a real phenomenon and that while the predicted rise in average temperature will gradually occur, the consequent increase in climatic variability is already being witnessed in the form of increasing incidents of climatic extremes. Partly due to the limited resilience of its inhabitants and partly due to the direct impacts of expected (and recently observed) climatic vagaries, the ASAL regions of the East African rangelands, the Sahel and Southern Africa have been shown to be particularly vulnerable to climate change.

1.3. Kenya Adaptation to Climate Change in Arid Lands

As the consensus on climate change grows, and its impacts become apparent in the frequency and severity of climate extremes, efforts to promote development and enhance livelihoods amongst populations that are particularly vulnerable to climate based hazards must explicitly incorporate a climate change perspective in their operations. This is indeed the justification for the proposed Kenya Adaptation to Climate Change in the Arid Lands (KACCAL) project. A joint initiative of the World Bank and the GoK, KACCAL aims to assist Kenya adapt to expected changes in climatic conditions that otherwise threaten the sustainability of rural livelihoods in its ASAL areas.

As envisioned, KACCAL activities will be implemented through the ALRMP. Despite ALRMP's successes, climate change related risks place a significant strain on its capacity to effectively carry out its mandate. As such, KACCAL aims to complement ALRMP efforts by providing the necessary resources and capacity to realign ALRMP activities to more effectively handle the additional set of challenges that climate change poses for development efforts in the ASAL. KACCAL's focus is twofold. First, it aims to improve the ability to reduce the near-term vulnerability to current climate variability and trends in conjunction with the ALRMP. Secondly, it aims to strengthen the medium- to long-term ability to address climate change impacts related to increased climatic variability and higher temperature, associated with changes of magnitude and frequency of extremes.

In an effort to ensure that KACCAL activities are effectively targeted and designed to meet their stated objectives, several preparatory studies have been commissioned to carefully examine the issues, critically review the capacity, capabilities and needs of the key stakeholders and offer a menu of context-specific recommendations to guide KACCAL's implementation. This report presents the results of one such study.

1.4. Study objectives and terms of reference

The International Livestock Research Institute (ILRI) was engaged by the World Bank for the pre-KACCAL study, 'Anticipating, adapting to and coping with climate risks in Kenya: Operational recommendations for KACCAL'. The effort comprised a set of activities that are to inform the implementation of KACCAL. Within the broader study, ILRI was charged to deliver on two separate but related activity lines: *Coping and adaptation strategies in arid and semi-arid lands of Kenya* and *Early warning, seasonal climate forecasts and information dissemination*. Given the obvious linkages between these two activity lines, and in the interest of exploiting the clear synergies that exist between them, both study subjects are considered in this report. Our systems approach views the two activities as critical components of a concerted and holistic effort to reduce the vulnerability of the ASAL population in Kenya to climate induced shocks and enhance their capacities to engage in sustainable and productive livelihoods.

This study illuminates the opportunities that exist to strengthen the link between disaster management and development in the context of climate change. It addresses interventions that equip communities with the capacity to prepare for and cope with the consequences of short-term impacts of climate based shock and to improve the effectiveness of disaster response, relief and recovery efforts undertaken by external organizations. An equally important aim of this project was to investigate the opportunities and pathways for promoting effective adaptation to climate change that includes stimulating sustainable adoption of livelihood portfolios that are relatively robust to climatic vagaries.

These objectives are entirely consistent with the terms of reference (ToR) set by the World Bank and ALRMP. In the *Early warning systems, seasonal climate forecasts and information dissemination* activity line, the objectives set by the ToR are stated as: i) critically review the capabilities of the various early warning systems (EWS) and seasonal climate forecasts relevant to managing risks in arid and semi-arid lands and ii) how these information systems can be utilized to foster adaptive responses of vulnerable households and communities. In the *Coping and adaptation strategies in arid and semi-arid lands of Kenya* the objectives as stated in the ToR read: i) review measures to adapt to and cope with current climate variability in their adequacy of enhancing the resilience of arid and semi-arid lands to current and future climate risks and ii) recommend adaptive capacity development needs for consideration in project implementation phase.

Developing recommendations for programmes and services that ultimately increase the resilience of the target communities and reduce their vulnerability to climate change is the salient common strand, clear in their ToR, that links these two activities together.

1.5. Structure of the report

The rest this report is structured as follows. In the next section, we briefly describe the methodological approach used for the study. As the major client of this report, the implementing agency for KACCAL, and the GoK's key vehicle for carrying out its development and risk management priorities in Kenya's ASAL, we place the study in context by summarizing the operational history of ALRMP, the evolution of its mandate,

its successes and limitations in Section 3. In Section 4 we highlight our approach to the study by defining the critical features of the conceptual framework that underlies our point of departure when thinking of risk management and climate vulnerability in general.

Sections 5 to 8 contain the meat of the report. Section 5 offers a synthesis of the available information on climate change projections and their consequent impact in Kenya with emphasis on climate change trends and implications for KACCAL pilot districts. In Section 6 we review the state of EWS in Kenya, analyse their evolving content and role and place it within the broader context of climate risk management. We then describe in more detail the ALRMP early warning system. Section 7 provides an analysis of the focus group survey data. We illuminate respondents perceptions on climate change, uncover their risk profiles and analyse their risk coping and strategies. We then document and discuss the development and risk management intervention priorities indicated by the communities. In Section 8 we draw from the preceding analyses to recommend priority interventions that we believe would be best bet investments for KACCAL to meet its objectives. The interventions span the gamut from management information systems to improve early warning services and the development of dryland commodities markets, to investing in processes to create a standards board for rural water projects and encourage the expansion of weather stations in the Kenya ASAL.

2. Methodology

KACCAL plans to embed a climate change perspective into the operations of ALRMP and to enhance the capacity and efficiency by which ALRMP engages its expanded mandate. As such, ALRMP, its activities and its mode of operations remained a focal point of this study and determined much of the study methodology. The study followed a three-pronged approach to collect relevant information and insights for analysis: community and key informant surveys, literature reviews and desk surveys and interviews with private sector and NGO implementers and innovators.

2.1. Community and key informant surveys

In depth, semi-structured focus group discussions (FGD) were conducted at the community level to generate information on perceptions of climate variability, access and use of early warning, rankings of key risks, coping and mitigation strategies, and information on risk management and development interventions considered beneficial to the communities.

Each target community was divided into three groups based on local food security classification bases: the food secure, the moderately food secure and the food insecure (FI). The mode of food security classification in each sample area is described in

Table 2.1. From each of these, 6 to 12 men were selected and interviewed; 6 to 12 women were also interviewed separately and concurrently. Women were interviewed in separate and parallel FGDs to uncover gender variations and perspectives. This approach also sidestepped the cultural inhibitions that would make it difficult for men and women to participate openly in the same discussion among some of the communities.

In addition to FGDs, interviews with key informants, comprising mainly knowledgeable social and development practitioners living and working with the target communities, and especially practitioners working in collaboration with the local ALRMP offices were conducted. These opinion leaders and experts provided rich, mainly qualitative, perspectives to the research questions. Five such interviews were conducted in each sampled district. Brief details on the key informants interviewed, and of other experts relevant to the project that we engaged are given in Appendix V.

Both the key informant and the focus group surveys were designed by ILRI scientists working on issues of risk and vulnerability and were reviewed in consultation with other colleagues, and World Bank and ALRMP staff involved in the project. A team of ILRI, World Bank and ALRMP staff pre-tested the instrument on two sets of focus groups and three key stakeholders in ALRMP communities in Kitui District. Insights and lessons from the dry run resulted in modifications to the initial instruments.

Table 2.1. The basis for food security level classification

District	Basis for food security classification
Turkana	Settlement, migration patterns and location of communities determined levels of food security among pastoralists. These factors influenced exposure to different types of vulnerability: disease, drought and conflict. For example, communities nearer the border with West Pokot District and Uganda experienced heightened risk of banditry and generally had lower food security. Among fishing communities, ownership of fishing equipment, experience and location were key in classifying communities.
Marsabit	Location and market access were the main factors influencing food security for agropastoralists as they determined exposure to risks such as poor yields, wild life attacks and post-harvest losses. Among pastoral populations, the number and range of species kept was important.
Malindi	Mixed farming communities were either food secure or insecure depending on their location and their exposure to risk of flooding. Farm size under cultivation was also a key factor. Fisher-folk in Malindi were classified on the basis of ownership of fishing equipment, nets and boats, and on their involvement in trade.
Garissa	The herd sizes and ranges of species were key for all communities; however, the ownership of farms, area under cultivation and irrigation equipment became an additional factor for food security status for agropastoralists.

2.1.1. District and community selection

The implementation activities for KACCAL, which this study has been commissioned to critically examine and recommend, are to be carried out in five pre-selected pilot districts under ALRMP coverage. These districts, Marsabit, Malindi, Mwingi, Garissa and Turkana, were selected in consultation with the World Bank, ALRMP and ILRI, and chosen to capture variation across key variables such as geospatial distribution, dominant livelihoods, agro-ecology and market access. Other than Mwingi, which was the subject of a similar study commissioned by KACCAL partner United Nations Development Programme (UNDP), our study team visited all four sites (Appendix I contains short profiles of the KACCAL pilot districts).

In this study, communities represent groupings of the populations within the district, living in close proximity or association and practising, usually, the same dominant livelihood activity. Community selection, also done purposively and consultatively, captured the major livelihood groupings in the pilot districts. Two communities were sampled in each district. A summary of the districts, livelihood groupings and communities involved in the FGDs is given in Table 2.2 .

Table 2.2. The districts, livelihoods and communities surveyed

District	Livelihood 1	Communities	% of population engaged in livelihood	Livelihood 2	Communities	% of population engaged in livelihood
Marsabit	**Pastoral all species**			**Agropastoral**		
Food secure		Korr	68		Dakabaricha	21
Moderately food secure		Korr			Quilta Korna	
Food insecure		Korr			Karare	
Turkana	**Pastoral**			**Fisheries**		
Food secure		Lomil	70		Eliye	11
Moderately food secure		Nabuin			Narengewoi	
Food insecure		Namoruputh			Katiko	
Garissa	**Pastoral all species**			**Agropastoral**		
Food secure		Nanighi	50		Sankuri	9
Moderately food secure		Nanighi			Sankuri	
Food insecure		Nanighi			Sankuri	
Malindi	**Mixed farming**			**Fisheries**		
Food secure		Dagamra	52		Malindi town	6
Moderately food secure		Goshi			Ngomeni	
Food insecure		Bomani			Ngomeni	

Source: Arid Lands Resource Management Project.

2.2. Literature reviews and desk analyses

Given the objectives underscored in the ToR, much of the study necessarily involved the analyses of relevant literature and secondary data. A wide review, analysis and incorporation of other relevant information has been used to highlight climate risk vulnerability in Kenya's ASAL and its linkages with poverty. Reviews of extant literature, largely on the relationship between vulnerability and adaptive capacity in general as well as specifically of Kenya's pastoralists and agropastoralists in the recent past, was used to inform our study design. The conceptual framework we outline in Section 4, based largely on a summary of the literature, underpins our analyses that sought to identify the range of traditional and innovative coping and adaptation strategies available to the target populations, highlight changes in the effectiveness and accessibility of these strategies, and uncover innovative strategies used in various areas that could be effectively applied to KACCAL project sites.

Sections 6, which synthesizes available information on the trajectory and expected impacts of climate change, draws heavily from a recent seminal ILRI publication (Thornton et al. 2007). The section also contains significant insight from another recent publication
(WRI et al. 2007). The desk study of relevant publications and grey literature also informs much of the review of early warning services and seasonal climate forecasts that currently offer advance information on climate patterns in Kenya's ASAL (Section 5).

3. The role and evolution of ALRMP

For over a decade now, the ALRMP has been the main government body tasked to respond to drought related emergencies in the Kenyan ASAL and to lead the implementation of its community based development efforts in the region. Through the years the relative successes of this project have led to an expansion of its geographical coverage and of its risk management and development mandate. It is therefore logical that KACCAL interventions are to be piloted in areas under ALRMP coverage and to be implemented through ALRMP's impressive institutional structure. As such, a general understanding of the role that ALRMP plays, the services it provides, the successes it can claim and the constraints it faces is important to provide the context for the opportunities that KACCAL can help leverage and the limitations it can help overcome.

3.1. The evolving role of ALRMP

ALRMP is currently in its second phase (ALRMP II); a six-year phase that builds upon the first phase (ALRMP I), expanding its objectives, reinforcing its successes and learning from its limitations. ALRMP I, which ran for 7 years, closing on 30 June 2003, was designed as a risk management outfit. Its aim was to establish a viable, government-run system of drought management that encompassed EWS, contingency plans, mitigation and quick response. Improved targeting and response time was assured by devolving responsibility to the district and community levels and by encouraging civil servants and other district development actors to empower local communities by including them in the design and implementation of development projects. ALRMP I was built upon the experiences of its predecessors, the Netherlands-supported Drought Management Project (DMP), the Drought Preparedness, Intervention and Recovery Project (DPIRP), and the EDRP.

ALRMP I set itself the objectives of strengthening and supporting community-driven initiatives to reduce the vulnerability and increase the food security of poverty stricken communities in the arid districts of Garissa, Isiolo, Mandera, Marsabit, Moyale, Tana River, Samburu, Turkana and Wajir, and the arid divisions of Baringo District. Along with this, a central pillar of the project was to conserve the natural resource base through: (i) improving crop and livestock resilience to drought; (ii) increasing economic linkages with the rest of the economy; and (iii) improving basic health services, water supply and other social services. In 1999, the result of a mid-term review formally amended the focus of ALRMP, 'to build the capacity of communities in the arid districts of Kenya to better cope with drought' (World Bank 2003a).

3.2. The operational structure of ALRMP

ALRMP II, like its predecessor ALRMP I, is located within the OP and run by a Project Coordinating Unit, PCU. The PCU consists of a National Project Coordinator assisted by a deputy project coordinator and three component coordinators in charge of natural resource and drought and management, community-driven development (CDD) and support to local development. A wide cast of officers managing finances, administration, procurement and human resources support the technical officers. These national officials coordinate smooth implementation in each of the 28 ALRMP project districts.

The natural resource and drought and management component of the project seeks to improve the management of natural capital, reduce the impact of natural shocks and reduce vulnerability by enhancing preparedness and mitigation activities. This component also aims to improve the effectiveness of response interventions. The CDD component of the project seeks to foster development capacity at both the community and household level and to empower communities to manage their own development agenda. ALRMP's third component, support to local development, aims to foster a conducive and enabling environment in the arid lands making it possible for communities to break out of the prevalent survival-relief continuum into a positive development plateau for economic growth and reduced dependence on external intervention (World Bank 2003a).

The successes of ALRMP I prompted the expansion of its coverage to include the following semi-arid districts: Kitui, Mwingi, Makueni, Tharaka, Mbeere, Kajiado, Narok, Transmara, West Pokot, Laikipia, Kieni East, Kieni West, Kwale, Kilifi, Lamu, Malindi and Meru North. The coverage ALRMP II districts across the nation is shown in Figure 3.1.

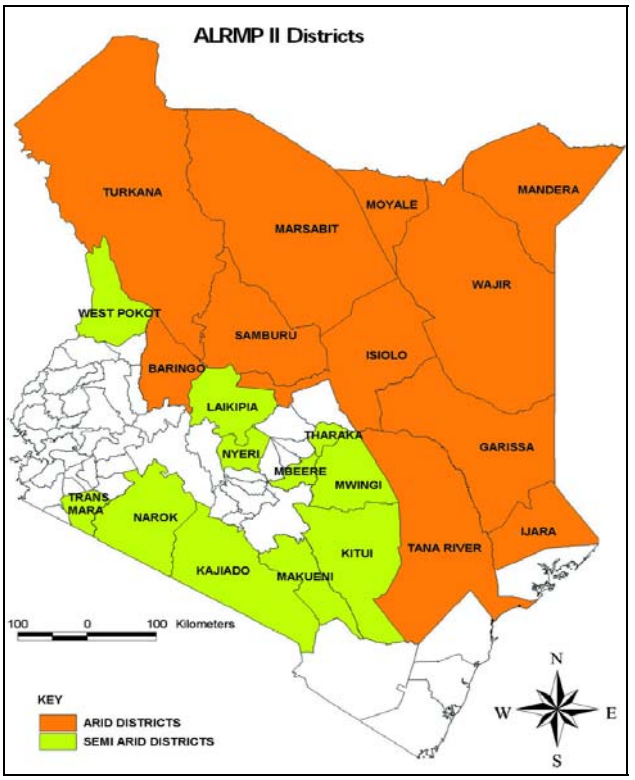
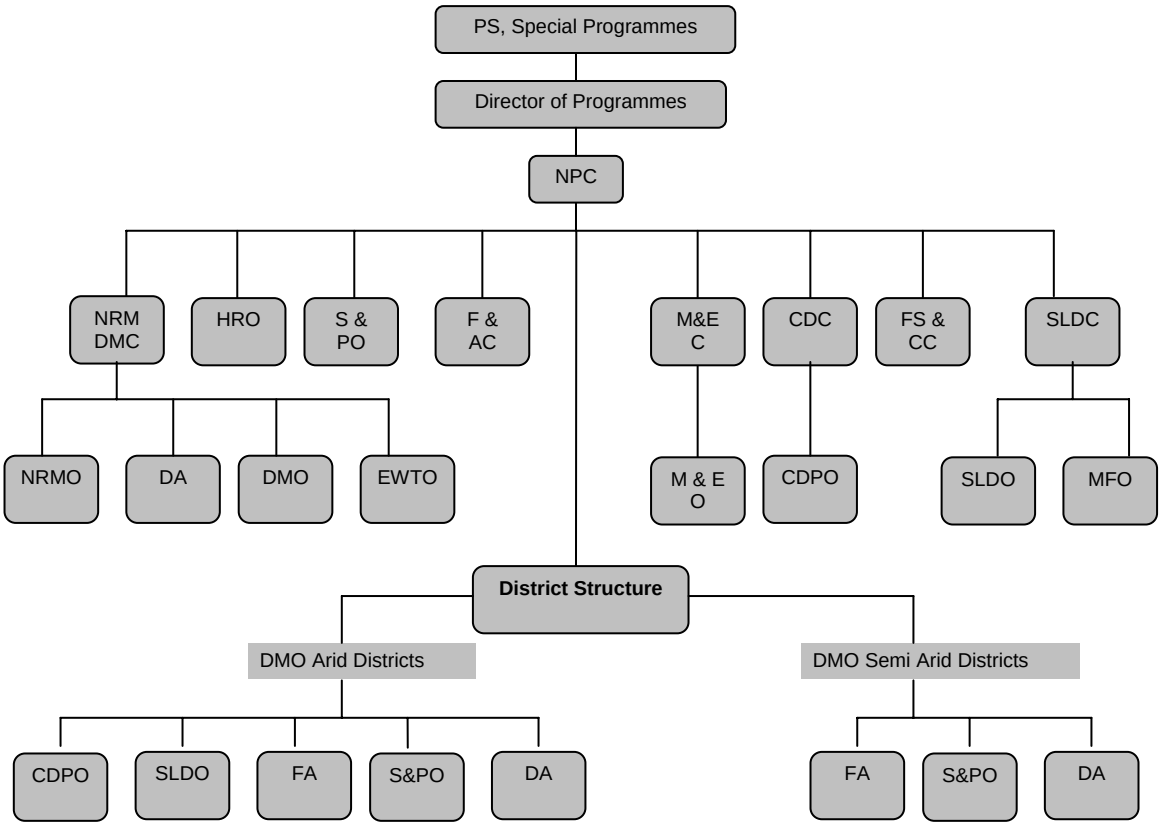


Figure 3.1. Geographic coverage of ALRMP II districts.

The location of ALRMP within the OP is strategic. It provides the important political gravitas required for a project of its nature to succeed and facilitates smooth contact with line ministries and access to the provincial administration structure spread across the country. At the inception of ALRMP I, disaster management and drought preparedness

had not received the administrative and political visibility they now enjoy as a critical function within the Ministry of Special Programmes in the OP.

As a result, at the district level the ALRMP is generally placed and viewed as part of the provincial administration and run by a District Coordinating Unit (DCU) headed by a coordinator who also doubles as the Drought Management Officer, DMO. In addition, the project employs a data analyst who coordinates collection and analysis of drought monitoring data from the districts. In semi-arid districts, the DMO and data analyst are the only technical officers employed. In arid districts, the project also employs a Community Development Officer (CDO), Support to Local Development Officer (SLDO) and Mobile Extension Team (MET) leaders in arid districts. METs, comprising district technical and partner agency staff, are responsible for formulating and updating community action plans through participatory rural appraisals (World Bank 2003b). This structure reflects the fact that only the drought management component is implemented in semi-arid districts. Further in all ALRMP districts, an additional officer manages the supplies, procurement and finance function. The ALRMP organizational structure is illustrated in Figure 3.2 (GoK 2005).



KEY

CDC	Community Development Coordinator	HRO	Human Resource Officer
CDPO	Community Development Project Officer	M&E	Monitoring and Evaluation
DA	Data Analysts	M&EC	Monitoring & Evaluation Coordinator
DMC	Drought Management Coordinator	M&EO	Monitoring & Evaluation Officer
DMO	Drought Management Officer	MET	Mobile Extension Team
DOP	Director of Programmes	MFO	Micro Finance Officer
FC	Finance Clerk	NPC	National Project Coordinator
FO	Finance Officer	NRMO	Natural Resource Management Officer
FS&CC	Field Support and Community Coordinator	PMU	Project Management Unit
EWTO	Early Warning Training Officer	PS	Permanent Secretary
FA	Finance Assistant	SLD	Support to Local Development
F&AC	Finance & Administration Coordinator	SLDC	Support to Local Development Coordinator
		SLDO	Support to Local Development. Officer
		S&PO	Supplies & Procurement Officer

Figure 3.2. ALRMP II project organizational structure.

A key institutional innovation during ALRMP I was the development of the District Steering Group (DSG), which brings together key officers from line ministries, NGOs operating in the districts, religious organizations and political leaders. The DSG is

supposed to coordinate the drought and community development efforts in the districts, reviewing early warning bulletins, food security assessments and other information to plan contingency and prioritize actions. Discussions with stakeholders revealed that the size and precise role of the DSGs varies from district to district; while in some districts there are attempts at joint planning and concentred action among the stakeholders, in others it is a little more than a discussion forum.

Two main criticisms of the DSGs emerged: they are still largely administrative units without legal backing and they have failed to evolve to meet the challenge of newly created districts. Overall, however, most informants saw the DSG as the key mechanism through which ALRMP manages drought and development in the ASAL. A related development during ALRMP I, strengthened in the course of ALRMP II, is the emergence of the Kenyan Food Security Meeting (KFSM) and the Kenya Food Security Steering Group (KFSSG) as coordinating bodies for actors in food security. Both ALRMP I and ALRMP II have been active participants in the development of these mechanisms (reference KFSM website: http://www.kenyafoodsecurity.org/inside.php). The relationship between ALRMP and these bodies is illustrated in Figure 3.3 while the specific roles of the KFSM are discussed in Section 6.

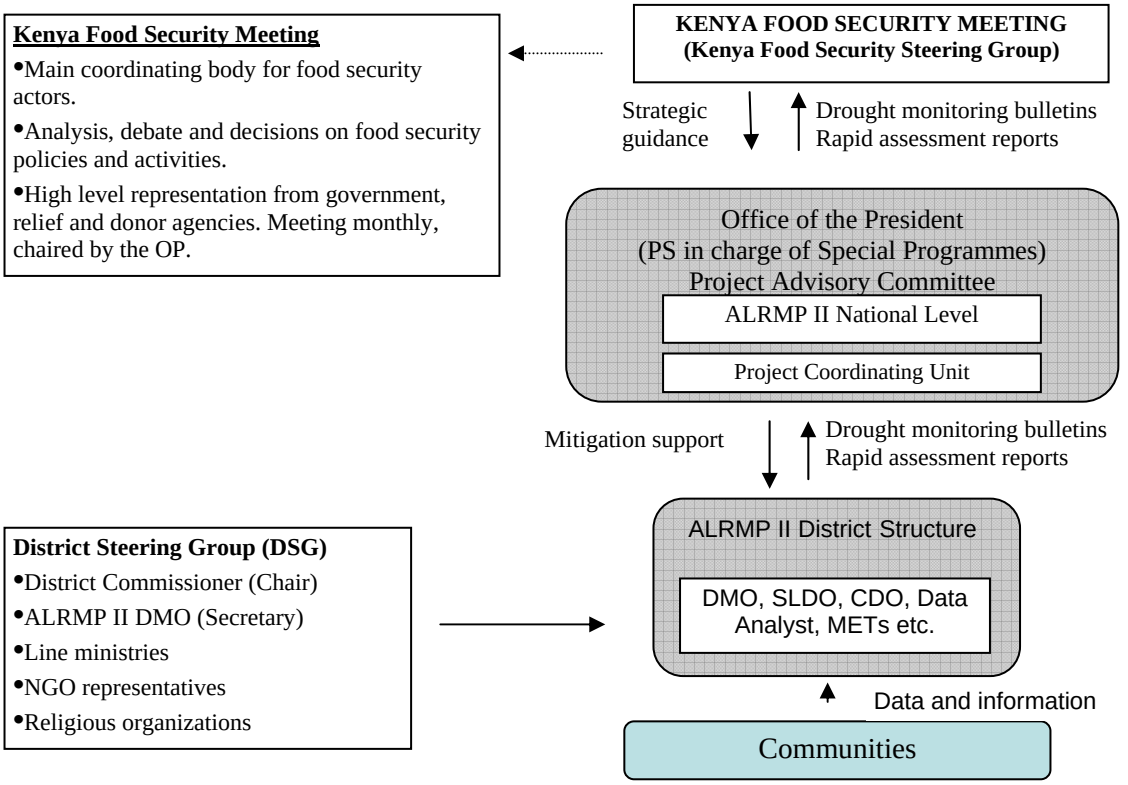


Figure 3.3. ALRMP II within the national food security management structure.

3.3. Some highlights of ALRMP I achievements

ALRMP I implemented a series of mainly small-scale community level projects, usually with 30% co-financing from the communities. These included wells and water sources for livestock, small-scale irrigation, classrooms, clinics, assistance to low income households for restocking with small livestock, and community enterprises such as stores, butcheries and beekeeping. Given the close alignment of the project with Kenya's poverty reduction strategies and policy papers, as well as deliberate focus on environmentally sustainable development of ASALs it was, in final evaluations commissioned by the World Bank, appraised as highly relevant (World Bank 2005). In total, more than 1200 micro-projects were implemented benefiting an estimated 180,000 people in the ASAL.

In drought management and early warning the project published 822 district and national EWS bulletins on a regular basis since 1996. These bulletins were mainly used by institutional partners within the DSG and KFSM in planning interventions in the affected districts. Most ALRMP data are designed to detect trends and, in particular to warn of slow onset disasters. There is evidence that ALRMP's monitoring system and institutional organization shortened response times and increased response capacity during the 1999/2001 droughts (World Bank 2005).

ALRMP I made available reserve grazing for pastoralists in 24 areas through tankering water supplies. Unfortunately, it is still difficult to establish permanent grazing reserves until land tenure systems are sorted out and usage clarified. The project also improved the overall carrying capacity of land and supported initiatives to reduce land degradation around boreholes (World Bank 2005).

In theory, it is the development of markets and infrastructure that encourages commercialization and greater economic integration. ALRMP I implemented 53 projects developing livestock infrastructure; stock routes were improved through the creation and rehabilitation of animal watering points and the reconstruction of holding grounds created near primary and secondary livestock markets. In some areas ALRMP supported the development of new livestock markets and slaughterhouses, and the improvement of pre-existing ones. Community water users associations were supported to improve management of ALRMP developed boreholes, water pans and shallow wells for livestock use.

3.4. Successes and lessons from ALRMP I

While ALRMP I was regarded as a successful project overall (World Bank 2005) some key limitations and lessons learnt from its design and operations were worked into the project development, influencing and expanding the operational objectives and risk management objective of ALRMP II. Many of these experiences are key to assessing the operational feasibility and suitability of interventions suggested under KACCAL.

One of the more important lessons from ALRMP I was the importance of participatory approaches to capacity building at community level to increase ownership and sustainability of interventions. Discussions with key informants and communities suggest

that while the DSG mechanism is effective in coordinating and planning interventions, ALRMP II has not yet achieved sufficient involvement of local communities in the selection and implementation of interventions.

Another lesson built into ALRMP II project design was the need for continuous capacity building at both partner and community levels. ALRMP II factored in a greater level of self reliance for staffing and technical expertise than ALRMP I did. Initial attempts to rely on line ministry officers such as MET staff, for example, did not work well for the project as these officers, tied down by responsibilities of parent ministries, were often unavailable for ALRMP work. Subsequently the project recruited METs for arid districts.

Importantly, the DSG mechanism which proved useful in coordinating disaster management at district level under ALRMP I, is being strengthened and institutionalized under ALRMP II. The DSG brings together key community actors and stakeholders, from civil society, government and NGOs. Securing partnerships, ownership and co-funding of interventions, the DSG has improved the implementation probability and eventual sustainability of interventions. ALRMP II also seeks to emphasize the final interventions and is much more results oriented than ALRMP I was—a lesson learnt from ALRMP I was that 'process oriented projects may spread themselves too thinly' (World Bank 2003b). This was to be corrected through greater precision in the definition of roles, ToR and funding commitments within the project implementation plans of ALRMP II (World Bank 2003b)

In its design, taking cue from phase 1, ALRMP II emphasized the importance of education and promised a deliberate plan to support development of mobile schools for nomadic pastoralists (World Bank 2003a). However, the connection between supporting education and capacity building for drought management, while strong, is indirect and longer term. This linkage is sufficiently articulated under ALRMP II and would be more tenuous under KACCAL.

Significantly, for the implementation of KACCAL, lessons from ALRMP I included observations on the trend of diversification amongst pastoral households, the critical role of mitigation strategies in limiting the impact of risk events and in speeding up recovery efforts, and the need to better understand the natural resource endowments of arid lands. Indeed, ALRMP II evidences an increased focus on drought management in its portfolio.

Non-drought risks that indirectly exacerbated the effects of droughts were considered important to the success of ALRMP II. Conflict is an important part of the risk profile and food security status of many communities in arid lands. The risk of conflict in some districts such as Turkana limits migration options that are fundamental to pastoral productivity. Immobile herds are highly vulnerable in the presence of water and forage scarcity and the capacity of pastoralists to mitigate or cope with the impacts of droughts are much diminished. Consequently, ALRMP II sought to give conflict management a bigger profile in its activities.

There is an indication of contingency planning in some ALRMP districts. ALRMP II, learning from the project's first phase, seeks to improve the availability of funds for emergencies, which, if channelled through normal government procedures would not reach affected communities at critical times. Contingency planning processes are now directed at the district level through the DSG where preparedness to deal with droughts and floods is greater, though resource availability is less. There are fewer examples of initiatives designed to help bolster the capacity of individuals within the community to mitigate perils. Similar observations can be made with regard to the ALRMP early warning system, which is designed to collect information and elicit alerts on slow onset disasters at the institutional level but does not feed back to the communities.

Further lessons from ALRMP I included the importance of ensuring that implemented projects are sustainable, up to standard and demand driven. Instead, phase 2, preferred approaches that would encourage communities to contribute to development interventions, thus increasing ownership and proposed support to more individual efforts, thereby encouraging sustainability.

3.5. ALRMP challenges and limitations

As highlighted in previous sections, ALRMP has made progress in institutionalizing drought management in arid lands and alleviating the suffering of targeted communities. Nevertheless, given the ambitions and important mandate of ALRMP, it faces considerable challenges and must continuously re-examine itself to improve on its limitations.

Financial and administrative
Reliance on the government machinery to channel financial resources from headquarters to district treasuries inevitably involves bureaucracy. While this process has improved over the years, increasing efficiency of procurement of goods and services, and of funds transfer still remains a big challenge. The nature of funding and administrative structure, for example, makes it difficult for ALRMP to implement larger projects with the possibility of high impact, across several districts. This is a flaw that can be corrected through KACCAL.

ALRMP is still faced with limited funding for emergency response. Emergencies do not wait for procedures and systems to resolve funding and this is yet to be fully streamlined. Some key informants appreciated the availability of contingency funds to meet major risk events. However, there is need for greater flexibility in using funds from other 'resource envelopes' for emergency activities.

It is also necessary to consider longer-term planning for financial independence and greater government support to ALRMP. A weakness experienced by ALRMP has been the poor continuity of coordinating institutions upon withdrawal of funds; this suggests the requirement for strategies to diversify sources of funding (government and other donors) and the creation of exit transition arrangements for supported interventions (self-sustaining interventions).

Managing partnerships
For a project with the mandate and resources of ALRMP, the importance of refining partnerships and communication strategies must be reinforced. Many of the projects undertaken can be improved through better partnerships with NGOs, community based organizations (CBOs) and others. This should be addressed within the context of KACCAL where tackling the effects of climate change must involve stakeholders. Enhancing the DSG infrastructure is a natural starting point.

Technical challenges
There are some technical challenges, particularly in deploying modern methods of data analysis and encouraging greater use of secondary information from other players. Some key informants cite a lack of quality control in the drought monitoring processes. Communication systems for real-time information sharing between and among districts could encourage greater intra-project learning. Flexibility in deployment and redeployment of staff across districts depending on perceived intensity of risk events and implementation needs holds the potential to enhance outputs.

Policy and institutional framework
In its strategic plan (2005–2009), ALRMP recognizes the need to support policy development. Stakeholders have made proposals and drafts for an ASAL policy and national pastoral policy. These policies have not been ratified through the political process. While political support for development projects in the arid lands has increased in the recent past (there is a pastoralists parliamentary group), actual enactment of policy would signal government intention and give impetus for wider involvement.

Insecurity
Intermittent outbreaks of ethnic violence, banditry and general insecurity makes it difficult to run sustainable development projects with any appreciable success. The dampening effects of insecurity on ALRMP investments should be carefully considered and resolved.

4. Conceptual framework

4.1. Defining vulnerability

The identification of effective, well-designed risk management and livelihood enhancement programmes must be guided by a conceptual framework that comprehensively identifies the various and interrelated constraints that leave poor households and systems vulnerable to downside risks, adequately defines the nature of the problem and provides a consistent platform to identify solutions. We start by defining the nature of the problem. The overall objective of KACCAL is to enhance the capability of ALRMP to implement various programmes and interventions that will reduce the vulnerability of the inhabitants of Kenya's ASAL to the increasing set of risks posed by climate change. This begs the obvious question: What is meant by vulnerability and what are the best avenues by which to reduce it or build resilience against it?

Vulnerability is a broad term, used differently in various contexts and disciplines. Despite the multitude of meanings, most widely used definitions of vulnerability are based on the interaction of two fundamental characteristics: the frequency and magnitude of risks that a system is exposed to and the ability of that system to withstand the impact of negative shocks (Alwang et al. 2002). Thus defined, the high degree of vulnerability inherent in the Kenyan ASAL communities is clear. Climate change threatens to further exacerbate the already significant drought risk they face and to raise the likelihood of flooding events and climate related disease epidemics. Meanwhile the capacity of these populations to cope is limited by the high levels of extreme poverty and complicated by eroding traditional support mechanisms, weak or non-existent formal social protection programmes and a dearth of alternative livelihood opportunities.

4.2. Advancing a dynamic poverty traps framework

Most definitions of vulnerability, especially those in the economics tradition, agree that the concept of vulnerability has no operational value if it is not referenced to the likelihood of crossing some undesirable threshold (Alwang et al. 2002; Barrett 2005). In other words, one's degree of vulnerability depends on the probability they will experience a loss relative to some unacceptable benchmark. For this study, we qualify this unacceptable benchmark as the state of chronic poverty. Given the inextricable relationship between vulnerability, welfare and poverty, a dynamic poverty traps framework provides a natural and logical conceptual approach to organize this research. The dynamic poverty traps framework is currently gaining considerable currency as an effective and comprehensive approach to understanding vulnerability and welfare dynamics (Barrett 2005; Carter and Barrett 2006).

The value and appropriateness of a dynamic poverty traps framework is best seen in the relationship between chronic poverty and vulnerability. Vulnerability is increasingly recognized as an important but distinct component of poverty that arises from critical structural differences between chronic and transient poverty. Transient poverty refers to a temporary state of poverty where the capacity to exit poverty is within one's means and

can be expected in the short or medium term. Chronic poverty, however, describes a situation in which 'poverty begets poverty': where the state of poverty strips one of the means and the opportunities necessary to exit poverty and, without external intervention, one can expect to be trapped in poverty indefinitely. In this view, vulnerable persons are those who have either been relegated into chronic poverty by previous shocks, or are highly likely to become trapped in poverty should they by exposed to an adverse event.

The rising popularity and use of poverty traps and vulnerability, which incorporate dynamics and the element of risk into traditional static conceptions of poverty, is not accidental. Rather, the dynamic poverty traps framework offers a solid theoretical justification for the increasing number seeking to shift the paradigm of emergency response toward more long-term sustainable interventions that go beyond saving lives to protecting and enhancing livelihoods in the context of a consistent threat of risks. Thus, the wisdom of the well known adage, 'give a man a fish and feed him for a day, teach him how to fish and feed him for a lifetime', is finally catching up with humanitarian operations which are moving toward integrating emergency disaster management and relief efforts with longer-term development concerns.

As climate change threatens to result in a higher incidence of emergency situations, response resources will be heavily taxed and growing relief-fatigue will take its toll. Even as donors and policy makers acknowledge the inadequate and unsustainable nature of conventional responses to emergencies caused by droughts, floods and other natural and human-made disasters, there is growing urgency for the creation of more effective, cost-efficient programmes and institutions targeted at increasing the resilience of vulnerable communities and stimulating development.

Following a dynamic poverty traps framework requires a menu of risk management interventions that assists households to lower their exposure to risk, protects against significant losses in productive assets, and supports affected households to cope with and rapidly recover from shocks. EWS and climate seasonal forecasts are critical elements of risk management allowing households to take pre-emptive steps to mitigate the consequences of impending shocks. External support in the form of food aid, food for work programmes and social protection support are also critical for helping affected households cope under duress and during recovery.

While risk management efforts must necessarily focus largely on programmes directly affecting poor vulnerable households, long-term success depends on providing transition options for poor households to get onto sustainable accumulations trajectories. Indeed, a fundamental feature of the dynamic poverty traps framework is its asset and livelihood based approach. Literature on the subject (Barrett 2005; Carter and Barrett 2006) shows that an individual's endowment of productive assets (the set of human, physical, financial and social capital that an individual commands or has access to), is a key determinant of their expected welfare trajectory and their resilience to shocks. A meagre endowment of productive assets limits income generating capacity and can relegate individuals into a poverty trap. A critical element of increasing returns to assets is expanding the livelihood

opportunities by which assets can be used, and creating an economic environment conducive to opportunity and innovation.

In seeking opportunities by which ALRMP can continue to empower Kenya's ASAL communities and reduce their vulnerability under the increasing stresses of climate change, we shall be guided by the dynamic poverty traps framework that incorporates both risk management and enhanced livelihood productivity. Improving adaptation and coping capacity to climate change means more effective delivery of relevant early warning and climate forecasting information. It means keeping households from falling into chronic poverty by providing some sort of social protection to affected communities and/or improving the effectiveness of short-term emergency response. It means lifting those trapped in chronic poverty by creating the means for them to engage productively in economic endeavour and improving their capacity to do so.

5. A synthesis of the available information on climate change impacts

5.1. Introduction

The literature on climate change in Africa and its impacts on agriculture is large and growing. There is a general consensus that the climate of Africa is warmer than it was 100 years ago and model based predictions of future greenhouse gas-induced climate change for the continent clearly suggest that this warming will continue and, in most scenarios, accelerate (Hulme et al. 2001; Christensen et al. 2007). The predictions for rainfall are less uniform. Hulme et al. (2001) illustrated the large regional differences that exist in rainfall variability. However, there is likely to be an increase in annual mean precipitation in East Africa (Christensen et al. 2007).

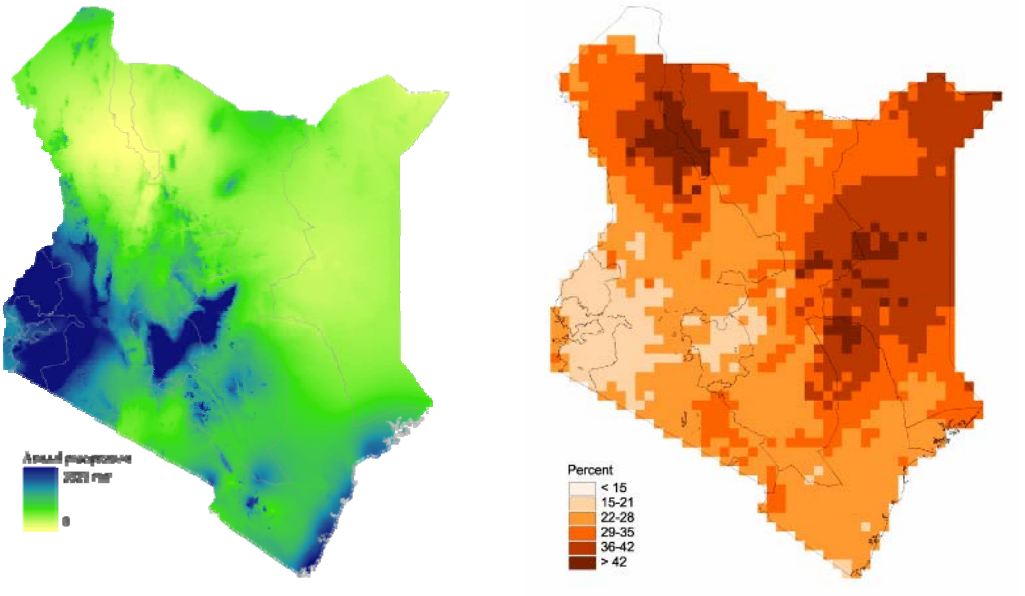
The challenges climate change poses for development are considerable (Thornton et al. 2007). Despite the uncertainties that exist in long-term climate predictions, it is necessary to explore the sensitivity of the environmental and social systems, and economically valuable assets to climate change (Hulme et al. 2001). High levels of vulnerability and low adaptive capacity in areas of Africa have been linked to factors such as limited ability to adapt financially and institutionally, low per capita gross domestic product (GDP) and high poverty rates, and a lack of safety nets. For example, sub-Saharan Africa is predicted to be particularly hard hit by global warming because it already experiences high temperatures and low (and highly variable) precipitation, the economies are highly dependent on agriculture, and adoption of modern technology is low (Kurukulasuriya et al. 2006).

The following section gives a brief overview of available literature on climate change in Africa, and specifically in Kenya. First a description is given of the current climate in East Africa and Kenya, and then an overview is provided of the range of predictions on climate change, followed by a section on uncertainties and limitations to knowledge and a few paragraphs on adaptation to climate variability.

5.2. Current climate characteristics

East Africa is defined as the area astride the Equator from 10°S to 5°N and eastward of 28°E. Because East Africa lies across the equator, much of the region experiences two rainy seasons. A longer rainy season starts around March through to June, with the peak occurring from March to May. The shorter rainy season runs from September and tapers off in November or December. However, some areas along the Lake Victoria coast, experience a prolonged rainy season that is evidenced by local mean rainfall maxima. Areas south of about 5°S have a single wet season with most rainfall received during austral summer. The presence of large water bodies such as the Indian Ocean to the east, and Lake Victoria and Lake Tanganyika to the west, and high mountains such as Mt Kilimanjaro and Mt Kenya induces localized climatic patterns in the region (KNMI 2007).

Kenya's equatorial location, lakes and varied topography give rise to a range of climatic conditions, from a humid tropical climate along the coast to arid areas inlands. While mean temperature varies with elevation, the more remarkable climatic variation is with respect to precipitation (Figure 5.1). The region experiences a bimodal seasonal pattern, with two rainy periods: short rains occur in October to December and long rains in March to May (coinciding with the passing of the Inter-Tropical Convergence Zone). Rainfall is correlated to topography, for example the highest elevation regions receive 1800 mm per year whilst the low plateau receives only 320 mm. Over two-thirds of the country receives less than 500 mm of rainfall per year (Osbahr and Viner 2006).



Source: Thornton et al. (2007).

Figure 5.1. Total annual rainfall and coefficient of variation of annual rainfall, 2000.

Rainy seasons in Kenya can be extremely wet and often late or sudden, bringing floods, such as in 2000. Major floods periodically afflict the Winam Gulf of Lake Victoria, the Lower Tana River basin and the coastal regions. Links between *El Niño* events and Kenyan climate variability have been suggested, and it is commonly perceived in Kenya that a large proportion of rainfall variability is attributable to *El Niño*. However, there is currently no clear relationship between either *El Niño* or *La Ni*ña events and prolonged drought or particularly wet periods. Both the dry periods in 1982/83 leading to the 1983/84 drought and the wet period of 1997/98 events have coincided with *El Niño* events (Usher 2000).

Orindi et al. (2007) indicate that over two-thirds of Kenya, particularly areas around the northern parts of the country, receive less than 500 mm of rainfall per year and are classified as ASALs. Kenya experiences major droughts every decade and minor ones every three to four years with the exception of the arid northern part where it is experienced regularly with varied consequences. In recent years, critical drought periods in the country were experienced in 1984, 1995, 2000 and 2005/2006 (UNEP/GoK 2000). The impacts of these droughts on the population are increasing exponentially (**Error!**

Reference source not found.) due to high population growth and increasing encroachment of agricultural activities in ASALs.

The 2000 and 2006 droughts were the worst in at least 60 years, and between these two extreme years, several other rainy seasons failed. Climate change introduces an additional uncertainty into existing vulnerabilities in the ASALs (Osbahr and Viner 2006). And it seems that the impacts of climate change are being felt in the increasing frequency and magnitude of climate extremes.

Table 5.1. Occurrence of droughts in Kenya

Year	Type of disaster	Area of coverage	No. of people affected by droughts
2004–2006	Drought	Widespread	3.5 million
1999/2000	Drought	Widespread	4.4 million
1995/96	Drought	Widespread	1.4 million
1991/92	Drought	Arid/semi-arid zones	1.5 million
1983/84	Drought	Widespread	200,000
1980	Drought	Widespread	40,000
1977	Drought	Widespread	20,000
1975	Drought	Widespread	16,000
1971	Drought	Widespread	

Source: Oxfam International (2006).

5.3. Projected climate change

Hulme et al. (2001) point out that climate change in Africa is not simply a phenomenon of the future, but one of the relatively recent past. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007) indicates that climate model projections for the period between 2001 and 2100 suggest an increase in global average surface temperature of between 1.1°C and 5.4°C, the range depending largely on the scale of fossil-fuel burning within the period and on the different models used. Since the first IPCC report in 1990, assessed projections have suggested global average temperature increases between about 0.15°C and 0.3°C per decade for 1990 to 2005. This can now be compared with observed values of about 0.2°C per decade, strengthening confidence in near-term projections (IPCC 2007). The climate model simulations under a range of possible emissions scenarios suggest that for Africa in all seasons, the median temperature increase lies between 3°C and 4°C, roughly 1.5 times the global mean response. Half of the models project warming within about 0.5°C of these median values (Christensen et al. 2007).

For precipitation, the situation is more complicated. Precipitation is highly variable spatially and temporally and data are limited in some regions (IPCC 2007). As indicated by Sivakumar et al. (2005) rainfall changes in Africa projected by most Atmosphere-Ocean General Circulation Models (GCMs) are relatively modest, at least in relation to present-day rainfall variability. Seasonal changes in rainfall are not expected to be large. Great uncertainty exists, however, in relation to regional-scale rainfall changes simulated

by GCMs. These rainfall results are not consistent: different climate models or different simulations with the same model, yield different patterns. The problem involves determining the character of the climate change signal on African rainfall against a background of large natural variability compounded by the use of imperfect climate models (Sivakumar et al. 2005). Like Hulme et al. (2001) illustrate, large regional differences exist in rainfall variability: the Sahel, for example, has displayed considerable multi-decadal variability with recent drying. East Africa appears to have a relatively stable rainfall regime, although there is some evidence of long-term wetting (Hulme et al. 2001). Over much of Kenya, Uganda, Rwanda, Burundi and southern Somali there are indications for an upward trend in rainfall under global warming (Thornton et al. 2007). The increase in rainfall in East Africa, extending into the Horn of Africa, is robust across the ensemble of GCMs, with 18 of 21 models projecting an increase in the core of this region, east of the Great Lakes (Christensen et al. 2007). The large-scale picture is one of drying in much of the subtropics and an increase (or little change) in precipitation in the tropics, increasing the rainfall gradients. This is a plausible hydrological response to a warmer atmosphere, a consequence of the increase in water vapour and the resulting increase in vapour transport in the atmosphere from regions of moisture divergence to regions of moisture convergence (Christensen et al. 2007).

Rainfall projections in Kenya are inconsistent; a range of models and scenarios suggest both increases and decreases in total precipitation (Osbahr and Viner 2006). For September–May, most models project increases in total rainfall of up to 30% with the largest increases expected in December–February (the hot, dry season). Changes in rainfall during the rest of the year are less clear and rainfall may increase or decrease by as much as 20% between June and August (Osbahr and Viner 2006). Hulme et al. (2001) discussed two fundamental reasons why there is much less confidence about the magnitude, and even direction, of regional rainfall changes in Africa. Two of these reasons relate to the rather ambiguous representation of climate variability in the tropics in most global climate models, for example of *El Niño* Southern Oscillation (ENSO), which is a key determinant of African rainfall variability. Another reason is the omission in all current global climate models of any representation of dynamic land cover–atmosphere interactions. Such interactions have been suggested to be important in determining African climate variability during the Holocene and may well have contributed to the more recently observed desiccation of the Sahel.

Research on changes in extremes specific to Africa, in either models or observations, is limited. Little can be said yet about changes in climate variability or extreme events in Africa (Sivakumar et al. 2005; Christensen et al. 2007). A general increase in the intensity of high-rainfall events, associated in part with the increase in atmospheric water vapour, is expected in Africa, as in other regions (Christensen et al. 2007). Rainfall may well become more intense, but whether there will be more tropical cyclones or a changed frequency of *El Niño* events remains largely in the realm of speculation (Sivakumar et al. 2005). In East Africa wet extremes (defined as high rainfall events occurring once every 10 years) are projected to increase during both the September to December and the March to May rain seasons, locally referred to as the short and long rains respectively (Thornton et al. 2007). The increase in the number of extremely wet seasons is increasing to roughly

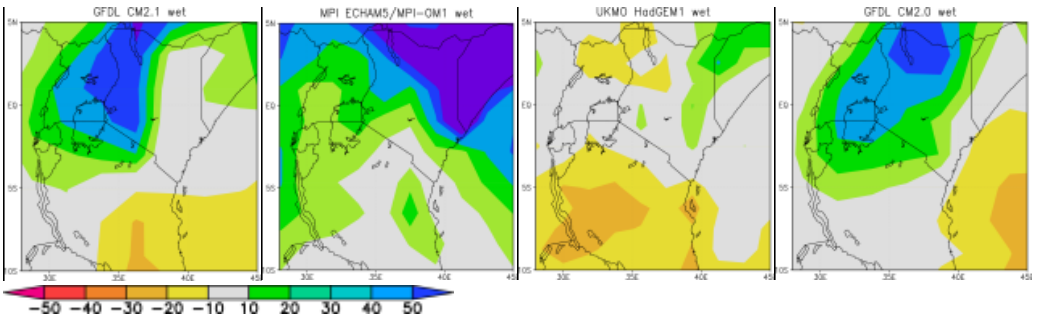
20% (i.e. 1 in 5 of the seasons are extremely wet, as compared to 1 in 20 in the control period in the late 20th century) (Christensen et al. 2007). Dry extremes are projected to be less severe than they have been, during September to December, but the GCMs do not show a good agreement in their projected changes of dry extremes during March to May (KNMI 2007; Thornton et al. 2007).

5.4. Projected changes in extreme events

KNMI (2007) showed the projected variations in wettest events that occur once every 10 years on average. However, climate models all underestimate the strength of the long rains in the current climate, limiting the confidence of these projections (KNMI 2007; Thornton et al. 2007).

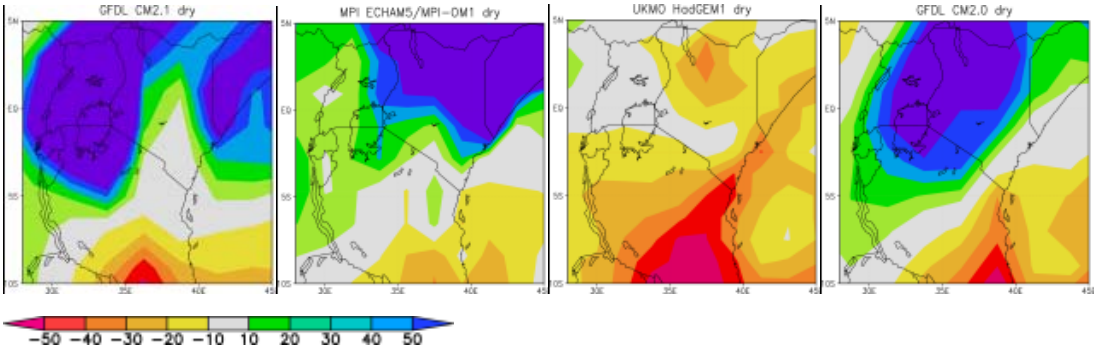
5.4.1. Short rains (September–December)

In the warmer climate around 2100, the GCMs show evidence of an increase in the intensity of extreme rainfall events in much of East Africa, notably in Kenya, Uganda, Rwanda, Burundi and southern Somalia. During the short rains, there are indications of the possibility of increases in excess of 50% in 10-year high rainfall events over the north of East Africa (Figure 5.2). Simulated changes in low rainfall extremes show (Figure 5.3) that these events are becoming less severe in some parts (especially in Tanzania). However, in certain parts of the region the simulated increase is far higher than 50%. Note that increases in both wettest and driest rainfall events have been found over the same areas, showing an overall shift in the rainfall distribution. This indicates that expected climate change will result in more rainfall variability, leading to more floods and droughts (KNMI 2007).



Source: KNMI (2007).

Figure 5.2. Projected changes in 'short rains' high rainfall events, 2100.

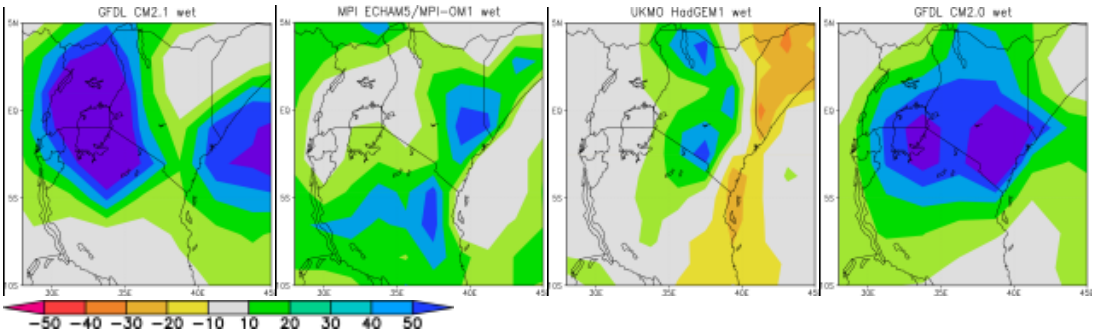


Source: KNMI (2007).

Figure 5.3. Projected changes in 'short rains' lowest rainfall events, 2100.

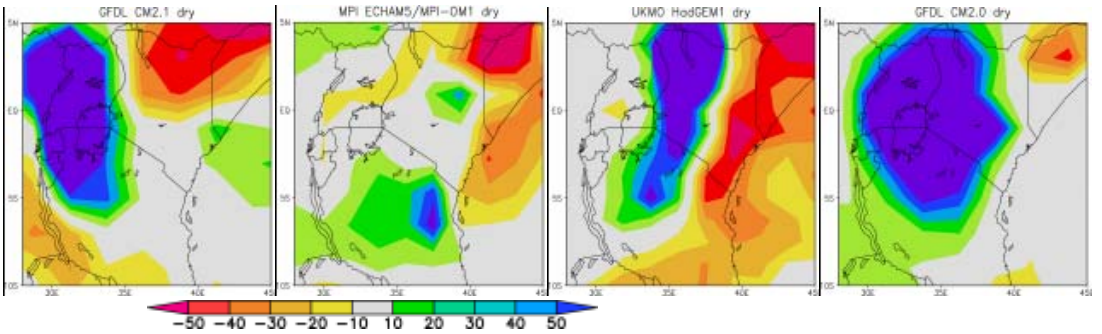
5.4.2. Long rains (March–May)

Even during the long rains, the GCMs continue to simulate an increase in the 10-year highest rainfall events in large parts of East Africa (Figure 5.4). However, there is no consensus between the GCMs on the likely changes in the severity of dry events (Figure 5.5). While some models show an increase in the severity of extremely low rainfall events in northern Kenya, others simulate a decrease over the same areas (KNMI 2007).



Source: KNMI (2007).

Figure 5.4. Projected changes in 'long rains' high rainfall events, 2100.



Source: KNMI (2007).

Figure 5.5. Projected changes in 'long rains' lowest rainfall, 2100.

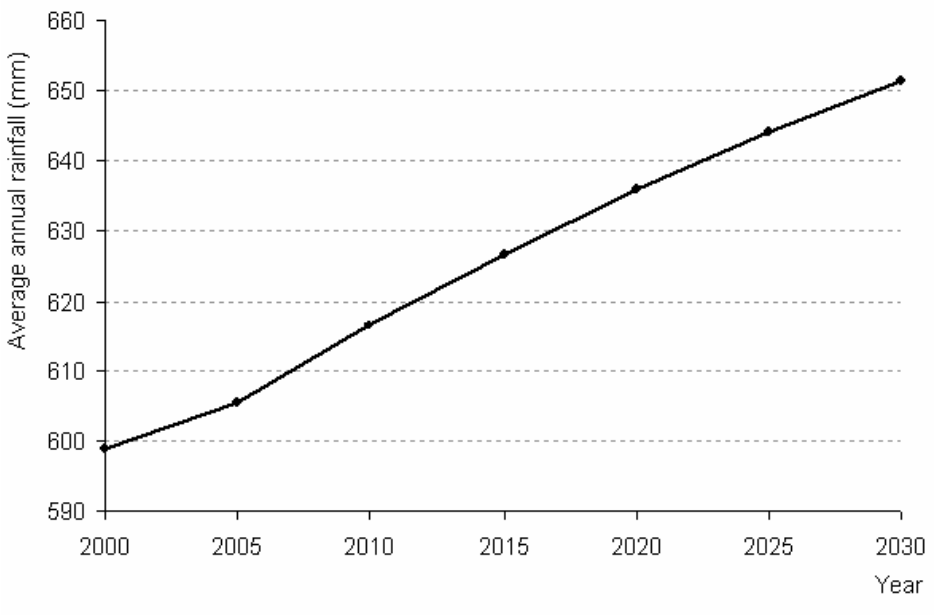
Osbahr and Viner (2006) specify that increases in temperatures would have a significant impact on water availability, and are thus expected to exacerbate the drought conditions already regularly experienced and predicted to continue. The unpredictability of Kenya's rainfall and the tendency for it to fall heavily during short periods are also likely to cause problems by increasing the occurrences of heavy rainfall periods and flooding.

Beside the effects of climate change itself, the coastal areas of Kenya should anticipate changes in sea level due to global warming. The projection that sea-level rise could increase flooding, particularly on the coasts of eastern Africa, will probably increase the high socio-economic and physical vulnerability of coastal areas. A rise in sea level in Kenya will have a damaging impact to the production of tree crops situated along the coast (mangoes, cashew nuts and coconuts) and other agriculture based enterprises. A rise in sea level will also affect ecosystems of coastal Kenya, e.g. mangroves and coral reefs with additional consequences for fisheries and tourism (Boko et al. 2007).

5.5. Projected changes in temperature and precipitation for ALRMP regions

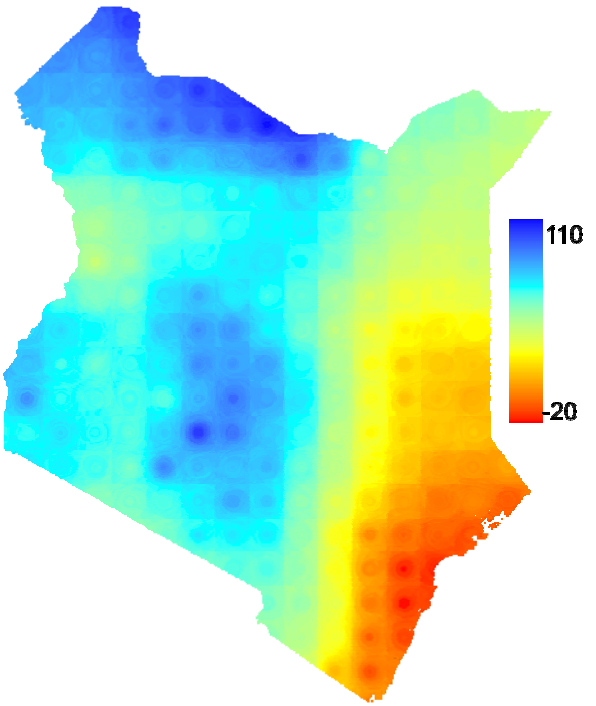
Limited information on climate change is available for East Africa at country level or local scale. While looking for the scenario predictions Thornton et al. (2007) used changes in aggregate monthly values for temperature and precipitation. For this study possible future long-term monthly climate normals (rainfall, daily temperature and daily temperature diurnal range) were derived using the WorldClim v1.3 climate grids at 1 km^2 resolution (Hijmans et al. 2004). The results of the Hadley CM3 Global Circulation Model for scenario B2 (Special Report on Emissions Scenarios; IPCC 2000) were used to derive climate normals at a 1 km^2 resolution for 2000, 2005, 2010, 2015, 2020, 2025 and 2030, using the down-scaling methodology described in Jones and Thornton (2003). These normals were then used with the weather generator MarkSim (Jones and Thornton 2000) to generate daily weather data characteristics of the appropriate climate normals. Thirty replicates of weather years were generated for each of the five-year intervals, and these weather files were used to run the crop models (Thornton et al. 2007).

The above mentioned climate grid data (Jones and Thornton 2003) were used to examine the projected changes in temperature and precipitation for ALRMP regions. As said, rainfall projections in Kenya are not certain. While looking at the total annual precipitation projections for Kenya (Figure 5.6) increases in total rainfall are found. For Kenya at large an increase in precipitation of 0.2% up to 0.4% per year is predicted. The precipitation predictions for Kenya correspond with findings of long-term wetting by Christensen et al. (2007) and Hulme et al. (2001). However, the regional variations in precipitation are large. The coastal region will become drier, while the Kenyan highlands and northern Kenya will become wetter (Figure 5.7).



Source: Jones and Thornton (2003).

Figure 5.6. The total annual precipitation (in mm) for 2000 to 2030.

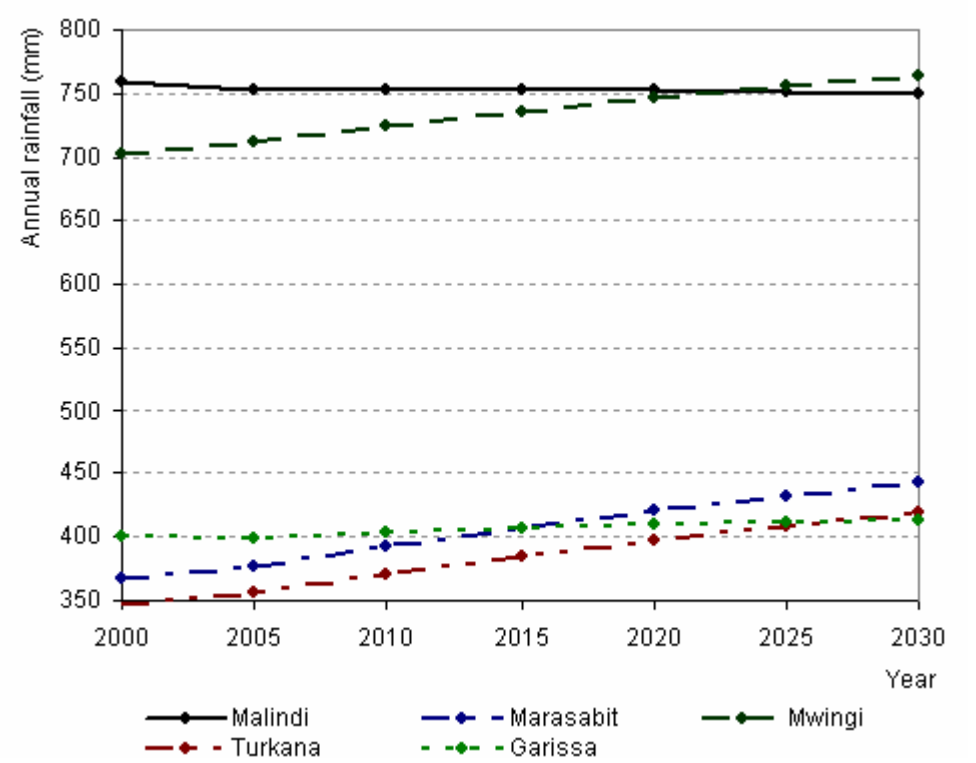


Source: Jones and Thornton (2003).

Figure 5.7. The change in total annual precipitation (in mm) between 2000 and 2030.

As the predictions in changes in precipitation show a large regional variation, we looked at the predictions for Garissa, Malindi, Marsabit, Mwingi and Turkana districts in

particular. Malindi is expected to become slightly drier over time, Garissa will remain more or less the same, while Marsabit, Mwingi and Turkana will become wetter (up to 20%) (Figure 5.8). However, as it is difficult to downscale the GCMs to regional or local scale; climate model simulations under a range of possible emissions scenarios suggest both increases and decreases in total precipitation for Kenya (Osbahr and Viner 2006). For September–May, most models project increases in total rainfall of up to 30% (the largest increases expected in December–February (the hot, dry season). Changes in rainfall during the rest of the year are less clear and rainfall may increase or decrease by as much as 20% between June and August.



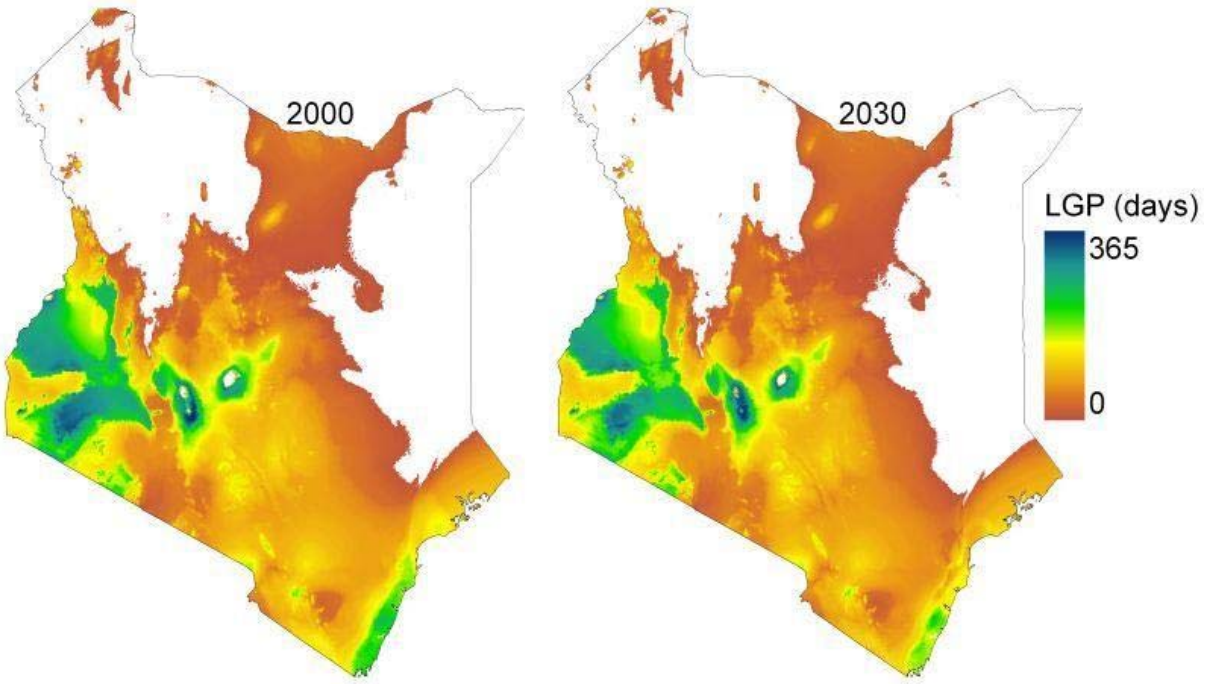
Source: Jones and Thornton (2003).

Figure 5.8. The total annual precipitation (in mm) for 2000 to 2030 for five districts in Kenya.

5.6. Agricultural impacts of temperature and precipitation changes

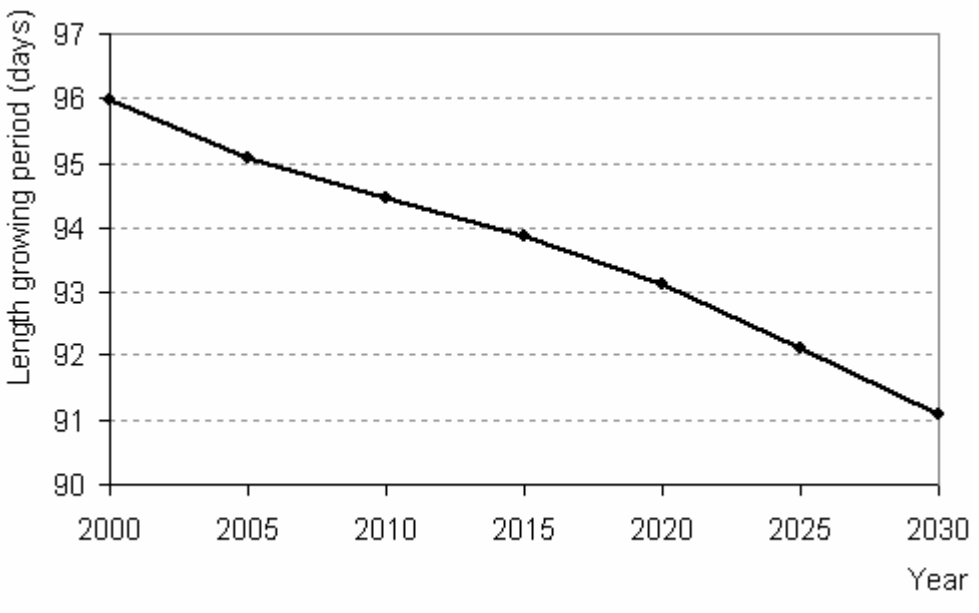
The combination of higher evapotranspiration and even a small decrease in precipitation could lead to significantly greater drought risks. An increase in precipitation variability would compound temperature effects (Sivakumar et al. 2005). Like Fischer et al. (2002, we assess the impact of climate change on agro-ecological characteristics by looking at changes in the length of growing period (LGP). Changes in rainfall patterns, in addition to shifts in thermal regimes, influence local seasonal and annual water balances, and in turn affect the distribution of periods during which temperature and moisture conditions permit agricultural crop production. Such characteristics are well reflected by the LGP

for Kenya which is reducing over time. However, as expected, there are large regional variations in the so-called LGP (Fischer et al. 2002). As shown in Figures 5.9 and 5.10, the LGP for Kenya is reducing over time. However, as expected, there are large regional variations.



Source: Jones and Thornton (2003)

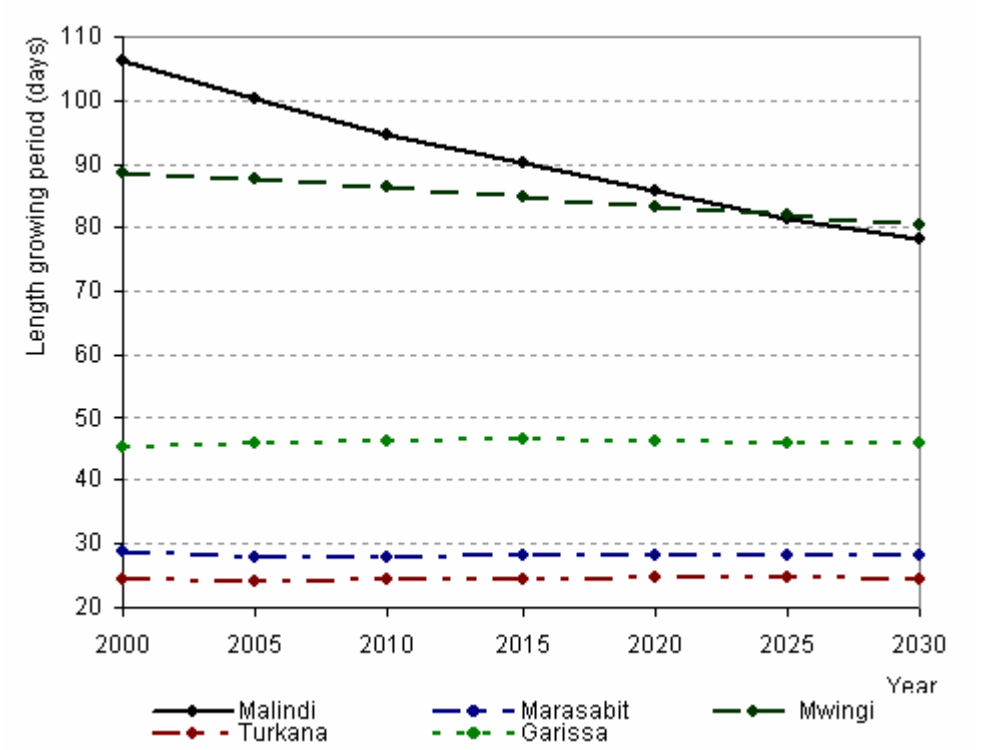
Figure 5.9. The length of growing period (in days) for 2000 and 2030.



Source: Jones and Thornton (2003).

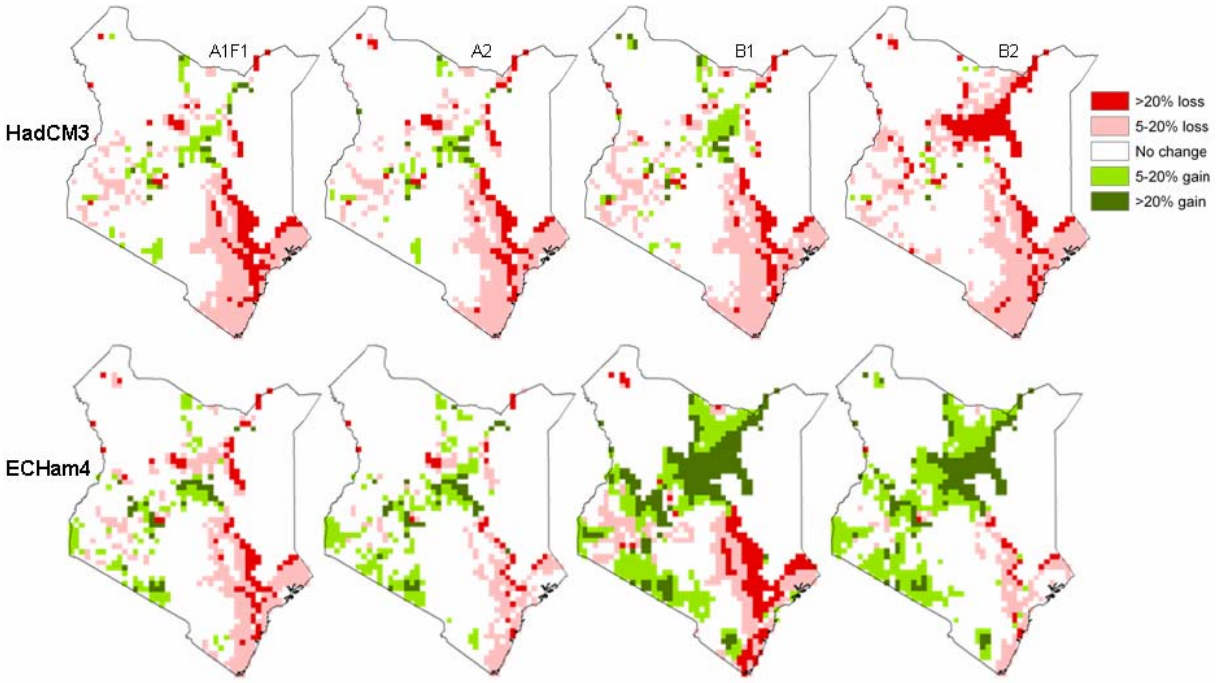
Figure 5.10. The change in length of growing period (in days) between 2000 and 2030.

As the predictions in changes of length in growing period show a large regional variation, just as for precipitation, we looked at the predictions for Garissa, Malindi, Marsabit, Mwingi and Turkana districts (Figure 5.11). The graphs shows clearly that although the areas with the least initial precipitation (Garissa, Marsabit and Turkana) are becoming slightly wetter, the length of the growing period is not expected to change over time due to increasing temperatures. The LGP for f Malindi and Mwingi districts is expected to decline over time (up to 25% compared with 2000) which is likely to lead to serious constraints to agricultural crop production. These results confirm the conclusions of Osbar and Viner (2006): although the projected increases in rainfall might appear to be good news for arid and semi-arid districts, the increasing temperatures mean a substantial increase in evaporation rates, which are likely to exceed any increases in precipitation. Overall, water availability is expected to become more problematic in the future, particularly if current population trends mean that demand continues to increase.



Source: Jones and Thornton (2003).

Figure 5.11. The length in growing period (in days) for 2000 to 2030 for 5 districts in Kenya.



Source: Thornton et al. (2007)

Figure 5.12. The percentage change in length in growing period to 2030 in Kenya.

The above results are all based on predictions of the Hadley CM3 Global Circulation Model for scenario B2, as this GCM represent rainfall patterns relatively well (Thornton et al. 2007). Thornton et al. (2007) illustrated the projected changes in LGP from 2000 to 2030, from down scaling outputs of the HadCM3 and ECHam4 GCMs for the scenarios A1F1, A2, B1 and B2. Note the large variation in predictions between GCMs and between scenarios. Variations in projected changes (Figure 5.12) make it quite challenging to come to a general consensus about projected changes in climate change for Kenya, or certain areas within Kenya.

5.7. Uncertainties and limitations to knowledge

Very few regional to sub-regional climate change scenarios using regional climate models or empirical down scaling have been constructed for Africa mainly due to restricted computational facilities, lack of human resources and problems of insufficient climate data (Boko et al. 2007; Christensen et al. 2007). The extent to which current regional models can successfully down scale precipitation over Africa is unclear, and limitations of empirical down scaling results for Africa are not fully understood. Hulme et al. (2001) pointed out that climate change scenarios for Africa based on greenhouse gas warming remain highly uncertain because of: (1) the problem of small signal-to-noise ratios in some scenarios for precipitation and other variables; (2) the inability of climate model predictions to account for the influence of land cover changes on future climate; and (3) the relatively poor representation in many models of some aspects of climate variability that are important for Africa (e.g. ENSO). Moreover, vegetation feedbacks and feedbacks from dust aerosol production are not included in the global models, and there is insufficient information on which to assess possible changes in the spatial distribution and frequency of tropical cyclones affecting Africa (IPCC 2007). The IPCC report (2007)

stresses the critical importance of further research in understanding how possible climate regime changes (e.g. ENSO events) may influence future climate variability.

Hulme et al. (2001) indicated that further work can be done to elaborate on some of the higher order climate statistics associated with the changes in mean seasonal climate shown here, particularly daily temperature and precipitation extremes. They also indicated that it may be worthwhile to explore the sensitivity of these model predictions to the spatial resolution of the models, i.e. explore the extent to which down scaled scenarios differ from GCM scale scenarios. The uncertainties in climate projections suggest caution and modesty in their interpretation. Rather than scientific predictions, we should think of them more as planning tools offering a range of possible scenarios that we must guard against. They also highlight the importance of building flexibility into climate risk management programs that can adjust to the occurrence of unexpected outcomes. Nonetheless, the tremendous implications that climate change has implies considerable returns to investments to improve climate science and increase the accuracy and information content of climate projections.

6. Early warning systems, seasonal climate forecasts and information dissemination

6.1. The rise and evolution of early warning services in Africa

The crippling famines that struck parts of sub-Saharan Africa in the 1970s and 1980s led to devastating losses of human life and left millions of affected survivors destitute, their livelihoods destroyed. Insufficient information to predict famines or to track the situation as the crises grew from bad to worse was widely blamed for the poor and belated response by national governments and the international donor community (Barrett and Maxwell 2006). The failure to mitigate famine and offer relief prompted the development of famine EWS whose objective was to prevent famine by providing national and international agencies tasked with responding to disasters with timely and accurate information on the conditions of vulnerable communities.

The availability of several EWS across numerous countries in sub-Saharan Africa is testament to the success of proliferation efforts. Moreover, to varying extents and with several exceptions, evidence exists that these EWS have generally been effective, catalysing early response and preventing the widespread devastation caused by famines (Barrett and Maxwell 2006). None of these systems, however, is perfect and all can improve on several fronts. The threat of increasing famines and other climate-related risks that climate change poses requires that much more efficiency from such systems.

EWS have experienced considerable evolution since their early days. Improvements in technology, in data availability and modelling capacity have led to increasing richness and precision and longer forecasting horizons. The early EWS often relied on crude and questionable indicators of impending drought such as cereal stocks or food prices and were often quite centralized; conditions of vulnerability and famine stress at the community level were rarely considered, often due to poor communication infrastructure, difficulties of access and the considerable expense of continuous monitoring and data collection. Currently, the reduction in transactions cost and markedly improved communication capabilities have placed the community level firmly under the EWS spotlight. EWS have moved to monitoring community-level indicators of imminent drought and even included measures of welfare and community-level resource endowments to accurately track vulnerability to certain levels of drought stress. Satellite technology has proved to be a boon for EWS and many now integrate the vast amounts of satellite biophysical data available into their EWS forecasts.

Lessons learned through time have also increased the scope of EWS. Initially, EWS were basically extractive. Information was first collected, collated and disseminated from central bureaus of statistics and national accounts of agricultural production. When community-level information became more accessible, more disaggregated measures of food insecurity and welfare were added to complement EWS. More recently, however, there has been an increasing emphasis on improving community capacity to respond pre-emptively to reduce exposure to risks and to mitigate its impacts as well as to facilitate

coping with inescapable consequences. EWS have thus incorporated broader elements of community development by taking the fight to the source. Most of such community based efforts cannot be distinguished from development initiatives as, by economically empowering communities, one also reduces their vulnerability to a given set of risks and increases their resilience.

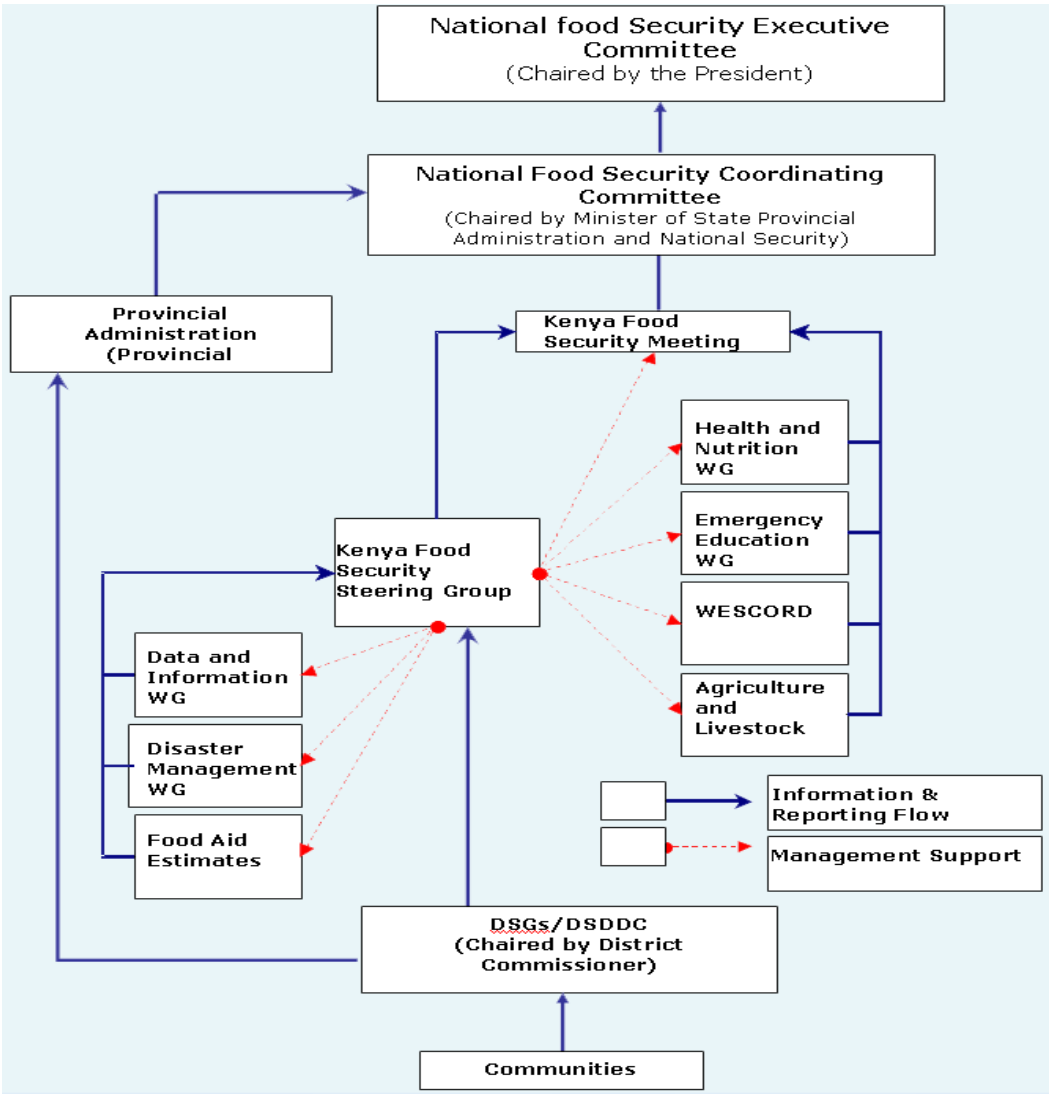
6.2. The state of early warning in Kenya

EWS in Kenya have come a long way since their inception and are generally considered to be well structured, integrated across all key stakeholders and clients, and relatively effective in initiating response (Buchanan-Smith et al. 1994). ALRMP, whose early warning efforts we detail in section 6.5, is one of the key government institutions that provides extensive drought monitoring coverage across much of the vulnerable areas of the country and is also largely responsible for coordinating and implementing response and recovery efforts. ALRMP arguably has the most widespread grassroots presence of any government or non-government institution for whom drought and disaster risk management is a key part of their mandate. ALRMP also plays a key role in national food security structures that regularly bring together the key stakeholders to share information and coordinate actions.

Kenya has for a long time been building its broader early warning capacity working on emphasizing coordination amongst the various EWS efforts of national, international and non-governmental agencies. By as early as 1990/1991 when Kenya experienced a serious drought in its ASAL areas affecting an estimated 1.5 million people (Oxfam International 2006), the capacity of Kenya's EWS to forestall disaster by timely response was recognized. Early warning stakeholders were involved in decision making, national EWS information was used for targeting, pre-programmed response options facilitated flexible context-specific response options, and there was relative transparency in decision making (Buchanan-Smith et al. 1994).

Relatively effective though they were, it was recognized that there was scope and need for improvement in producing and disseminating EWS and sufficiently tying it into resource mobilization and response plans. Significant changes in the institutional and operational framework of food security structures within Kenya began in early 1999. Changes resulted in the improvement of existing food security structures, the clarification of roles and responsibilities for improved coordination and response and the development of complementary bodies aimed at providing technical and methodological backstopping and setting standards for data collection, analysis, assessments and interventions. Food insecurity is at the core of EWS and indeed, EWS were originally established to provide information on deteriorating conditions of food security.

The current national level food security and drought management institutional linkages are shown in the organogram below.



Source: KFSSG Website (http://www.kenyafoodsecurity.org/mod.php).

Figure 6.1. The current and national level food security and drought management institutional linkages.

At the apex of the structure we have the National Food Security Executive Committee (NFSEC) that is chaired by the President. This committee meets only under special circumstances of widespread disaster where available resources outstrip the capacity of line ministries, special programmes and other disaster response partners and international appeals become necessary. Below that is the National Food Security Coordination Committee (NFSCC), chaired by the Minister of State for Provincial Administration and National Security that meets occasionally at the behest of the KFSM or the Provincial

Administration, to discuss matters of growing food security concern and the means to respond effectively to them.

The KFSM, however, is the main food security coordinating body that brings together food security actors in a forum where information is exchanged, options are debated and decisions on necessary actions are taken. KFSM boasts high level representation of a broad grouping of organizations at the national level with an interest in food security. The KFSM meets monthly and is co-chaired by the director of the ALRMP. Its members include food security related line ministries, UN agencies, the Red Cross Movement, NGOs and donors (KFSM website http://www.kenyafoodsecurity.org/mod.php). Together, these interested parties coordinate emergency response, work to improve the general effectiveness of Kenya's existing web of EWS and its disaster risk management efforts, and summarize the current level of food stress across the nation, along with its corresponding needs, for referral to the NFSCC, the NFSEC and donors. The KFSM has six sectoral working groups that provide technical backstopping and delve into the detailed food security complexities specific to the various sectors. The sectoral working groups (and key responsible institutions) are: Agriculture and Livestock (Food and Agriculture Organization of the United Nations (FAO)/Ministry of Agriculture/OP), Water and Sanitation (United Nations Children's Fund (UNICEF)/Ministry of Water), Health and Nutrition (UNICEF/Ministry of Health), Disaster Management (Kenya Red Cross/OP-Relief and Rehabilitation), Food Aid (World Food Programme (WFP)/OP) and Education (UNICEF/Ministry of Education).

The KFSSG was originally formed and charged with the responsibility of geographical food aid targeting and distribution decision making and coordination. KFSSG has increasingly been taking on new responsibilities that go beyond simply food aid to gathering information, analysing and providing monitoring and provision recommendations for other disaster interventions activities. While the ToR of the KFSSG are still being developed, it is anticipated that it will eventually form the Food Security and Drought Management Secretariat (FSDMS) within the Drought and Emergency Coordination Department of the OP. The KFSSG currently operates on a multi-agency basis with GoK leadership. ALRMP co-chairs its meetings with the WFP and its membership includes the Ministry of Agriculture, the Ministry of Health, UNICEF, WFP, United Kingdom Department for International Development (DFID), United States Agency for International Development (USAID), Oxfam and Médecins sans Frontières (MSF).

Along with the extensive data collection efforts that inform ALRMP drought EWS, WFP and USAID are also heavily involved in their own data gathering, monitoring and analysis efforts. USAID's Famine Early Warning System Network (FEWSNET) provides early warning and information on food security threats to decision makers and planners to prevent famine and improve food security. FEWS has been implemented in roughly 5-year phases since its inception in 1985. The latest phase of the activity places an emphasis on networking among individuals and institutions, hence the more recent name FEWSNET. Spanning across Africa, Central America and the Caribbean and Afghanistan, FEWSNET functions to develop and strengthen information networks and

build local capacity to generate and disseminate information. Its operations are premised on the belief that the bridge between information and action is 'planning'.

In Kenya, FEWSNET is engaged in activities that strengthen its ability to monitor the national food security situation and propose informed suggestions to aid decision-making processes. FEWSNET has adopted an array of technological approaches (ranging from remote sensed data collection to computer generated programming) that provide information on vegetation densities, crop performance indicators (in relation to water availability during growing seasons) and climate based information. The data collected are translated into maps and images which are easily accessible via the FEWSNET website. Since 2000, FEWSNET has adopted a livelihoods approach to its food security assessment methods; this has enabled a greater understanding of the levels of access to food, to complement assessments of food availability. Currently, FEWSNET is in the process of developing a number of livelihoods products for Kenya to mirror this approach to food security assessments. Analysis of the generated information provides the tool for understanding what could or is happening to people's livelihoods in relation to their food security position. Early warning is thus the outcome of food security analysis (combined with hazard and risk analysis) and is supported by FEWSNET partners in the USA like the United States Geographical Society (USGS), National Oceans and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA) and USAID.

A second approach to the gathering, monitoring and analysing data is the WFP's Vulnerability Assessment Mapping (VAM). Established in 1998, VAM seeks to identify the people most vulnerable to hunger and target their needs. By assessing emerging food security problems the aim is to better understand the risks these may pose to livelihoods (Benson 2003). VAM monitors a range of indicators such as rainfall patterns, crop conditions, food prices in local markets, local food consumption, food sources and expenditure on food, shocks, coping mechanisms and migration. In Kenya, this primary information on food security is then processed via satellite imaging to develop a variety of vulnerability maps. In combination with secondary nutritional information (mainly obtained from UNICEF or NGO data from area level surveys), a monthly bulletin on food security and vulnerability is compiled in conjunction with FEWSNET, ALRMP, the Ministry of Agriculture and UNICEF to help provide timely information for early warning and to inform interventions targeting those most vulnerable.

The KFSSG brings together, among others, the main sources of early warning information, (like ALRMP, WFP and FEWSNET) key to the decision making process. This strong coordinating mechanism collates and analyses pertinent information on the degree of drought vulnerability of communities across the country and coordinates the required response at the district level. To what extent, however, do such analyses feed back to the communities themselves? The DSG mechanism connects district level information sourced by the community to activities occurring at the national level yet, due to capacity constraints, limited efforts appear to exist to ensure the downward flow of information from the national level to the communities at district level.

6.3. Ex post *and* ex ante *roles of early warning information*

To be forewarned is to be forearmed. As the previous section highlights, EWS are crucial mechanisms for providing external agencies such as governments and international aid agencies with precise information on impending disasters by which they can initiate timely and effective responses. However, there is a fundamental difference between EWS informing external agencies and EWS that provide information to community members meant to activate mitigating responses to imminent shocks. A crucial distinction between the two clients is that EWS targeting external agencies are meant to trigger *ex post* emergency response while EWS for community clients is aimed at prompting *ex ante* mitigating response to reduce the likely impacts of the predicted hardship.

This distinction is central because it speaks to important differences in the set of information and services that are required for the different clients, as well as the response that is expected or desired from them. Traditional early warning (targeting the external client), is an *ex post* measure aimed at signalling a disaster situation already in progress to elicit a response before the consequences reach catastrophic proportions. Improvements in traditional early warning were geared at reducing the time lag between the onset of a disaster and external response. Indeed, drought and famine early warning systems such as those carried out by ALRMP and FEWSNET and others are now trying to 'forecast' the imminent onset of severe drought that would require external relief activities to effectively eliminate the time lag between onset and response activities. More timely response is both cost-effective and would protect key livelihood assets and lead to faster recovery.

Ex ante roles of early warning occur before disaster strikes and are often targeted toward communities. Indeed, much of the necessary *ex ante* efforts, which enhance community capacity to respond to climatic or other shocks, and reduce their exposure to risks, is broader than simply providing early warning information. While informing the community of heightened disease likelihood is indeed early warning to which they can make pre-emptive preparations to reduce their exposure, preparing contingency response plans and informing community members about various activities they can engage in to mitigate their risks and enhance their capacities to cope falls within the wider umbrella of climate risk management or even adaptive development responses. As will be expanded on later, certain outfits that are loosely defined as EWS, e.g. the Livestock Information Network and Knowledge System (LINKS), provide market information that is just as beneficial to the target clientele during times of normalcy as it is during times of drought for it guides clients to make informed restocking decisions at all times.

Whether the EWS is *ex post* or *ex ante*, communities, especially those most vulnerable to climate induced shocks, have a key stake in the promotion of efforts to generate and disseminate critical early warning information. Where the community is the client, involving them in all stages of EWS development and operation is crucially (ISDR and FFO 2006a). It provides awareness of the risks to which they are exposed and expands the space of effective strategies they can use to reduce the damage that may be inflicted. The past decade has witnessed an increasing number of efforts aimed at complementing

EWS solely designed to facilitate the information requirements of international aid agencies with community based EWS to improve the mitigating capacity and preparedness of community members.

6.3.1. The community as providers and recipients of information

Despite the clear differences in client and objectives, EWS serving government and international aid agencies tend to generate their outlook based on data either collected from the community or from satellite based data (satellite data simply provide estimates on conditions actually viewed or experienced by the community). Locally generated data are context specific and thus provide more useful information on the economic position, nutritional status, food and water shortages and the capacity of the community to handle certain levels of risk exposure (Ashmore 1997). Given that community members experience in real time the data that EWS use to estimate their models and run their analyses, this begs the question: What additional information can EWS offer to community members that they do not already have? How can external early warning information complement indigenous community information and thus provide advance warning services that go beyond what the community already has available to them? The answer to this question can be seen in different models of EWS currently targeting community members.

For early warning information to be more than an update of real time experiences or projected events, communities need to be endowed with a wider range of information and capacities upon which they can rely to mitigate imminent crises. A clear understanding of the knowledge and experience of communities can guide early warning information and services content in such a way that valuable information can be provided at the grassroots level. Existing attempts that can be loosely described as community based early warning efforts share a common overarching goal of providing community members with information, tools or services that will help them more effectively manage the risks they face and/or reduce their exposure to risk. These either take the form of provision of seasonal climate and disease risk forecasts, providing timely information on the distribution of prices of key commodities across major markets or providing information on the geospatial distribution of forage and water availability or simply offering advice on effective and available risk mitigation strategies and how best to respond in the advent of a shock.

6.4. Community based EWS

An ideology (or an understanding of what the content of community based EWS should be) that is growing in popularity is commonly referred to as ‘people-centred’ EWS (PCEWS). The objective behind this approach is to empower individuals and communities at risk with enhanced and pertinent information that is disseminated in a timely manner through a trusted and effective medium to facilitate an efficient and appropriate response to minimize negative effects (ISDR and FFO 2006a; Kariuki 2006). PCEWS evolved from a community focused vision of EWS that supports and empowers people to protect themselves. It is sensitive to the needs, priorities, capacities and cultures of those at risk. In this view, at-risk communities must be active partners in the system, not controlled by it (ISDR and FFO 2006b). Elements of PCEWS are certainly oriented

toward empowering populations by offering them enhanced livelihood options, encouraging them to save for a rainy day or to join community groups that provide social support to affected members or generate income during periods of normalcy that are used for consumption smoothing and risk management during difficult times.

The four key underlying elements guiding the PCEWS approach are (adapted from ISDR and FFO 2006a):

1. A demonstrated awareness of the risks faced by communities based on the collection, analysis and understanding of the data is required to help motivate people to prioritize the needs of EWS and to steer the preparations required for disaster prevention and response.

2. A strong monitoring and warning service component to ensure that the correct parameters are being monitored based on sound scientific knowledge with which to make forecasts with and allow the accurate and timely generation of warning.

3. Communicating and disseminating information is therefore critical. Certain factors must be considered to ensure that warnings reach those at risk. PCEWS attempt to improve regional, national and community-level communication systems and promote the establishment of authoritative voices. The use of a variety of communication channels is acknowledged as necessary to ensure that as many people as possible have been forewarned.

4. For communities to respond to a warning, they must possess the capability to act; an integration of up-to-date, tested response plans, utilization of local capacities and knowledge all assist to help communities prepare to act upon early warning information.

While the ideas, intention and experience embodied in PCEWS are not new, the formalizations of these concepts into a more structured and defined framework is nascent. As such, there are currently few active programmes fitting the PCEWS vision which allow for a robust evaluation of its impact or successes. The theoretical basis of PCEWS is indisputably comprehensive and covers all the key prerequisites for an effective EWS and also incorporates more *ex ante* climate risk management and adaptive development perspectives. However, the jury is still out on whether programmes based on such a framework are sustainable and practical. Indeed, the all-encompassing nature of the framework may make it difficult for one programme to capture all its components. In what follows, we highlight some of the few PCEWS-type activities in Kenya that seek to serve the community.

6.4.1. The Livestock Early Warning System (LEWS)

Initiated in 1998, the Livestock Early Warning System (LEWS) arose to respond to a vacuum of capacity to detect drought-related stresses on pastoralists and a lack of systematic mechanisms for effective and sufficient information dissemination (Sommer 1998). The main objective of LEWS was to develop methodology and technology to address the informational needs of pastoral communities, relative to emerging forage conditions in response to climatic conditions (LEWS 2003). As a project of the Global Livestock-Collaborative Research Support Program (GL-CRSP), LEWS is led by researchers at Texas A&M University, in collaboration with a large network of national agricultural research systems (NARS), NGOs, and development agencies in Ethiopia, Kenya, Tanzania and Uganda.

The LEWS team has developed an integrated suite of technology capable of predicting the nutritional status of livestock from faecal profiling and estimating livestock forage availability, deviation from normal, and percentile ranking for a large portion of the four project countries. These estimates were mapped using geographic information systems (GIS). In addition, 90-day forecasts were modelled on the basis of these estimates that afforded the mapping of information such as current forage conditions relative to historical conditions, conditions at the same time during the previous year, and likely forage response in the next 90 days (LEWS 2003). LEWS was essentially a blend of monitoring, modelling and spatial technologies aiming to provide food security information and disseminate this effectively to pastoral communities (Kariuki 2006).

One of the main accomplishments of LEWS was the complete automation of its modelling processes. The various models that used a suite of satellite weather and biophysical data were linked together into an integrated system that would automatically download model data from the various sites producing it and continuously update the model. These automated products were universally accessible through a website run by Texas A&M and could provide various model estimates at the touch of a button. Besides the website, LEWS distributed its maps and situation reports, updated every 10 days, via WorldSpace radios, email, CDs and newsletters to over 400 organizations and 300 decision makers in the region.

The strength of LEWS is that it not only observes the initiating conditions of rangeland production, but uses scientifically based biophysical modelling to predict the effects of those initiating conditions on forage production and animal well-being. With many current EWS measure indicators (such as human malnutrition, crop and livestock prices, and livestock mortality) the response is only observable as crisis conditions have already set in and little room is left for preparation and mitigation. In pastoral and agropastoral areas, where welfare is largely determined by livestock productivity and thus rangeland conditions, attaining reasonably accurate spatially explicit estimates of forage quality and availability offers a significant advantage.

Despite the clear theoretical benefits of LEWS, there were several significant obstacles that limited its potential effectiveness. First, the paucity of actual data for ‘ground truthing’ required to calibrate models based on satellite data call to question the accuracy and precision of LEWS models. Many assumptions were made in specifying the model that adds

substantial noise to its estimates. However, as LEWS developed, an increase in data availability and site coverage used for ground truthing has improved the accuracy of the models. The second big challenge LEWS faced exacerbated the reliability concerns that were being raised. Despite the significant efforts that were made in disseminating LEWS outputs to as many relevant clients as possible, getting the reports to the communities was difficult and it was not clear if the information content was much utilized (Ryan 2004). The dissemination system relied heavily on strong and lasting commitments from its partners who are assumed and expected to deliver the reports to pastoralists in a reliable and timely fashion. The information content of the LEWS reports was not always so straightforward and required some technical capacity to fully understand and clearly relate it to the end user. Furthermore, target communities which have through time developed their own indigenous methods of forecasting have been reluctant to accept and sceptical of any supplementary information. One study of a LEWS site in Laikipia District, Kenya, indicated that it would take 4–8 years before the Laikipia Maasai were likely to accept the LEWS advisories as accurate and useful, and this, only if the LEWS information proves to be accurate consistently across that range of time (Ryan 2004).

6.4.2. Livestock Information Network and Knowledge System (LINKS)

Evolving naturally from the LEWS project, LINKS, initiated in 2003, improves on the communication technology developed in LEWS to provide a wide range of market related information to participants in the livestock marketing chain. Using a partnership approach with existing livestock marketing institutions in Ethiopia, Kenya and Tanzania, LINKS has designed and is delivering an equitable livestock information and communication system that provides monitoring and analysis technology to foster strategic partnerships between pastoral communities, markets and policy (LINKS 2005).

The main objective of LINKS is to increase the household income of pastoral communities in Eastern Africa by improving livestock marketing efficiency, strengthening institutional market policy and increasing livestock offtake during the emergence of drought, through the implementation of an integrated livestock marketing system. The implementation of a reliable market information system creates transparency and a basis for the pastoralists to make marketing decisions. The LINKS programme has established the necessary technical framework for the reporting of livestock prices and volumes, and has helped to establish a limited number of monitoring markets.

In Kenya, LINKS covers 15 key secondary and tertiary livestock markets: Nairobi (three markets), Marsabit, Isiolo, Wajir, Garissa, Emali, Marigat, Mombasa, Mandera, Moyale, Garsen, Chepareria and Suguta. Livestock prices and volumes are collected through interviews with traders (usually buyers due to security reasons) during the peak of a market day. Trained livestock market monitors collect data on five cases of each of the dominant animal breed, class and grade combination on that market day. Average prices by animal kind, breed, class and grade is then calculated along with the total volumes of livestock by animal kind. The coded data are saved into the LINKS database and configured into formats compatible with different dissemination channels. Livestock information can be accessed using the Internet, either via email or directly from the

website. In addition, for a standard fee, those with mobile phones (mainly livestock traders) can request instantaneous information on the price of various livestock types in their different market locations via the standard short message service (SMS). The need to expand the livestock markets monitored by LINKS is currently being considered in conjunction with more robust training programmes for monitors and a campaign to create awareness to sensitize clients.

So far, LINKS has demonstrated the benefits of technological integration into its livestock marketing system. For this reason, one of the major aims of the LINKS project is to exploit the application and usefulness of integrated spatial, information and communications technologies in improving livestock market information infrastructure in Eastern Africa. The spatial, information and communication toolkits being used here include: global positioning systems (GPS), mobile phones, WorldSpace radios, computing analysis and web-based platforms. Integration of these tools makes it possible for the system to carry out market chain analysis indicating the location, quantity and associated costs of acquiring the desired goods and services.

While the information collected and disseminated by LINKS is invaluable, and is an attempt to analyse and determine the welfare gains of the suite of information collected, it is not clear that such a programme should be classified as a system for early warning. Furthermore, dissemination to the community level and the intended final user has been weak (LINKS 2005) making it difficult to accurately determine its impact. Pastoralists in remote locations, who are most vulnerable to drought, have more difficulty accessing LINKS information. As LINKS continues to expand to meet its vision of an integrated EWS, the need to investigate client usage has been recognized as a means to better improve service provision and target those communities at risk.

6.4.3. The Community Based, Livestock Early Warning System (CB-LEWS)

While LEWS/LINKS was designed to cater for the needs of pastoral and agropastoral communities and real attempts were made to ensure that the information was widely disseminated, there is scant evidence that the clients themselves were accessing it, and even if they were, that it makes any difference to actions. Critics of LEWS in particular mention that the information it presented was too abstract, for example, elegant maps that varied in colour and tone depending on the deviation of forage conditions from historical norms were not easy to read. The usefulness of such information was also questioned. If migratory routes were blocked because of hostile and armed bandits or the privatization of previously communal rangelands, knowing that forage and water availability were superior in a no-go zone was not particularly helpful. Access to LEWS information is also largely restricted to those with access to the Internet, mobile phones and WorldSpace radios.

The Community Based Livestock Early Warning System (CB-LEWS) seeks to improve on LEWS by actually engaging the community, training them to understand LEWS bulletins and other advance warning or contemporary information that may be helpful, preparing contingency response plans with communities to improve their mitigation and coping

responses, and in some cases providing them with resources to enhance their risk management capacity. CB-LEWS is largely driven and supported by a tripartite collaboration involving the ASARECA-Animal Agriculture Research Network (A-AARNET), the Kenya Agricultural Research Institute (KARI) and the Ministry of Livestock and Fisheries Development (MoLFD). CB-LEWS activities aim to ensure that community prioritized contingency plans are developed and transparent intervention mechanisms established. CB-LEWS integrates top-down early warning forecasts with traditional drought indicators (mainly meteorological, biological/ecological, astrological and cultural) to improve the community responsiveness to the CB-LEWS advance warning bulletins. The use of participatory approaches for both collecting and disseminating information are crucial ingredients aiding the process of dealing with drought related situations affecting pastoralists.

The CB-LEWS project structure is designed to allow the contributions and experiences of community-level members to influence decision making at all levels. An open two-way line of communication is crucial for the effective operation of the system and the project structure is designed with this in mind. The structure also allows for ease of information flows with the intention being to reduce time lags and assure that information is sourced and distributed as efficiently as possible. The philosophy of CB-LEWS is that if information is trusted, collated through collaborative mechanisms and effectively disseminated, communities are more likely to act on it.

CB-LEWS is a relatively recent initiate that began preparatory operations in 2005/06. The initial stages focused on developing the necessary structures, objectives and partnerships required to attain the vision espoused by project. A careful plan of action and well delineated set of objectives exist. Thus far, CB-LEWS has selected its baseline project areas and conducted community stakeholder sensitization workshops to directly engage their clients to ensure that efforts are demand-driven. Extensive training of various staff and stakeholders with different functions has been carried out (namely, the community management committee, veterinary and extension officers, GIS and remote sensing officials, etc.). CB-LEWS equipment has also been distributed to CB-LEWS community sites and zonal headquarters (WorldSpace receivers, GPS, computer hardware and software, mobile phones, solar panels etc.). With an impressive portfolio of activities already taking place catering for the needs of local communities, the opportunities available for the project's effectiveness within Kenya's sphere of EWS are positively projected for their future operations.

6.5. Seasonal climate forecasting

Seasonal climate forecasts (SCF) represent the next step of EWS particularly critical at a time where climate change is expected to change the amount and distribution of rainfall in ways that will not only cause damage during times of climate extremities but could have even greater consequences on food security. If climate change affects seasonality in a way that producers of rainfed agriculture are unable to tell when they should prepare their fields for cultivation and plant their crops, the resultant reduction in agricultural output would have a catastrophic effect on many economies in sub-Saharan Africa and significantly raise the already precarious state of food insecurity. This increases the need

for accurate seasonal climate forecasts that can advise farmers, pastoralists and any other individuals whose livelihood is directly tied to climate change.

As we learn in Section 5, Kenya will experience a variety of changes in normal climatic patterns across the country. This will have a significant impact on various sectors of the economy, especially agriculture which is currently largely rainfed. Across most of Kenya the LGP, a key indicator of agricultural productivity, will decrease due to long-run trends in rainfall and temperature (Figure 6.2).

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Figure 6.2. Projected variation in length of growing period over time.

Furthermore, if northern (southern) Kenya is currently experiencing a wetting (drying) trend that is expected to continue it is very difficult to predict the effect such trends will have on seasonality and rainfall distribution. These expected changes, coupled with the inherent uncertainties, make SCF efforts critical.

Incorporating climate information into agricultural and other development decision making has the potential to improve productivity and reduce vulnerability in the face of uncertain climate. Farmers have been shown to adopt conservative, low-return management strategies due to climatic uncertainties. Rather than investing in new, enhanced technologies, they opt for less risk but less profitable cropping practices, even under favourable climate conditions. Reducing this uncertainty should have a direct and positive effect on livelihoods, especially when climate variances look set to increase due to climate change (Hansen et al. 2004). Unfortunately, the science of climate forecasting is still nascent and while short-term predictions of temperature and other weather variables such as predicting whether rainfall will be above, similar to or below normal are relatively good, predicting more relevant seasonal variables such as when the start of the rainy season is expected to be and how rainfall is expected to fall is still fairly inaccurate.

Nevertheless, advances in seasonal climate prediction allow decision makers to anticipate probability shifts in rainfall and productivity well in advance of the start of the growing season, potentially reducing both the *ex post* (through timely implementation of individual coping responses and safety net interventions) and *ex ante* impacts (allowing decision makers to relax conservative strategies, shift portfolios toward more productive assets and more aggressive investment on average) of climate variability. Statistical (Mutai et al. 1998; Indeje et al. 2000) and dynamic (Hansen and Indeje 2004) forecast models that incorporate understanding of relationships between the atmosphere and its underlying ocean surfaces provide a fairly high degree of predictability of the October–December short rains at a long lead time over much of Kenya and credible but weaker predictability of the March–May long rains. Seasonal rainfall forecasts can be downscaled and translated into forecasts of crop yields or range vegetation conditions (Hansen and Indeje 2004; Indeje et al. 2005).

Periodic regional climate outlook forums in eastern Africa have fostered awareness and dialogue. However, they have not yet incorporated advances in methods for downscaling

forecasts and modelling agricultural impacts, and they lack an effective mechanism for reaching rural communities with relevant information. Surveys and pilot studies with farmers in semi-arid Kenya and similar environments elsewhere have demonstrated a high level of awareness and interest and have identified a range of promising livelihood management responses (Ngugi 2002; Tarhule and Lamb 2003; Ziervogel 2004). They have also identified several obstacles (O'Brien et al. 2000; Ingram et al. 2002; Tarhule and Lamb 2003) including: (a) timely and equitable access; (b) mismatch between farmers' needs and the scale, content, format and accuracy of current operational forecasts; (c) the cost, risk and learning time farmers face during adaptation and adoption; and (d) access to credit and production inputs. Relaxing these constraints through studies and well designed pilots could unleash the potential benefits of SCF, especially as the science of climate forecasting continuously improves its range and accuracy. One of the key challenges of SCF, especially as forecasting information improves, is the direct relationship between complexity of the information and the dissemination formats used and precision of the forecasts. Enhanced methods to train and to adequately translate SCF information to the target clientele are essential.

6.6. The ALRMP early warning and disaster response system

Drought management is one of the largest operational mandates of ALRMP; the resource envelope responsible for drought management is the most heavily funded and more ALRMP districts receive drought management resources than either of the other two ALRMP components. The ALRMP EWS falls within its drought management portfolio and aims to measure the drought related stress levels of target populations by regularly monitoring key indicators that include welfare proxies, child nutritional status, both household and community level economic status and the state of the natural resources base among others. Food security trends are actively monitored against four warning stages which correspond to the increasing severity of food insecurity and inform different levels of interventions.

The bedrock of the ALRMP EWS is the expansive and detailed data collected at each site. Household surveys are conducted monthly in a randomly selected group of 30 community members. The 30 respondents are chosen annually and are repeatedly surveyed for 12 months before a new set of respondents is selected. Questionnaires collect general household demographics, detailed livestock ownership and management data, income sources, food aid receipts, child nutritional status and the like. A community level survey, also conducted monthly, gathers general information on whether it rained the previous month, the use and availability of water sources, forage and cereal availability, the prices of key food commodities, receipts of food aid, incidence of human and livestock diseases, the state of security etc. The survey is fielded to key informants within the community, usually the chief, community elders and other such members of influence who may possess a wealth of knowledge to complement and verify household survey information. In communities involved in subsistence agriculture, a quarterly supplementary survey is conducted at household level. This module aims to gather information on cultivation choice and practices and crop marketing decisions.

In addition to the rich source of information generated by these survey instruments, ALRMP field staff write monthly field reports on the general status of the community based on personal observation and discussions with community members, civil society, and NGO partners. Field reports also include key observations and conclusions made by other agencies that have a similar mandate of emergency relief and community development. These include rapid assessments that are carried out by NGOs, often after the short and long rains and during acute emergencies. These quantitative and qualitative data from the surveys and critical information from the field reports are then analysed and synthesized into regular monthly drought monitoring bulletins. The bulletins serve as the main document by which ALRMP determines the extent of food insecurity and general vulnerability in its target communities and makes resource allocation decisions.

6.6.1. Use of ALRMP drought monitoring bulletins

The drought monitoring bulletins, published monthly by ALRMP field staff, aggregate community level data into a district level document. Should the experience of a particular community in one district vary significantly in a manner that requires special attention by ALRMP staff, the condition of such a community is often individually highlighted in the reports. The bulletins, which often follow a standard format, provide a situation overview that includes summary bullets on the condition of environmental indications (rainfall, water resources and sources and forage availability), rural economic indicators (livestock conditions, livestock and food prices and livestock diseases), human welfare indicators (child nutritional status, milk consumption, livestock to cereal prices ratios as a food security signal and human diseases), and others (food aid receipts, migration activity and insecurity). Following the situation overview is a more detailed exposition on these indicators that includes price trend analysis of the key commodities (livestock and cereals). A section on other key issues of importance to drought monitoring and risk exposure follows after which a series of recommendations are provided.

On the basis of the data and the analysis, each site is systematically categorized into one of four clearly predefined drought warning stages: normal, alert/alarm, emergency and recovery. Each site in the district is categorized separately. This information is often included on the front page of the bulletin. Each of these stages has a specific set of activities which are prioritized. In the normal stage, ALRMP and its DSG partners prepare contingency plans, focus their attention on community development efforts and work on building their own capacity to handle crisis when it hits. In the alert/alarm stage, focus shifts to attending to human and animal health activities, facilitating livestock offtake, managing access to and use of grazing reserves and stockpiling pumps for boreholes. When emergency strikes, relief efforts take centre stage. Sourcing and distributing food aid and offering nutritional supplements takes up most of the resources. At recovery, restocking assistance, rehabilitation of boreholes and infrastructure development take precedence.

These bulletins are circulated to members of the DSG to inform community level response and to provide a basis by which such responses can be coordinated, consistent and based on the same source of information. Bulletins are also forwarded to ALRMP headquarters and are used to determine resource distribution to communities and to

reallocate resources across resource envelopes where necessary. Headquarters can use these bulletins to continuously monitor the situation on the ground and make rapid micro-adjustments on resource provision depending on changes in risk exposure and need. Other agencies tasked with the provision of emergency relief support such as FAO, WFP and USAID also find these bulletins extremely useful. The wide grassroots network that ALRMP has and the continuous flow of information it generates provides these agencies with an effective food security monitoring tool to supplement their own information and guide their own operations. In its role as the co-chair of the KFSSG and of the KFSM, ALRMP bulletins certainly receive attention in the most relevant food security and early warning forums in the country.

6.6.2. Informing external disaster risk response

As it stands, the client of ALRMP EWS is clear. The EWS, comprised of the data collection exercises, field monitoring report and summary bulletin, channels drought monitoring information and analysis sourced from the community to decision makers at the community level (via the DSG), and primarily to ALRMP decision makers at headquarters. Further, the bulletins and the recommendations and efforts emanating from headquarters influence the response and activities from international aid organizations. Consequently, the ALRMP EWS monitors the community to inform the external client and influence the level of requisite resources and the effective distribution of resources across activities.

Discussions with ALRMP colleagues suggest a clear intention to shift focus toward the community. There seems to be a feeling that EWS should serve the communities themselves, especially since the information is sourced from the communities. However, insufficient evidence exists to indicate that the information analysed and synthesized into the bulletin is fed back in a systematic way to communities. Moreover, local staffers of ALRMP are fully occupied with their current terms of reference, which do not include the dissemination of early warning information to community members. Indeed, the employment structure of ALRMP, its operational mandate and the design of its current EWS does not officially provide for direct dissemination to the community.

One can argue that since the DSG is the local representative for community members and the key first-level decision maker for distribution of risk management resources to the community, keeping the DSG informed is tantamount to informing the community. Such logic does not satisfy genuine efforts of directing EWS at community members. As mentioned earlier, *bona fide* CB-EWS seek to empower individual members of the community to take pre-emptive action to mitigate the impact of risk exposure, either by providing them with forecasts of forthcoming climatic extremes, contemporary but useful information that they otherwise would not access, to assets and services that can dampen the consequence of a negative occurrence.

6.6.3. The community as client?

Simply distributing drought monitoring bulletins to community members, assuming they are all literate, would not qualify as community based early warning. While it may have the benefit of keeping community members involved and opening a downstream line of

communication to complement the current upstream nature of the ALRMP EWS, it will not add to the space of knowledge that they can act on to reduce their risk of exposure. For the community to benefit from early warning information, it must receive information that it can act upon and would not otherwise easily source. As such, the information must not only be pertinent and sufficiently precise, but it must be understood and trusted. For example, community members could have benefited from receiving advance forecasts of the outbreak of Rift Valley fever in late 2006 before it happened. Assuming that they trusted this information and understood the likelihood and impact of an outbreak, such information may have generated a pre-emptive response that could have reduced the intensity and spread of the outbreak and reduced the number of both human and livestock deaths that consequently occurred.

In addition to disease early warning, communities can also be provided with forecasts of the likelihood of famine. Mude et al. (2006), for example, use a combination of ALRMP and climate satellite data to construct an empirical model that can precisely predict the onset of famine 3 months in advance. This information, provided to the community, would be supplementary information that communities can react to. However, it is justified to ask if community members are really the best outlet for this information. Clearly, severe child malnourishment, which Mude et al. (2006) used as a proxy for famine, is an undesirable outcome and anyone would do their very best to assure that it does not occur. As such, it is not clear whether informing individuals of the likelihood that they may experience famine would make any difference. Such a model is clearly intended for external agencies that have resources, food or otherwise, which they can introduce into the community to dampen the impact and intensity of famine. While it is more plausible that information on an imminent outbreak of Rift Valley fever may change individual behaviour in a way that reduces its impact (e.g. by moving livestock away from mosquito prone areas or reducing the density of livestock by managed offtake), it is arguable that such information is best acted on by community agents such as veterinary and health officers who can enforce quarantine restrictions or other necessary measures to limit the spread of the disease.

What then can ALRMP offer its community members in terms of early warning services? What type of information do community members want? How much benefit will they gain compared to other activities that ALRMP could funnel its resources toward? It seems that the majority of communities that practise, trust and rely on traditional early warning and seasonal climate forecasting to guide their decisions are less likely to respond to external information, especially on climate conditions already internally predicted. In thinking through these issues, it helps to have a clear definition of what is meant by EWS, especially in relation to the sorts of community based EWS that exist.

Traditionally, EWS refers to a set of information used to generate forecasts, either empirical or otherwise, to signal the likelihood of some impending disaster and allow for preparatory measures to be taken. Because this information is usually sourced from communities, they therefore often perceive such signals in real time. Consequently community based EWS as they are conceived often include components outside the scope of traditional EWS. CB-LEWS, for example, aims at actually training community

members to understand, trust and effectively respond to advance warning information. Effective contingency response plans are drawn up in conjunction with community members and resources to access information are distributed to allow adequate pre-emptive response. Importantly, especially in project communities such as Turkana and Marsabit that rely heavily on indigenous forecasting systems, CB-LEWS also works to integrate traditional methods with more scientific forecasts. LINKS provides up-to-date, detailed spatial market information to allow individuals to make wise and effective market decisions that would strengthen their capacity to cope with shocks. It also produces detailed maps on forage availability in the area.

ALRMP, both within its EWS and in its other roles as implementer of community development projects and local capacity builder, already does much of what the innovative community based EWS claims and intends to do. As discussed, when conditions are normal, ALRMP works with its partners in the DSG to develop, fine tune and update contingency response plans and access needs. During the alarm/alert stages it initiates concerted efforts with stakeholders and community members to best prepare themselves, through improved management of scarce water and forage resources, improved marketing for livestock offtake and the like. Such efforts are consistent with the objectives to which CB-LEWS and LINKS subscribe. In this way, the traditional EWS operations of ALRMP, which culminate in reports that are sent upstream, also have a direct impact on communities through the drought-level contingency activities that ALRMP and the DSG initiate. However, ALRMP is evidently weak on the packaging and dissemination of useful information, early warning or otherwise, to community members.

7. Strategies for coping and adapting to climate change

7.1. Introduction

Pastoralists, agropastoralists and other communities inhabiting Kenya's ASAL have for years been exposed to droughts, floods, diseases and other risks that negatively affected their livelihoods. In response, they developed a range of strategies to help reduce their sensitivity to the various shocks they face, to effectively cope with resultant hardship and to speed up the recovery process. While selection through time resulted in strategies that were relatively efficient, climate change coupled with rapid socio-economic evolution is significantly undermining the effectiveness of traditional risk management mechanisms.

Kenya's ASAL areas, especially the arid lands of northern Kenya have traditionally been isolated from Kenya's large modernizing urban centres. Poor road access and unreliable communications infrastructure helped insulate traditional lifestyles and maintain cultural norms. In the recent past, however, growing economic and cultural integration has fostered a socio-economic evolution that is threatening the viability of traditional livelihoods. Increasing population and rangeland competition, exacerbated by privatization of land is constraining the mobility of pastoralists which in turn increases their vulnerability to droughts. Proliferation of guns and the competition for rangelands and livestock is leading to an increase in violent banditry. Moreover, rural–urban migration and the increasing demand for money are eroding informal social solidarity and

insurance networks. As such, relatives are less able to rely on each other to provide safety nets during periods of duress.

The increasing frequency of climatic extremes and the increasing unpredictability of weather patterns thus place added stress on already diminished coping strategies and limited adaptation options. Oftentimes, affected populations are driven into destitution, incapable of fending for themselves and with no hope of recovery. The constant flow of food aid and other emergency resources into the Kenya ASAL, as well as the proliferation of NGOs that serve the area attests to the high degree of vulnerability these populations face. Examining the perceptions of affected ASAL communities on climate change, the evolving risk profile they face, and the risk management strategies available to them is the first step toward articulating and designing a coherent strategy to build individual resilience and local coping and adaptation capability.

As previously mentioned, KACCAL will be implemented in five ALRMP pilot sites, four of which were featured in survey work for this report. A vast literature assessing the impacts of various development initiatives across different scales and with varied objectives has consistently shown context specificity to be a key determinant of success. As such, much of this section delves into analyses of the survey data and illuminates the perspectives, experiences and needs of surveyed community members and key informants taking into consideration the agro-ecological and socio-economic circumstances which naturally circumscribe the set of feasible and effective interventions. These analyses will play a central role in determining the list of priority recommendations for KACCAL implementation vis-à-vis improving adaptive capacity.

7.2. Perceptions of climate change

Section 5 presents the scientific evidence on the causes and expected consequences of climate change in Kenya and in the pilot sites. However, we also wanted to understand the perceptions of climate change on the ground. The manner in which people prepare for, anticipate and react to climate conditions are all conditioned by their perceptions and expectations of what these conditions will be. Consequently, the first section of the survey focused on eliciting information on local climatic changes. As the risks whose outcomes KACCAL is largely concerned with and ALRMP currently deals with are largely hydro-meteorological (rainfall based hazards, e.g. floods, droughts and storms), we used three distinct characteristics of rainfall to anchor climate conditions and provide a relevant point of comparison: the total amount of rain that falls, the timing of the rains and the distribution of the rain across the season.

All communities surveyed thus far reported that the rainfall pattern had changed. The changes were largely manifest in the form of increased drought and changes in the onset of seasonal rains. With the exception of Malindi, the communities reported declining rainfall amounts and unpredictable onset and distribution patterns. In Malindi, the amount of rain was reported as having increased in the previous 2 years in inland divisions such as Dagambra. The increasing rainfall, however, was not well received and was said to have increased vulnerability as much of the increase was distributed in intense periodic

downpours that often led to floods that left residents scrambling for higher ground, and damaged both crops and possessions.

Evolving perceptions on the conditions and consequences of climatic patterns were established by asking similar questions on climate variables contemporaneously, as they were 10 years ago, and as they expect them to be in 5 years time. The historical anchoring for 10 years was useful as it coincided with *El Niño*, a climatic event that had disastrous consequences across the country and is well etched in the minds of many. Indeed, there is a general belief that *El Niño* marked a turning point in climatic regularity and that in subsequent years climatic patterns become demonstrably unpredictable and the regularity and onset of the seasons did not seem to return to what it was previous to the *El Niño* period. Since then, respondents indicate that variability in the rainy seasons has increased with long rains being reported from April–July, February–April and March–May. In some instances the long rains shift to June/July. Rainfall was also observed during some dry seasons.

For those who were willing to speculate on the likely trend into the future (some communities in Garissa declined to answer this question as the future was considered 'in the hands of God'), predictions of the coming seasons were largely based on expectations of erratic rainfall seasons: inadequate rain or flooding and delays in the onset of rains. This was based on their experiences over the previous 10 years. Explanations for the cause of climate change varied enormously across respondents and sites: from divine intervention as punishment for trespasses against God, to the more traditional destruction of woodlands and other natural causes. Fortunately, both for individuals in terms of the mitigating strategies they use or for development agencies concerned with improving community adaptation options, the cause of climate change is not as important as the perception of evolving patterns and its consequences.

The impact of the changes in rainfall patterns have been felt across livelihood and food security groups in all districts. These changes include destruction of farms by floods or droughts; loss of livestock to increased incidence and emergence of new diseases; loss of livestock to drought; fewer fish holdings due to changes in water levels and conditions; and loss of property and human lives to floods and droughts. As we will see in more detail later, pressure on communities meant diversifying into livelihood strategies other than pastoralism, fishing or farming. These included burning of charcoal and casual labour. While diversifying to other livelihood strategies, Malindi farmers still planted the same crop varieties and prepared the land for the rainy seasons as was the practice before the *El Niño* event of 1997. In Marsabit, communities diversified to agropastoralism, specifically growing *khat* as it is a drought resistant crop with a large market.

7.3. Risk profiles and their evolution

In assessing the vulnerability of respondents, we felt that apart from soliciting their perceptions on climate change, it was also important to understand what sources of risk they were more concerned about in general. Clearly, climate variability is a key constraint for livelihoods and welfare. However, the impacts of climate change manifest

differently across different groups. Furthermore, even in an environment of increasing climatic extremes, there could be other concerns of greater import that need to be considered if welfare improvement is the main objective. As such, we asked respondents to describe the set of risks that were of central concern to their community and to rank the top five in terms of the degree of concern which they provoked. To illuminate trends in these risk profiles, we also asked respondents to compare differences in the severity of these risks across time, i.e. to rank those risks that were most pressing 10 years ago, those of greatest concern today, and their expectation of what risks will pose the greatest problems in 10 years time.

Ranking of answer options was a strategy we used for several questions to allow us to compare responses across respondents and solicit variations in intensity within respondents. As the impacts of climate change are felt slowly through time, we also used comparisons across time often. For the pertinent rankings which we present here, we normalize them for ease of comparison. As we asked for the top five rankings, we normalize these rankings from [0, 1], with zero being not ranked, and one, which was the highest rank, normalized to one.[1]

The ranking of risk concern responses across time are presented in **Error! Reference source not found.**. What immediately stands out is that the first two risks of greatest concern in the present, past and future are closely associated with climate phenomena. Food insecurity, ranked as the highest concern for both the present and the future, is largely a function of failed rains for communities such as those in the pilot districts that depend on rainfed agriculture and livestock production for their food. Moreover, as markets in these communities are not well integrated with national markets, droughts bring about a marked increase in food prices. Floods, which are ranked fifth, are also directly related to climate vagaries and certain human diseases (e.g. malaria) ranked third, and livestock diseases (e.g. Rift Valley fever) ranked fourth, are indirectly affected by climate.

[1] Normalization is conducted using the formula: $rank_n = \left(1 - \left(\frac{rank - 1}{\max rank}\right)\right)$, where rank is the rank order on the survey, and max rank is the rank order of the highest item ranked by a respondent.

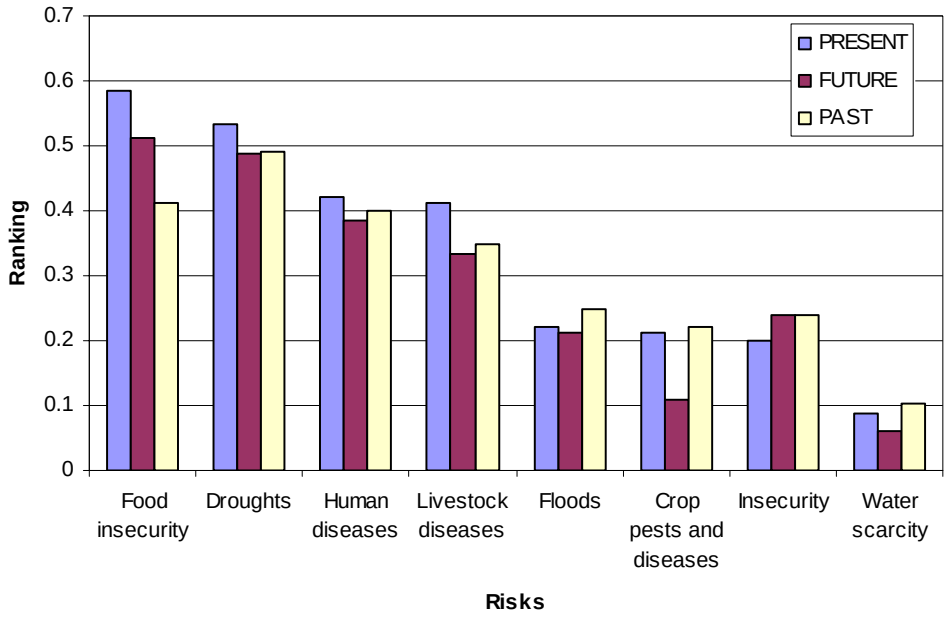


Figure 7.1. Evolution of risk concerns.

Interestingly, the top four risks of present concern all outrank similar risks in both the past and the future. This may be due to the natural tendency to discount the future in favour of the present, as well as the fact that having survived past risks, the memory of their impact (or the fear of their impact), is likely to have subsided. This could also suggest an optimism of better things to come in the future. In the following analyses we focus our attention on current concerns and look at how risk rankings vary across district.

There are large differences in key risks faced across survey communities (Figure 7.2). In Garissa, concerns over droughts and floods (direct climate impacts) are ranked first and third respectively. The fact that the experience of heavy flooding in late 2006 in Garissa is still in the minds of residents could account for the high ranking for floods. Similarly, livestock diseases, which rank second in Garissa, may be explained by the outbreak of Rift Valley fever, also in late 2006, that had its greatest impact on Garissa. Interesting, despite the high ranking of drought and flood, food insecurity in Garissa is ranked lower than in the other districts. This could be due to the better roads and market infrastructure that Garissa has (at least in comparison to Marsabit and Turkana) and the fact that resident's receive quite significant amounts of food aid.

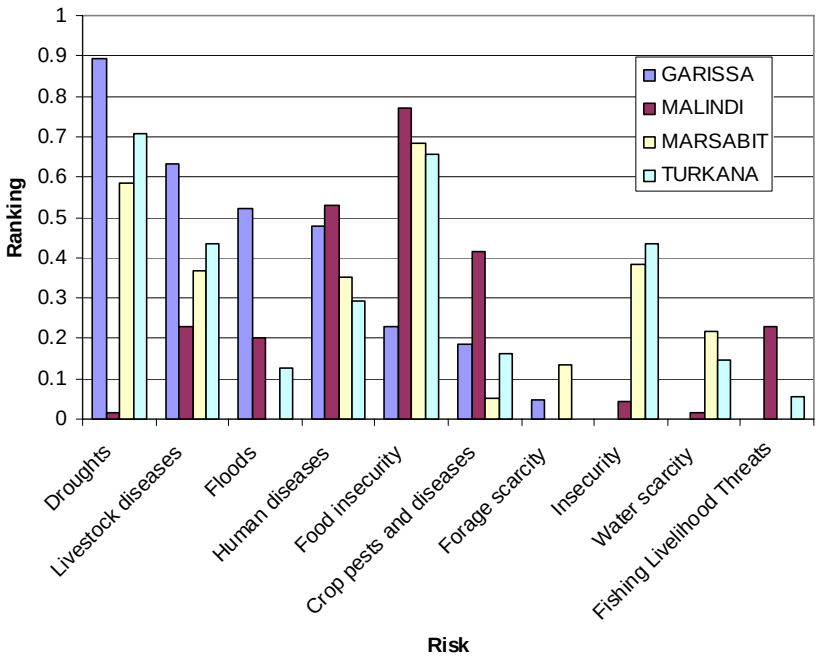


Figure 7.2. Current risk concerns by district.

Malindi seems to be somewhat of an anomaly. Although drought risk registers trivial concern, and floods are also relatively low, food insecurity is ranked as the highest concern. Compounding the puzzle is the observation by both our research team and key stakeholders that many residents of Malindi do not cultivate large proportions of the land they own. Furthermore, while they seem to be concerned with crop pests and diseases, key stakeholders mentioned that this was not as much of a constraint as it was in other parts of the country that produced higher crop outputs despite less favourable agro-ecologies. This is a central issue that needs to be addressed as it suggests human failings or surmountable technological constraints, rather than agro-ecological or climatic obstacles are the main cause of food insecurity. This thus presents an opportunity to reduce the food risk that these populations face. Another key concern in Malindi, especially among the fisher folk who were interviewed, is the threat they faced to the fishing livelihood. This was either in the form of illegal poisoning of fishing sites, lack of equipment to brave more resourceful but dangerous fishing grounds and excess rains that were churning the water. This is in contrast to fisher folk in Turkana who were facing diminishing fishing stock due to lack of rain.

Residents of Marsabit and Turkana seem to face a fairly similar risk profile. Droughts, food insecurity and insecurity in general are their top three concerns. Insecurity in both cases largely refers to inter-ethnic conflict and banditry related to livestock raids and difficulties associated with accessing forage or water sources that are controlled by other ethnic groups. This plays a large role in threatening the viability of pastoralism, the key livelihood sources in both districts, whose productivity largely depends on the ability of pastoralists to migrate to greener and wetter pastures during droughts. That concern over

livestock diseases is a close fourth in rank in both Marsabit and Turkana is a testament to the key role that livestock plays in these areas.

7.4. Strategies for mitigating and coping with climate risk

Increasing climate extremes have exposed affected communities to increasing vulnerability, especially as other forces combine to weaken their capacity to withstand shocks to their livelihoods (Hulme 2004). Communities whose livelihoods are dependent on rainfed agriculture and wealth generated or supported by the surrounding national resource base are especially vulnerable. The impacts of growing climate stress are further exacerbated by an erosion of traditional institutional norms and knowledge systems that provided a framework for social insurance and reciprocity for coping with climate variability and other shocks (Dube and Sekhwela 2007).

Despite diminished resilience, affected communities must do what they can to survive climate-related onslaughts. Attempts to support communities and restore their capacity to weather such shocks must therefore be guided by an understanding of the current risk management strategies they use, determinants of access to and effectiveness of these strategies, how the perceived effectiveness of these strategies have evolved through time and why. This sub-section reviews responses on the effectiveness of risk mitigation and coping strategies pursued by the communities surveyed.

7.4.1. Risk mitigation

Mitigation refers to actions or strategies pursued to limit exposure to risk and/or to reduce the impacts of a risk event before it occurs. As such, mitigation is a voluntary activity or set of activities taken to insure against catastrophic loss should a shock occur. The ability to change one's behaviour, engage in less risky livelihoods, to accumulate more secure assets is often restrictive for the poorest members of a community—those with insufficient endowments of physical, human and social assets. Indeed, especially among the food insecure groups we visited, the pursuit of mitigation strategies was uncommon and many seemed resigned to their fates. Their hope was that the government, or some aid agency, would move in to save lives and protect against destitution in the event of a shock.

The ranking of mitigation options that respondents pursed compared across a temporal scale are presented in Figure 7.3. The top ranked strategy was community action which includes joining self-help groups, Savings and Credit Cooperative Society (SACCOs), community natural resource management (NRM) initiatives and community policing against livestock raids. Communal solidarity, which in the past found form in traditional cultural institutions, now seems to take the shape of formalized groups. This is an important development as formalized structures supplant traditional informal insurance systems that have been progressively eroded by modernity and the breakdown in social cohesion.

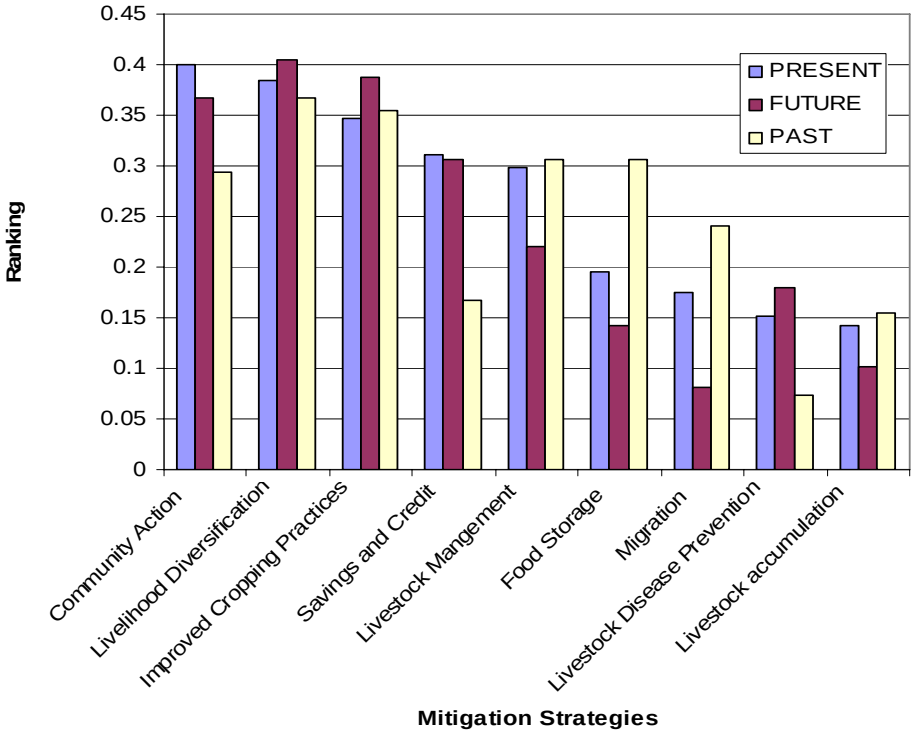


Figure 7.3. Ranking of mitigation strategies across temporal scales.

The temporal analysis (Figure 7.3) shows that communities surveyed regard the deepening of financial services (mainly savings and credit), diversification of livelihoods, improved cropping practices and livestock disease control as mitigation strategies whose effectiveness in reducing vulnerability would increase relative to the past. Conversely, traditional mitigation measures, such as migration, livestock accumulation and food storage are not only regarded as relatively less effective but are losing their significance; most communities do not see them as effective strategies as they move into the future. The reduction in emphasis on migration is probably due to the increasing privatization of rangelands, increasingly violent livestock raiding episodes and socio-economic trends that favour sedentarization. As migration is a critical element of pastoral productivity, restrictions on migration also affect the effectiveness of livestock accumulation as a strategy.

The conventional wisdom that the unfavourable agro-ecology and market infrastructure of the ASAL offers little hope for diversified livelihood approaches to risk management is not supported by our findings. Although food insecure groups had fewer options open to them, there is lots of evidence from some community groups, key informants and entrepreneurs of a wide variety of viable socio-economic activities. This also explains the prominence of livelihood diversification in the rankings.

The ranking of mitigation strategies across the four districts (Figure 7.4) highlights the importance of context specificity in the perceived effectiveness of mitigation strategies. Malindi, as seen from its risk exposure profile, is unlike the other three districts since pastoralism is not a major livelihood activity. The highly ranked community action in Malindi takes the form of groupings designed to manage the sharing of meagre resources rather than to develop greater resilience and adaptive capacity. This leaves Malindi residents vulnerable to widespread covariate shocks. Interestingly, despite a superior agro-ecology for agriculture, and despite the observation of low productivity and under-cultivation in Malindi (though they demonstrate a high degree of food insecurity concern (see Figure 7.4)), improved cropping practices are ranked higher as a mitigation strategy in Garissa, and almost as high in Turkana. In Malindi, the opportunities for livelihood diversification are greater as evidenced by casual labour and trade being indicated as a non-trivial mitigation strategy.

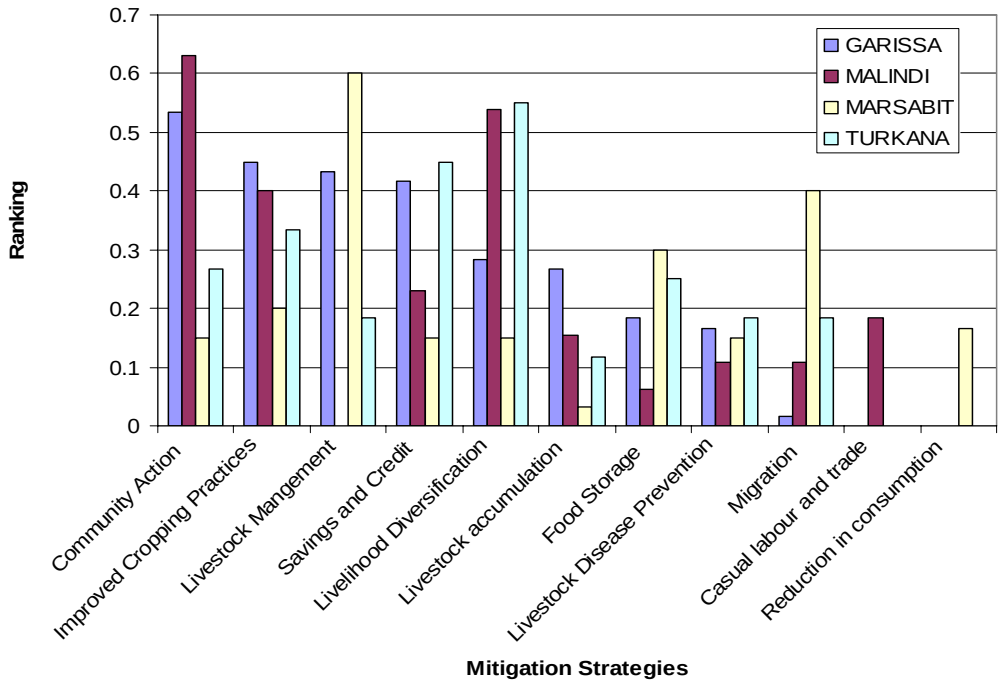


Figure 7.4. Rankings of current mitigation strategies by district.

In the mainly pastoral settings (Garissa, Marsabit, and Turkana), mitigation strategies that preserve and improve livestock found greater prominence (Figure 7.4). However, even within these pastoral settings we can observe interesting variations. In Turkana, where development agencies have intervened for longer and with greater density, the pastoralists are more aware of the potential to mitigate by pursuing additional and alternative livelihoods. This contrasts with Marsabit where the populations are more isolated and continue to rely heavily on their traditional pastoral livelihood. Indeed, in Marsabit, livestock management and migration, both central to the productivity of the pastoral system, are ranked as the two most important mitigation strategies.

7.4.2. Risk coping

Coping refers to the actions taken or support received to help survive the impacts of an experienced risk and facilitate recovery. Coping mechanisms ranked according to perceived effectiveness across time are presented in Figure 7.5. The top two strategies ranked as most effective are those that facilitate inflow of resources into households and communities, thus smoothing consumption. However, food aid and reliance on relatives depend on factors external to the households and thus expose the households to vulnerability in the event of shock. Large populations rely on relief food that is supplied under the GoK/WFP emergency relief operation between 2004 and 2008. While most communities realize the critical importance of saving lives through food relief, they are also acutely aware of the limitations of food aid in replenishing and supporting livelihoods. Institutionalized food aid erodes the ability of communities to develop adaptive capacity to cope with common perils in ASALs. This lack of sustainability, to a large degree, partially explains why food aid is ranked as a less important future coping mechanism.

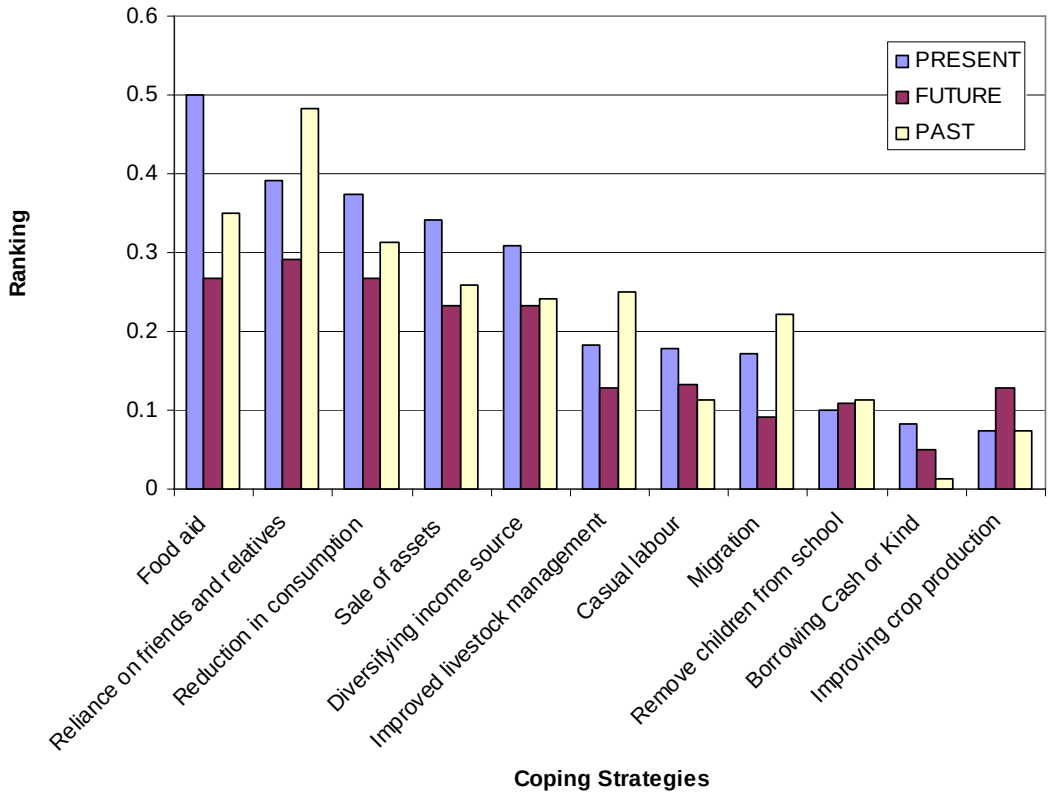


Figure 7.5. Ranking of coping strategies across temporal scale.

The third and fourth ranked coping strategies are those that involve an involuntary reduction in consumption followed by the distress sale of assets. In this case, coping strategies are not voluntary activities. They are taken when the affected parties are under significant stress and are often involuntary, pursued only as a measure to survive and to

‘tighten the belt’ in a bid to recover. As such, diversifying income source, ranked fifth, could be thought of as similar to casual labour ranked seventh; a desperate attempt to bring in income in any way in order to make ends meet. All top seven mitigation strategies will be less useful to these communities in the future suggesting an emerging gap in coping capacity.

When coping strategies are analysed across districts (Figure 7.6) a similar pattern of ranking emerges, albeit with greater inter-district variation. Food aid is ranked as the most effective coping strategy in both Garissa and Marsabit and is only second to sale of livestock in Turkana. Malindi’s most important coping mechanism, probably due to its proximity to a bustling tourist centre, is casual labour. The sale of assets and reduction in consumption are ranked second and third in Malindi. Reduction in consumption was also ranked second in Garissa. This is puzzling when considered in relation to the fact that removing children from school is ranked fourth despite the increasing importance of school feeding programmes. Some informants suggested that the practice was infrequent and that the use of child labour to herd left over animals during drought and the unpredictability of flooding occurrence may be to blame for this. Other than food aid, which has been going on for decades and is, in some parts, a way of life, reliance on relatives through complex traditional support systems and improved livestock management practices were listed as more effective in dealing with drought occurrences in Marsabit. For Turkana the pattern changed slightly with sale of assets being viewed as much more effective than reliance on relatives, food aid and diversification.

Some of the strategies listed and ranked would be difficult to pursue in the middle of a disaster (improving livestock and crop production) while some would require external support (food aid and reliance on relatives and friends). Moreover, given that surveys were conducted at the community level, the rankings solicit respondents’ perception of the effectiveness of the various strategies. As such, it is not necessarily the case that community level rankings of perceived effectiveness would match up with household level rankings of actual strategies that are used. These observations should therefore be interpreted modestly.

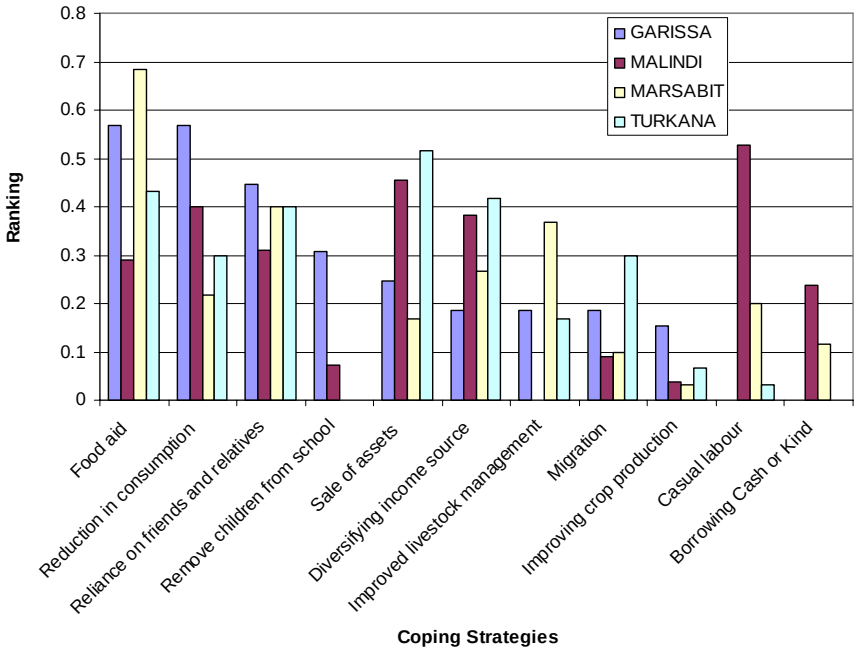


Figure 7.6. Rankings of current coping strategies by district.

7.5. Analysis of risk management and development priorities

The previous sub-section presents an analysis of the options and strategies that households use to manage risks, discusses how the effectiveness of these strategies have evolved and examines issues of access to and importance of these strategies as a function of livelihoods and food security status. While it is certainly important to have a clear understanding of the perspective community members have on these issues, it is not as clear how external agencies aiming to reduce vulnerability and increase resilience should use this information. For example, food aid has been shown to be an important risk coping mechanism for many segments of these societies and clearly, as a basic necessity, it is critical to disburse food aid where communities are otherwise lacking. However, even when there is no pressing need, food aid is an important handout that can release recipients from the need to exert effort and spend resources to source food. Consequently, households may claim (and perhaps rationally from their perspective) that food aid is a critical coping mechanism. However, this certainly does not mean this should be an optimal strategy for an external agency to pursue. Indeed, the literature has demonstrated numerous instances where providing food aid has negative countervailing effects, causes dependency and is inefficient (for an excellent review see Barrett and Maxwell 2006).

Though food aid and other relief efforts certainly play an important role in emergency and crises situations, food aid will ultimately prove increasingly ineffective without a focus on empowering communities, increasing their access to assets and productive livelihoods, and helping them help themselves. Indeed, we are already witnessing the emergence of a ‘relief trap’ whereby limited national and donor resources led directly to

emergency spending crowding out development spending, which means that subsequent emergencies become more likely, exacerbating the effect until external agencies are trapped in an almost perpetual and complete relief mode (Barrett and Maxwell 2006). The answer to the relief trap, especially as emergency incidents are likely to increase with climate change, is to reverse the trend, focus as much effort on development initiatives as possible, and improve the efficiency of relief and recovery.

Even when exposed to considerable risk, communities in the ASAL regions of northern Kenya and southern Ethiopia have consistently been shown to value development based interventions over risk management support. As part of a research effort investigating questions of pastoral risk management in northern Kenya and southern Ethiopia, the USAID-funded Pastoral Risk Management Collaborative Research Support Program (PARIMA CRSP) project interviewed 30 households in 6 communities in northern Kenya and 5 communities in southern Ethiopia from March 2000 to 2002 at quarterly intervals. Various modules on wide ranging subjects were fielded in 2001 in Kenya and 2002 in Ethiopia, including a community based follow up in 2006, during which a development and risk management ranking survey was fielded (McPeak et al. 2007).

Before showing results from our own analysis, we present some of the results from the PARIMA project which are very instructive (

Table 7.1). To elicit perceptions of the benefits of certain risk management and development interventions, households were asked whether they had experienced certain interventions, and to rank how important these interventions had been (‘which has been the most beneficial?’), and how important they believed these interventions would be in the future (‘looking [10] years ahead, which do you think provides the greatest opportunity to improve your life’). These rankings were solicited both from a personal perspective and from what the individual thinks is best for the community. To allow for consistency with our own community-focused surveys, the results of the past (what has been most helpful) and the future (what, TODAY, will be most beneficial to your future) rankings of development interventions most beneficial for the community as a whole are presented (

Table 7.1). Rankings of actual experience of interventions are also presented; the table is sorted by future ranking.

Table 7.1. Rankings of risk management and development priorities for PARIMA communities

	Past Experience	Past rank Community	Future Rank Community
Human Health	2	2	1
Water	4	1	2
Education	5	5	3
Livestock Health	3	3	4
Livestock Marketing	9	6	5
Conflict resolution	7	7	6
Restocking	11	10	7
Food Aid	1	4	8
Cultivation	10	8	9
Alternative income	16	16	10
Savings and credit	14	12	11
Transport improvement	6	9	12
NRM	8	11	13
Institutional dev.	15	15	14
Phone, electric	13	13	15
Wildlife management	12	14	16

Source: McPeak et al. (2007).

There are several key insights we can extract from these results (Table 7.1). First, there is a large degree of inconsistency between the resources and activities channelled to actual intervention activities, and community members' perceptions of what is important. Food aid provides a clear example. It is ranked as the most experienced intervention, suggesting that substantial resources are used in the provision and widespread distribution of food aid. However, development based interventions that focus on water management, human health and livestock health are perceived to be of greater importance. As far as the communities are concerned, if their votes or preferences were to determine development and risk management resource distribution, food aid would have been a fourth priority. Furthermore, looking into the future, food aid as a priority drops even further to eighth place. This likely a reflection of the communities understanding that food aid is a hand out and reliance on food aid is accepting a future circumstance of need and a lack of capacity to fend for oneself.

Certainly, food aid does not improve the productivity of current livelihoods, provide access to enhanced livelihoods or contribute to the formation of an enabling economic environment. However, development based interventions, i.e. interventions that increase productivity are considered top priority (Table 7.1). Other than food aid, rankings for the past and for the future are roughly consistent. First, basic needs such as water and health must be met. Illness and lack of water are fundamental to human integrity and capacity; they constrain labour output and place a significant burden on both finance and time resources. Education comes next, a clear signal of the recognition that as the economy evolves a good education opens doors to alternative and relatively lucrative income sources. The next set of priorities, livestock health and marketing, focus on increasing the returns to pastoral production—the key livelihood source in these areas. It is only then that risk mitigation (conflict resolution) and risk coping (restocking and food aid) interventions feature as important interventions.

Given the richness of the PARIMA study and the similarity in the livelihood systems and agro-ecology of PARIMA sites with some KACCAL pilot districts, we fielded the same development and risk management instruments in our focus group surveys. This would also allow us to cross-check our results with those of the exhaustive KACCAL effort. (Note, however, that the PARIMA data, unlike the KACCAL survey, are at a household level and were collected during a significantly more extensive study.) The development and risk management intervention ranking results of our research are presented in Figure 7.7.

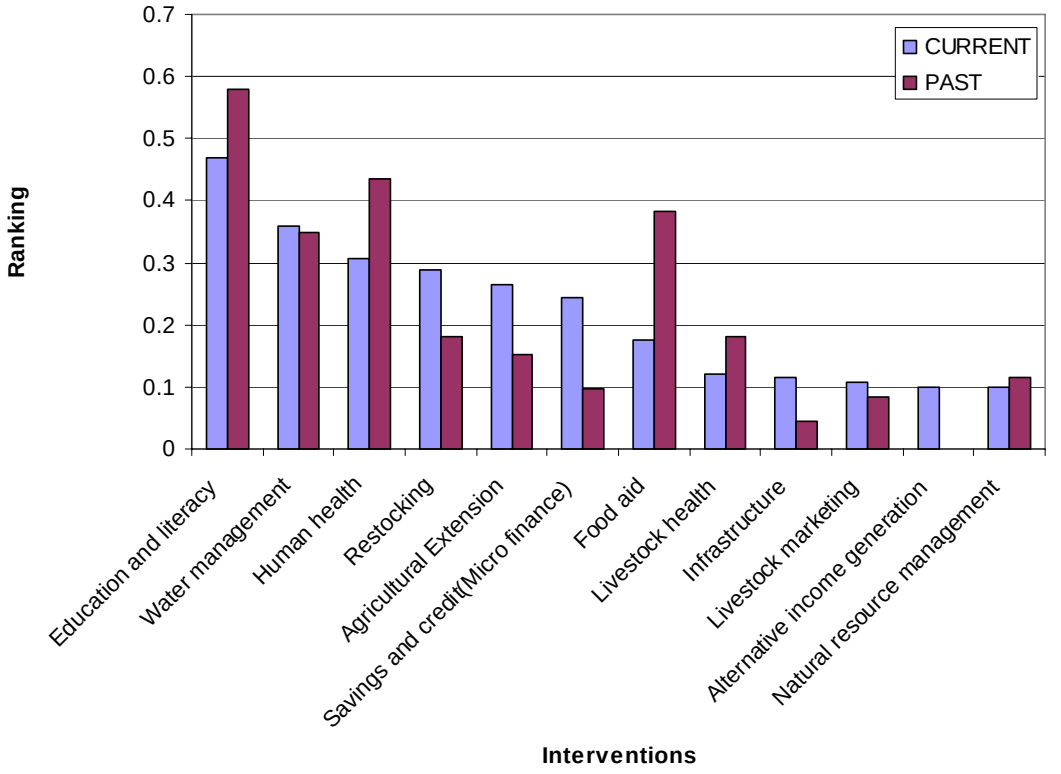


Figure 7.7. Rankings of development and risk management interventions across time.

Evidentially, there are striking similarities. The top three ranked priorities are the same, the only difference being a switch in ranking between education and human health. Food aid suffers a similar decrease in ranking. Where it was ranked as the third most important intervention in the past, it falls to seventh when its usefulness as an intervention for future welfare is considered. The main difference has to do with the relative rankings in livestock-related interventions. KACCAL survey districts put less of an emphasis on livestock health and management issues though restocking ranks somewhat higher among KACCAL communities. Interestingly for KACCAL districts, non-trivial decreases in the ranking of education and human health interventions are witnessed from perceived effect on past welfare and expected impact on future welfare. Conversely, increasing importance seems to be placed on agricultural extension, savings and credit interventions, and alternative income generation. As we will discuss in greater detail in Section 8, this has clear implications for guiding intervention decisions.

As expected, variations in livelihoods, agro-ecology and market access gives rise to substantial inter-district variation in development and risk management intervention rankings (Figure 7.8). While education continues to be among the top ranked across all districts, education seems to be a considerable priority in Garissa relative to other districts and to other interventions in Garissa. Garissa also puts much more emphasis on food aid than do the other three districts. In Marsabit, where an overwhelming majority of households are pastoralists, restocking, which we consider a risk management,

intervention is considered most important. Again, as restocking is often subsidized as is food aid, the indicated importance needs to be considered against the need for sustainability and consistency where the overall goal is to reduce reliance on handouts. Water management, second only to restocking in Marsabit, is ranked highly as a concern across all districts. Nonetheless, water scarcity seems to be a greater constraint in Marsabit. Interestingly, in Turkana, savings and credit interventions are ranked as the most important intervention, followed by education and literacy and agricultural extension. It seems that pastoralists and agropastoralists in Turkana are seeking to diversify their livelihoods and tap into non-traditional sources of income. This is certainly consistent with their rankings of risk mitigation strategies which placed livelihood diversification and savings and credit interventions as first and second respectively.

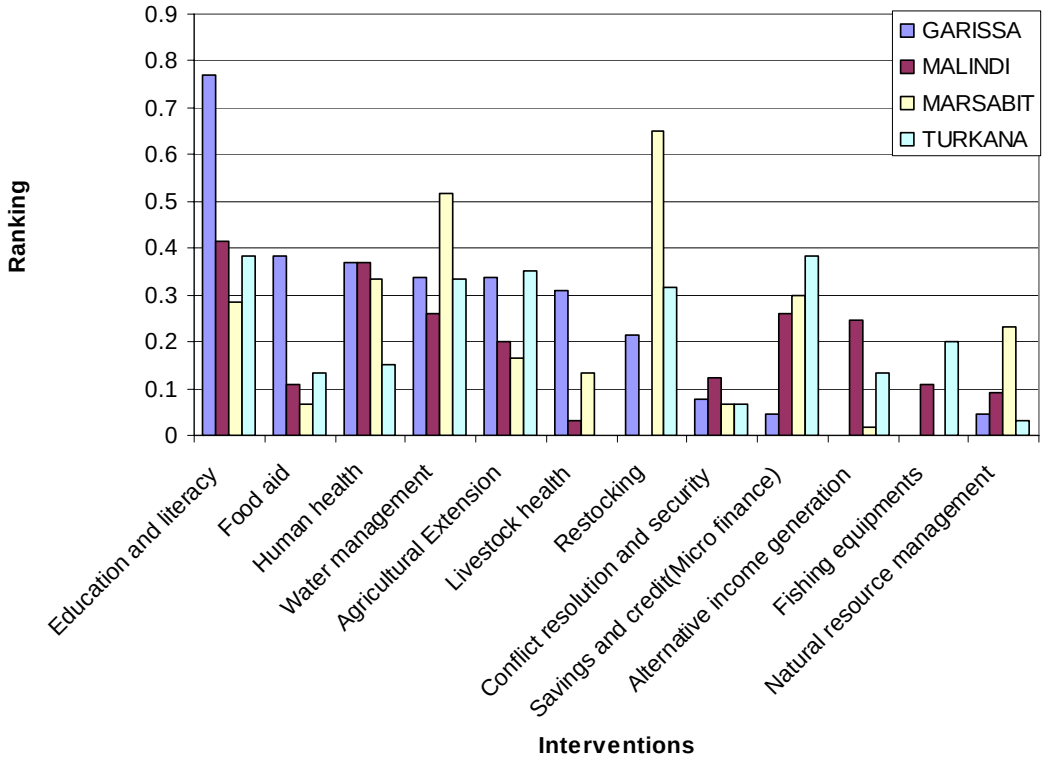


Figure 7.8. Rankings of development and risk management interventions across districts.

8. Interventions for reducing vulnerability to climate change

8.1. Introduction

The preceding review and analyses highlighting climate trends and their consequences in Kenya and identified KACCAL pilot districts; reviewing the capabilities, limitations and opportunities for enhancing early warning systems and climate risk management information tools in general; and zooming into the risk and vulnerability profiles of pilot district communities to uncover options for improved adaptation to climate risks

enhanced livelihoods, was undertaken to inform KACCAL's agenda to implement various activities and programmes that would overlay a climate perspective on ALRMP operations.

In this section we distil the lessons, facts, opinions, identified obstacles and opportunities of our analyses into concrete implementation proposals that we believe would have the highest and most wide-reaching impact. KACCAL's objective is undoubtedly grand and given its limited budget and timeframe it is important not to overestimate its potential impact. Furthermore, in making our recommendations we recognize that several other initiatives, including much of what ALRMP is already doing, share a similar aim. KACCAL can therefore maximize on its investments by leveraging other such efforts and partnerships. It is also important to keep in mind that KACCAL investments are at the pilot stage and aim to implement a suite of activities and programmes that should be monitored, evaluated for effectiveness and eventually scaled up and out as deemed necessary. Consequently, KACCAL should not shy away from implementing and/or encouraging innovative but promising initiatives. However, it is also important that KACCAL not spread its efforts too thinly by funding a host of numerous but small-scale projects. There are already numerous NGOs and CBOs that engage in such projects and experience has shown that while they do in most cases make non-trivial welfare contributions, larger more comprehensive investments that incorporate sustainability components often have a more substantial and lasting impact.

While these concerns offer guidelines to the set of activities that we recommend for implementation, the selected interventions were identified entirely as a result of the analyses we undertook. This includes what community members prioritized as their development and risk management needs, the insights of experienced stakeholders at the community level, discussions with development experts and innovators, identified needs from ALRMP staff, feedback from DMOs at the ALRMP/World Bank workshop, and reviews of the determinants of successful and not so successful projects.

Consistent with the conceptual framework advanced in Section 5 and the ToR for the project, our recommendations follow a two-pronged approach to reduce the climate-related vulnerability community members face and empower and equip them to effectively adapt to the current and expected consequences of climate change. Improving the provision of climate risk management services which comprises both traditional EWS and community based risk mitigation though SCF, contingency planning and training etc., defines one prong. Climate-robust development interventions which includes introducing and supporting the adoption of improved livelihoods and the development of an enabling economic infrastructure defines the other.

8.2. The temporal range of intervention options

Climate change is a long-term phenomenon. Most models of climate change predict the trend of related variables at 50 to 100 year spans. However, while climate scientists have made such predictions for several decades now, climate change as a phenomenon of great import to human welfare has only recently received significant political and economic attention at a global scale. This is arguably because the impacts of climate change, in the

form of increasing climate extremities, are being felt across the globe and are having significant humanitarian and economic consequences. As such, when dealing with climate change risks, it is important to recognize that the starting point for enhancing adaptive capacity and 'climate-proofing' livelihoods is reducing existing vulnerability to climate variability (Sperling and Szekely 2005).

Strengthening national and local capacities to manage climate related risks as they currently manifest, and building climate resiliency within economic systems and opportunities, is likely to also improve their capacity to deal with future climatic changes, especially if such measures take a dynamic approach and consequently can be adjusted to further changes in risks and vulnerabilities. Medium- and long-term adaptation is enhanced by short-term climate risk management and adaptation efforts. Moreover, as is evident, mobilizing national and international political and financial resources to manage existing vulnerabilities is much easier than attempting to garner support for hypothetical and uncertain futures (UNDP 2002).

Consequently, the recommendations that we generate will focus largely on the short term, aiming to enhance capacities today to improve ability to cope and adapt to both present and future risks. Nonetheless, some of the investments we recommend may be more geared toward having impact in the medium term and beyond. Indeed, while such investments may be beyond the resource capacity of KACCAL, some of these resources can and should be used to leverage additional resources by supporting or catalysing other processes and policies that similarly aim to inculcate a culture of incorporating climate change as a key element in social and economic decision making.

8.3. Enhancing climate risk management services

By climate risk management we mean the suite of activities and services that either depends on collecting, disseminating and acting upon climate information or related variables (such as the likelihood and severity of impending drought), or educating stakeholders, (such as farmers in climate-vulnerable areas), on methods by which they can equip themselves to cope with climate shocks or reduce their exposure by making effective livelihood or asset accumulation choices. As such, the investments recommended in this section are consistent with the ToR on EWS, SCF and information dissemination.

8.3.1. Investments in EWS for the external client

1) Management information system (MIS)

One of clear successes of the ALRMP EWS is the rich source of data that it collects regularly and upon which its monthly bulletins are largely based. While the data collection has been ongoing since ALRMP I, poor data storage protocols and unclear data collection methodology resulted in a regrettable waste of data, much of which has subsequently been lost. Fortunately, increasing recognition of the important role of the data led to a renewed commitment to ensuring the quality and use-value of the data. This led to a streamlining of the survey instruments in 2005 aimed at focusing the questionnaire on the most pertinent questions and redesigning it to be equally relevant to the semi-arid districts that were introduced in ALRMP II. At the same time, new data

storage and analysis software, REWAS III was launched. This software enables a more systematic analysis of ALRMP data and facilitates the inclusion of a broader set of non-food indicators that offer a more holistic overview of the situation on the ground. Furthermore, the data are now stored electronically and updated monthly as data come in from each site. This will assure that data are not lost and that rich empirical analysis (that can complement the largely qualitative and basic quantitative data currently on offer) can be carried out.

However, the value of the data is far from being fully recognized and appropriately exploited. First and foremost, after all these years, and after the great effort and resources that have been used, there is still no codebook carefully documenting how the data are collected, what methodologies are in place, how data integrity is assured, what the data cleaning protocols are etc. This is a significant deficiency that can be easily rectified. Similarly, lack of clear documentation on respondents makes it impossible to exploit an extremely important structural feature of the data. Discussions with ALRMP staff suggest that once respondents are randomly identified, they are surveyed each month for a year before a new set of respondents are generated. If this is actually the case, then the data are in panel form and would allow for the kind of robust empirical analysis that is impossible with only cross-sectional or panel data. Unfortunately, because of a serious oversight in data collection, there is currently no way to identify the same household across time.

Once the basic, but critical, issue of documentation is resolved, ALRMP data can be used to uncover a wealth of important insights that can improve the targeting of resources, increase the efficiency of ground-level responses, and also dramatically improve the forecasting skill of empirical EWS informed by its data. Mude et al. (2006), made the first attempt to use ALRMP data to develop a statistical model that generated surprisingly accurate forecasts, three months in advance, of the likelihood of famine in ALRMP sites. Imagine the improvement in forecasting accuracy and range if such models had access to the complete set of stored data. Complete and well documented data would also improve the content of the bulletins and by extension, hopefully the response that it generates from other key stakeholders such as those that sit with ALRMP on the KFSM and the KFSSG.

Investment in an MIS that caters for all these concerns is a crucial and extremely valuable public tool. Web based automation whereby the level of drought risk, or a slew of other risks, can be mapped across sites and the estimates of various models can be accessed by all would be an important step that would cost-effectively channel the various sources of information and model estimates based on ALRMP data in one, easily-accessible framework. ALRMP data are a national public good that should be easily available; making it widely available would justly raise the profile of ALRMP. Indeed, numerous agencies (FAO, WFP, Oxfam etc.) decry the loss and improper use and accessibility of ALRMP data. ALRMP needs to take advantage of its well developed network infrastructure, extensive ground presence, and the goodwill of its partners to finance a substantially improved MIS.

The benefits of improving data collection capacity and protocols and the introduction of REWAS III cannot be fully captured without strengthening both the technical and human capacity in all ALRMP districts. Currently, analysis conducted by REWAS III is only possible at headquarters and district level officials must send data to headquarters for final analysis before completing their bulletins. This inefficiency could be avoided if district officers were trained in analysis and in understanding the information content provided and equipped with the necessary computing and Internet access facilities. This would also facilitate any efforts to increase the flow of information from headquarters and other external agencies to communities on the ground.

The good news is that rapid improvements in information and communication technologies and the proliferation of effective MIS in other contexts should make it relatively easy for KACCAL to find well qualified developers and relatively competitive prices. What is essential, even if it means outsourcing maintenance and analysis services, is to ensure the sustainability and integrity of the system.

TARGETING: Investments in a MIS for ALRMP data need not be targeted to any particular pilot site. Indeed, the MIS should be overarching, implemented from headquarters and encompassing all district sites. There are instances, however, in which select MIS enhancements can be targeted at the pilot districts where resources are a constraint. For example, as previously mentioned, key constraints to making full use of the data collected are the staffing, capacity and technology constraints on the ground. These certainly need to be improved. Phasing in improvement of these across the ALRMP districts can start with the pilot sites. We have no particular reason to recommend one pilot district over another if only a few can be targeted. Highest return on MIS investments will depend on several other factors including synergies with other KACCAL investments and ALRMP objectives: is it more important to build the capacity of the relatively new and understaffed Malindi office or would they prefer to locate in Turkana or Marsabit which are more remote and are subject to more regular shocks?

While generally neutral on district-specific targeting for this component, we would like to emphasize the importance of digitizing all available hard copy data. As part of the effort to build their model, Mude et al. (2006) initiated a process of searching for and locating hard copy data long forgotten in back offices and digitizing it. Time and resource constraints limited what could be recovered to only a fraction of what was available. We recommend some funds go into finishing off this process. While this is a small component of the larger MIS undertaking, it is nonetheless critical.

2) Streamlining the data collection efforts of different players

As data collection efforts become more valuable and resource availability more constrained, it becomes critical to guard against overlapping efforts by partners. We have seen that ALRMP, FEWSNET, WFP's VAM and a host of other organizations all collect data to inform a similar objective: early warning of imminent disaster to facilitate timely response. Through the KFSSG and the KFSM, where most of these organizations sit, there is a good opportunity to streamline the data collection—perhaps by agreeing to field one consolidated document that has the set of variables each is interested for their own

specific analyses. This way, more sites can be monitored, and more resources will be available for training enumerators to assure the quality of the data and ensure a long-term commitment to data collection.

TARGETING: This process should be initiated by the national level ALRMP coordinators with their partners in the KFSSG and the KFSM.

3) Improving climate data infrastructure

This is perhaps an investment that would have more of an impact in the medium term. The density of weather stations in Kenya, especially around the ASAL areas, is extremely low. Yet time series climate information is very important to climate risk management. While satellite coverage is comprehensive, satellite data only provide an estimate of actual conditions on the ground. Furthermore, the accuracy of satellite data can only be calibrated using real time data on the ground. Investing in weather stations across the ASAL should therefore be a priority. While World Metrological Standard Met stations are costly, it is possible to set up cheaper monitoring sites with rain gauges in various areas whose readings are updated daily into a general server. Rather than actually commissioning the creation of weather stations, KACCAL can spend its efforts lobbying the Kenya Meteorological Department (KMD) and interested stakeholders to think of creative and cost-effective way to build the climate data infrastructure in the ASAL. With the increasing interest that climate change has generated, sourcing the necessary funds should not be a huge challenge.

TARGETING: This effort should be led by the World Bank team in collaboration with national level ALRMP coordinators and relevant stakeholders from KMD, pertinent ministries, and all donors concerned about the impacts of climate change.

8.3.2. Investments in community based climate risk management

Both the emphasis of the ToR and the intention registered by ALRMP national coordinators indicates a keen interest in focusing early warning efforts toward the community. As we have indicated earlier, analysis has shown this to be the weakest element of ALRMP EWS. Where it is strong in extracting important advance warning information from the community and feeding it to the relevant stakeholders at the national and international level, it is relatively weak at getting pertinent information down to community members. However, we also note that this perception has quite a bit to do with the broad definition of community based early warning which not only encompasses the provision of standard early warning information but also includes efforts to prepare communities to deal with imminent risk, to encourage strategies that reduce exposure to risk and so on. Given this definition, a segment of the community development work that ALRMP already engages in can be classified as early warning.

To escape the vagueness resulting from the tag ‘community based early warning systems’, we instead emphasize efforts to improve climate risk management activities among community members. As explained before, this encompasses both provision of information signalling imminent catastrophe of various kinds, information that improves

livelihood decision making, and services that help mitigate risk. Our recommended investment in this area aims to encourage a comprehensive climate risk management programme by consolidating the disparate efforts of current key providers and capitalizing on their strengths.

1) Synergizing community based efforts within a formal dissemination vehicle

The greatest deficiency currently hampering community based climate risk management efforts is the weak link between the information providers, the educators and community members. While ALRMP's presence and partnerships on the ground are commendable, and there are opportunities by which community leaders and officials share information with community members at large, the information needs of the community are so great and varied that even efforts such as the METS are unable to adequately deliver consistent and credible messages. This is especially the case in some of the communities we are dealing with where the belief in indigenous systems is so ingrained that scepticism of scientific information makes adoption a challenge.

As such, a concerted, comprehensive effort that provides a variety of information and training services, is focused on the particular task and is consistently available is likely to generate the necessary critical mass of awareness. We recommend a Climate Risk Management Unit that incorporates the main strengths of CB-LEWS, LEWS/LINKS, ALRMP, and the International Research Institute for Climate and Society (IRI). As explained in Section 7, CB-LEWS, while still nascent, currently has a superior information dissemination and training infrastructure. With its participatory focused design, CB-LEWS is well integrated with the community, involves members in its planning, and has a substantial training component associated with its programme. CB-LEWS is also particularly conscious of targeting its messages to the relevant segments of the community, such as traditional forecasters or respected elders, whose buy-in would result in wider impact.

Where CB-LEWS offers an effective information dissemination structure, LEWS/LINKS provides important information, both early warning in the form of its regular forage density maps, and critical livestock marketing information that would help pastoralists make efficient herd offtake decisions. Currently LEWS/LINKS is not as effective as it could be as its communication channels are not well linked to its community client. Furthermore, the information content of its forage maps needs careful explaining to be fully understood.

The same is true with SCF that go beyond the basics—above average, below average, average—that is currently the norm. IRI, which had a successful project in Machakos in the past and is currently pursing similar efforts in Makueni, is a world leader in distilling complex SCF in the form of probability distributions and in training communities to interpret the forecasts and to understand their implications for agriculture and NRM. IRI scientists have teamed up with colleagues at KMD, IGAD Climate Predictions and Applications Centre (ICPAC) and the Ministry of Agriculture to continue improving their methods, training educators and informing communities. Supporting this effort within an

umbrella programme that integrates the strengths of CB-LEWS and LEWS/LINKS would be an interesting pilot with potentially important technology adoption effects.

What is important to remember when piloting such an initiative is that community members have not highlighted early warning information as a priority development concern. It is arguable that this is because they have not been receiving such information or do not as yet appreciate its value. However, it is critical for the sustainability and scaling up of such a pilot to put in place monitoring and evaluation (M&E) systems that can accurately track the adoption rates and impacts of the information and services being offered under a climate risk management programme. This would not only help tailor the services and information being provided to growing demand, but would also help generate financial support for up scaling. The community can appreciate such a service when the people are able to see the benefits in helping them protect their assets and increase the returns to their production activities. Indeed, the provision of agricultural extension services is a highly ranked priority (Figure 7.7). Bundling up these various climate risk management initiatives and providing them through an enhanced information channel that could also act as a source for disseminating agricultural information should have ready demand.

TARGETING: For the all inclusive Climate Risk Management Unit that we envision, we recommend that it is targeted in Malindi, Mwingi and either Turkana or Marsabit. First, these three areas vary in agro-ecology and market access and are geographically spread across the nation. They would thus afford an opportunity to understand how these three key variables affect the impact effects and adoption rate of the programme. Clearly, differences across the districts will require tweaking of their 'syllabi' for context sensitivity. In Malindi, for example, the forage maps that LEWS produces may not be pertinent. This, however, is not certain as vast swathes of Malindi are rangelands that are often penetrated by pastoralists from North Eastern Province. Furthermore, in both Malindi and Mwingi, the impact of market information from LINKS may be enhanced if it were bundled with information on the price of agricultural goods. The Kenya Agricultural Commodities Exchange (KACE) has a similar programme to that of LINKS but for key agricultural staples; coupling the two programmes may be a good idea. For SCF and the kind of products IRI provides, semi-arid areas have in the past been more preferred as they offer a combination of both climate risk and agricultural activity that can be enhanced by improved use of climate information. Mwingi would thus be a natural target and Malindi may also benefit. It is less clear, however, how communities in Turkana would respond to SCF.

The expected variation in the return on different climate risk management investments across districts may provide a case for varying the content provided in the Climate Risk Management Units. Nevertheless, what we feel is essential is the creation of infrastructure that is well resourced and has a well defined mandate to deliver climate risk management products. Infrastructure for training community members to read resource availability maps similar to LEWS, for example, that could just as easily provide content such as the productivity potential of various agricultural commodities would be a clear positive externality. IRI, for example, has adopted this idea and couple agricultural

extension information with the climate forecasts that they offer. Their infrastructure not only gives members access to expectations of climatic patterns, it also offers them advice (and provides access to services) on how to make the best use of the information they are getting to maximize production. Bringing the relevant groups together to decide on the form and content would be a necessary first step.

There is, however, a particular component that we would like to recommend across all districts. LINKS has an impressive distribution of livestock markets from which it collects information. Discussions with LINKS personnel has revealed an expressed demand for the provision of market information from several as yet uncovered markets in each KACCAL pilot district: Dadaab in Garissa; the town markets of Malindi and Mwingi; North Horr and Merille in Marsabit; and Lodwar, Kakuma and Lokichoggio in Turkana. We believe that LINKS information is a vital service and would recommend funding the expansion of the network into these sites. It is not a costly venture, needing only the provision of a couple of cell phones per market, training and maintaining two data monitors per market, and airtime and incidental expenses for monitors. Furthermore, LINKS is in discussion with other partners to begin moving toward making this a sustainable venture by charging a small fee for its information. This has been shown to work for KACE, and it would likely work for LINKS. As such, initial funding that pays for the equivalent of a year or so worth of information gathering from the markets may be all that is necessary.

8.4. Climate robust development interventions

In essence, interventions for improved adaptation to climate change are synonymous with development and welfare enhancing interventions circumscribed by increasingly pressing climate realities. Climate change has, and progressively will have, a substantial effect on the returns to various assets and methods of production, and by extension, to livelihoods and welfare. Similarly, at a more macro-scale, climate concerns will have to be considered more carefully in the creation of a more conducive economic infrastructure for growth and development. Agriculture, tourism, demography, industry, energy and more will all be affected both directly and indirectly by climate change. The roads infrastructure will have to be more robust to floods and landslides, as will the development of living quarters. As such, any investments and interventions will increasingly need to include climate vagaries as a key variable in estimated returns, sustainability and impact.

With this in mind, investments for improved adaptation that we recommend for KACCAL pilot sites focus on releasing identified constraints that are bound to increase in the face of climate change and are central to welfare enhancing livelihood efforts that encourage production of climate robust commodities and staples. We also champion investments in the development of market services, which provide individuals with the tools to secure assets, maximize the returns to these assets and increase their flexibility to shift resources across livelihoods and income source options depending on prevailing conditions.

8.4.1. Investments in water management

Improved water management is the central most pressing concern. First, as detailed in Chapter 6, significant changes in climatic variables are expected across Kenya. More importantly, while a wetting trend is expected, the distribution of rainfall across seasons cannot adequately be forecasted but is predicted to be more variable. Already, increased incidents of heavy flooding around Kenya, and indeed across the globe, are providing a glimpse of what is likely to become even more extreme. With increased flooding comes increased incidents of diseases, more losses in agricultural production and, as rainfall becomes distributed in single-shot inundations, an increase in droughts. In such an environment, water management is essential. Proper drainage infrastructure must be put in place to minimize the damage caused by torrential rains. NRM concerns also become a central component of water management as nutrient runoff and damaging erosions become significant problems. Water storage infrastructure, whether in the form of giant county council tanks or dams or smaller household level tanks, is also critical and necessary to trap water during heavy rains that can be stored for use during dry periods. Mechanisms to enhance the effectiveness of natural aquifer regeneration during wet periods are also essential.

A second reason why water management is a priority is because it has been identified as such by the survey communities. Water management ranks only second to education as a crucial intervention for improving the welfare of concerned populations (see Section 8.4). Results from our survey also mirror the results of more extensive, household level work done in the ASAL regions of northern and southern Kenya, which we also present. Water scarcity is a significant hindrance as it is both a necessary input for health (which is a function of labour productivity), and for many aspects of economic endeavour. Furthermore, the amount of time that individuals, particularly women, spend fetching water daily places a significant drain on time resources that could have otherwise be spent more productively.

The importance of water and the substantial hardship that its scarcity imposes on affected communities has been recognized by ALRMP, its partners and the many NGOs that operate in these areas. In the ALRMP II Annual Environment Audit for 2006 the emphasis on water is evident; many of the projects audited have to do with water. What is also clear is that many of the water projects are sub-standard, not sustainable, do not incorporate necessary natural resource and user rights management components and they do not have well defined user and access rights. Sanitation and the safety of the water is also an issue. As water management becomes an increasingly pressing issue, it is critical that such projects incorporate these concerns from the outset in order to achieve maximal and lasting impact.

TARGETING: Given the limited budget that KACCAL has and its vast water management needs, we recommend that a substantial chunk of the funds allocated to water management focus on one significant project that is comprehensive and incorporates all components necessary for sustainability and maintaining natural resource integrity. The rest of the funds should be allocated toward rehabilitation of existing water projects in the pilot districts to bring them up to a set minimum standard—a needs

assessment, auditing and mapping of all the water projects in the pilot districts, should be conducted by well qualified water experts who are committed to sustainable water development in rural areas. Finally, some resources should be committed towards a process that seeks to set strict and enforceable minimum standards for any new water management projects that incorporates issues of sustainability, access rights and NRM. This is a crucial component, especially for reducing climate risk vulnerability in the medium term and making the most of limited resources.

For the large project our recommended target site is Marsabit. This is because respondents in this district are much more concerned about water management and scarcity that their counterparts in the other districts (see Section 7.4). The research team's visit to central Marsabit also revealed profoundly greater water stress than was witnessed in the other survey districts. It was a common site to see long lines of people waiting patiently for only a few litres of water after trekking long distances, a trip they would have to repeat the next day. Furthermore, over the years, the water sources that feed central Marsabit have been steadily diminished. Much of this is being attributed to massive illegal deforestation along the slopes of the once thickly wooded Mt Marsabit. Meanwhile, just about 50 km or so away in Logologo, an extremely rich and wide aquifer is under-utilized. Currently, water trucks move back and forth between Logologo and Marsabit to feed the few households that can afford it and the hotels and other such institutions.

We highly recommend that KACCAL fund the building of piping infrastructure from Logologo to central Marsabit that has several distribution points across the town and its environs. Given the pressing needs, 50 km is not an insurmountable distance and is well within KACCAL resources. Indeed, there are several rural water development engineering outfits that have undertaken similar projects in other areas of Kenya within KACCAL's budget and that also take a comprehensive, sustainable approach to water management. Ivory Consult, a highly recommended rural water engineering and management company (see Appendix III) built a 40 km pipe with three major arteries and included both security and well thought out community management components for less than US$ 500,000. Such an initiative would surely make a lasting impact, would be demand driven and would reduce the vulnerabilities that populations in Marsabit face due to lack of water.

8.4.2. Opportunities in dryland commodities

Referring back to Figure 7.7 on development interventions, we highlight the marked increase over time in the importance that is placed on agricultural extension which jumps more that 10 percentage points in ranking. Furthermore, alternative income generation, which received a zero ranking as a helpful intervention in the past, is now becoming an important issue among some communities. This indicates a growing awareness that traditional livelihoods must be replaced, or enhanced, by new sources of income or improved production and marketing technologies. One could also claim that the jump in the importance of savings and credit groups, which is an important component for financing technology adoption or livelihood diversification, is further proof of the

realization that improved welfare is to be found not only in increasing the return to traditional livelihoods, but also in pursuing novel and promising opportunities.

Dryland commodities, as evidenced by the increasing interest they engender, are one such non-traditional livelihood that could potentially catalyse growth in the ASAL and offer high returns. Across the ASAL districts, and especially among the more arid areas, numerous NGOs and CBOs are increasing community awareness in the commercial wealth that exists in a variety of tree crops and shrubs that grow naturally and in abundance in these areas. And as communities wake up to the wealth they have been squandering by exploiting the resources to produce charcoal and firewood, the perceived benefits of dryland commodities such as the acacia tree, the aloe plant, *Jathropha*, neem and others are growing in several quarters. Natural resource experts value the soil fixing and regenerating value of these trees. Environmentalists concur and also see growing opportunities for propagating such trees to tap into the increasing demand for carbon trading and payments for ecosystems services. Development agencies, on their part, see significant potential in the welfare generating capacity of these products.

While there are several suitable and promising dryland commodities, we highlight two that seem to have the greatest potential in Kenya and that are already show encouraging signs: gum arabic from acacia and biodiesel from *Jathropha curcus*. While we describe the opportunities inherent in *Jathropha* and offer our intervention recommendations, we delve deeper into the opportunities afforded by the acacia tree as we are most encouraged by the potential and the available infrastructure for drastically expanding the adoption and returns that members of the pilot communities can expect from acacia production.

1) *Jathropha curcus*

Jathropha curcus is a drought-resistant perennial that grows well in marginal/poor soils. As a succulent that sheds its leaves during the dry season, *Jathropha* is best adapted to arid and semi-arid conditions and requires no more than 400–500 mm of rainfall but can handle long periods of drought so long as humidity is sufficient. Although it can also handle substantially more rainfall, *Jathropha* requires well-drained soils with good aeration and does not fare too well on heavy soils where root formation is reduced and water logging has a substantial negative impact on production. The economic life of *Jathropha* is between 35 and 40 years and fruiting starts within the first 2 years with full harvests attainable after the third year (UNECOSOC 2007).

The increasing popularity of *Jathropha* is expressly linked to the spike in demand for bio-fuels. The *Jathropha* seed has a high oil content which ranges from 25% to 37%. Depending on yields, up to 8.8 tonnes of *Jathropha* seeds or 2200 litres of *Jathropha* oil can be obtained per hectare per year (UNECOSOC 2007). *Jathropha* oil burns clean and can also be used to power engines in its pure form. Other than biodiesel, extracts from oil production can be also be used to produce fertilizer seed cakes, soaps and candle wax.

Jathropha cultivation, oil extraction and the eventual production of biodiesel can occur at different scales: at the individual micro-scale, in cooperative settings and at larger agro-industrial levels. Several successful examples and pilot trials exist across Africa.

Ghana has taken the lead in *Jathropha* cultivation and after two large successful demonstration, capacity building, awareness raising projects—'Production and utilization of *Jathropha* oil in the West Mamprusi District of the Northern Region', and 'Cultivation of the physic nut to produce biodiesel and mitigate the threat to climate change'—the government has now commissioned a national biofuel policy to guide and encourage the expansion of Jathropha (UNECOSOC 2007). Several other concerted efforts in Mali, Mozambique, Tanzania and elsewhere are underway.

In Kenya, the momentum on the development of a *Jathropha* industry is building. In July 2006, the Vanilla-Jathropha Development Foundation (VJDF) in collaboration with the Trees on Farm Network (TOFNET) of ASARECA, the World Agroforestry Centre (ICRAF) and the National Bio-diesel Organizing Committee held the first National Conference on *Jathropha curcus* value chain development in Kenya that generated a lot of interest in expanding the industry (ICRAF 2006). There is certainly significant potential for *Jathropha* development within the country and various groups, key among them VJDF and TOFNET, are spearheading pilot efforts to investigate the feasibility and economic viability of the plant both in large and small-scale settings. We recommend a modest amount of resources targeted at one of these or some other recommended *Jathropha* development schemes, to assist in training, propagation and capacity building in an attempt to assess the true value of the tree in Kenya.

While there is a lot of promise, however, there also exists some reason for caution. In its first year, *Jathropha* needs a significant amount of care to maintain. It is very susceptible to competition by weeds and needs regular herbicide treatment and can also be easily overtaken by diseases (ICRAF 2006). Despite initial optimism, a *Jathropha* pilot site managed by the Tana and Athi Rivers Development Authority (TARDA) reported dismal results due to the sensitivity of *Jathropha* to water logging (Independent Consultant, TARDA, personal communication). Despite this note of caution, we still feel that there exists enough promise to justify modest KACCAL resources targeted at building awareness of *Jathropha* and financing a pilot effort or two. The caution should merely serve to assure that KACCAL resources are carefully funnelled toward efforts showing potential that are cognizant of these pitfalls and have had past successes.

TARGETING: The coastal region of Kenya is the greatest swathe of the country that is suitable for growing *Jathropha*. The low altitude, high humidity and porous, sandy soils contribute to an environment well suited to the plant. As such, among the KACCAL pilot sites, we recommend that *Jathropha* development efforts be targeted to Malindi. Indeed, discussions with the DMO Malindi revealed that there are already various efforts underway to promote **Jathropha** in the district. We would like to emphasize, however, that substantial attention be paid to proper extension and to identification of the right kind of constituents willing and capable of cultivating and caring for *Jathropha*. Malindi revealed the conundrum of a population with relatively good and large pieces of land, of which only a small portion was cultivated despite worries of food insecurity. The Malindi DMO recognized this problem and attributed it to a lack of awareness and poor cultivation technology. To ensure that this constraint does not limit the returns to *Jathropha* investments in the community, efforts to promote it must place significant

emphasis on training, extension and follow-up. Indeed, as *Jathropha* intercrops well, coupling *Jathropha* development with extension of high value food crops would be a good idea.

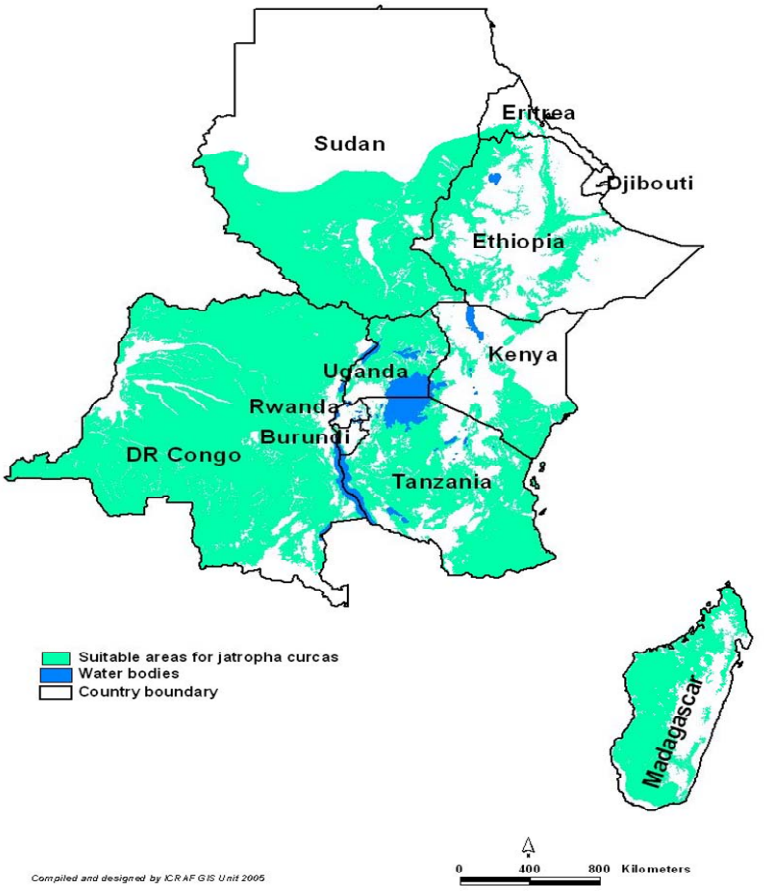


Figure 8.1. *Jathropha curcus* suitability map of ASARECA region.

2) Gum arabic

Gum arabic is defined as a dried exudation obtained from the stems and branches of *Acacia senegal* or *Acacia seyal*. In Kenya, gum arabic from *Acacia senegal* has several local names: adad (Somali), olderikesi (Samburu) and ekunoit (Turkana). Northern Kenya is the principal producing region. Traditionally it is eaten as food by children and herdsmen in the bush. It is also used as medicine to ease joint and back pains. However, gum arabic has important commercial uses in the food and pharmaceutical industries:

- as an emulsifying, stabilizing and clouding agent in the soft drink industry (it is a key additive in Coca Cola)
- prevents crystallization of sugar in ice creams and is a glazing agent in cakes, candies and dairy products
- as a suspending and emulsifying agent in pharmaceutical products (syrups and shampoos) and as a binding agent in tablets

- in paint, printing and textile industries as a binder for watercolor painting and to protect and etch images in lithographic processes.

The role of acacia trees in sub-Saharan Africa (Kenya included) cannot be over-emphasized. These resources are found in the hot and dry regions where they have proved useful as windbreaks and shelter belts against desert encroachment and hence desertification. The trees are also very useful in rehabilitating degraded lands. Species in the genus *Acacia* improve soil fertility through their ability to fix nitrogen. Meanwhile, foliage and pods are valuable dry season fodder while stems produce various wood requirements for local use.

Gum arabic, however, is the most valuable product of the acacia tree and can contribute to improved livelihoods of rural communities and national governments in terms of food security, income generation and foreign exchange earnings. In the Sudan for example, gum arabic was, until the discovery of oil, the number three foreign exchange earner. In 2001 it exported on average 25,000 tonnes worth US$ 37.5 million. Sudan is the world's leading producer/exporter of gum arabic which accounts for 45–50% of world exports. Other key players are Chad and Nigeria where gum arabic is contributing significantly to foreign exchange earnings. There are about another dozen countries (Kenya included) producing/exporting gum arabic.

Kenya's role in the international gum arabic market started in earnest in the late 1980s and picked up in the early 1990s. Before this period, these commodities were exported through Somalia as part of Somalia exports. Exports of gum arabic from Kenya are still very small relative to the resource potential. Annual exports have been only a few 100 tonnes which reached a peak of 460 tonnes in 1995. Export volumes reached a peak of 1130 tonnes worth about US$ 2.6 million in 2000. One problem in Kenya is that trade statistics are still mixed and generally poorly documented.

In Kenya, the resource potential far exceeds current levels of production. Estimated potential for gum arabic production is 3000 tonnes against an average production of 400–500 tonnes. Beyond its capacity for generating income for ASAL communities, gum arabic is also a perfect drought risk insurance product. It so happens that the acacia tree produces a higher quality and quantity of gum when it is under water stress, i.e. during periods of drought. As such, just when the returns to livestock products are declining, the returns to gum production increase resulting in perfectly countervailing livelihoods.

Several organizations in Kenya have been working to improve community production of and market conditions for gum arabic. The Network for Gums and Resins in Africa (NGARA), which is housed by the Kenya Forestry Research Institute (KEFRI) is one of the main organizations spearheading gum production in the Kenyan ASAL. NGARA has a wide network of partnerships and relevant projects and also promotes the development of several other dryland commodities including resins, aloe, neem and *Jathropha*. NGARA is a proactive organization with a suite of activities, large capacity, a range of partners, and a community centred focus for its programme. The organization appears interested in offering a concept note to KACCAL on the various related services that

NGARA would recommend, and could provide in concert with its partners (Appendix IV). The agenda drawn up by NGARA, complete with objectives, targeting of KACCAL districts, and a rough budget estimate seems consistent with broader KACCAL objectives and with our own inclination towards dryland commodities as an important livelihood area that KACCAL should exploit and encourage.

TARGETING: See Appendix IV.

8.4.3. Improving livestock and livelihood productivity through extension and market deepening

Other than the significant potential inherent in dryland commodities, there is also an expanding space of opportunities that is providing significant welfare returns to small pockets of early adopters or communities fortunate enough to receive training and the provision of the necessary facilities and assets to engage these opportunities. These include both avenues to increase the productivity and returns to traditional livelihoods through the promotion of value-adding activities and improving market access and services, and introducing various income generating activities into communities. There is, however, immense potential for encouraging wider adoption of the more promising prospects and in scaling up demonstrated successes. There is a glaring obstacle that has been limiting increased adoption of enhanced livelihood opportunities that needs to be squarely addressed. As has been identified by the communities by their insistence on education and agricultural extension, there is simply a lack of awareness of the potential opportunities and how to go about harnessing them. The increasing importance of community groups is a testament to this. Communities are now realizing that association in groups is a way in which to access and exchange ideas, encourage savings and innovations, and access NGO extension and seed capital provision. In recommending interventions to enhance livelihood options we highlight the importance of attention to complementary extension and market development services.

One of our key concerns in prioritizing recommendations, and one that we highlight later, is the existence of a credible and effective institutional infrastructure or organizational structure through which to channel the interventions in partnership with ALRMP for maximum returns. It is because of the demonstrated success and commitment of Ivory Consult that we feel comfortable to recommend a significant water project for central Marsabit. Similarly the resolve and successes of NGARA and its partners led us to believe that investing in the development of a robust gum arabic market will reap high returns. For many of the productivity enhancing opportunities that we uncovered, we have been very fortunate to find a trusted, well-established and committed NGO, Terra Nuova, that has been engaged in just such endeavours and had been looking for opportunities to continue and expand the scope of its work. Indeed, it was the demonstrated impact of Terra Nuova's Trans-boundary Environmental Project (TEP) in Garissa (Annex V) that prompted the National Coordinator of ALRMP to suggest we contact Terra Nuova to discuss the role the NGO may be able to play with KACCAL. Terra Nuova is closing down TEP after a successful run and handing over to ALRMP due to funding constraints. Discussions revealed that Terra Nuova was similarly interested in some of the livelihood enhancing interventions we were considering, had already done

preliminary investigations as to their feasibility and suitability and had the capacity to engage them. Much of the content for the next three suggested interventions come directly from Terra Nuova and have only been revised for targeting, and to include components that we think are important. While we believe that Terra Nuova would be best suited to implement these interventions, their potential is independent of the NGO and it is possible that other suitable implementation vehicles could be identified.

1) Value adding to livestock

The livestock sector is currently the most import livelihood support in the arid and semi-arid areas of northern Kenya. In view of the uncertain forage supply due to low and erratic rainfall, recurring drought events and widespread overgrazing, intensification and increased productivity of the livestock sector is tenuous. There is, however, considerable margin for value adding through livestock product processing. The proposed activity intends to support and facilitate the establishment and initial running of small decentralised processing plants for various livestock products (meat, hides and skins, slaughter offal, dung and ingesta, milk and honey) as private businesses or community based enterprises. The action will include technical support, basic training, and micro-finance and credit support. The action will create employment opportunity and will generate income for livestock producers (pastoralists). Milk and honey processing and marketing will be particularly supportive of women and women's groups. The proposed income and employment generating activities related to livestock product processing will be introduced to the local communities in strict collaboration with the local authorities (NEMA, ALRMP, District Livestock Production Officer (DLPO), District Veterinary Officer (DVO), District Development Officer (DDO) etc.) and with local interest groups and CBOs.

The activities that will be supported will be:

1. Establishment, rehabilitation or upgrading of local abattoirs or slaughter slabs for more hygienic conditions, higher dressing percentages, and better presentation of valuable cuts for local markets and consumption; training of personnel in clean and efficient processing techniques.
2. Processing of meat, in particular camel meat, into dried meat (biltong) including spicing, smoking, packing and labelling for high price down-country markets, training of personnel in clean and efficient processing techniques and in quality control.
3. More efficient use of slaughter offal through processing of blood, bones, condemned inner organs or condemned whole carcasses into animal (chicken) feed; training of personnel in clean and efficient processing techniques.
4. Tanning of hides and skins using locally available vegetable matter, i.e. bark of *Prosopis juliflora* as source of tannins, training of personnel in efficient processing techniques and in environmentally benign effluent disposal.
5. Using horns and hooves as raw materials for handicrafts in small home industries.
6. Using animal dung and ingesta collected at abattoirs and dung collected in night enclosures, livestock markets, and larger watering places to produce dung briquettes for use as fuel for domestic purposes.

7. Establishing local milk collection systems in combination with small-scale dairies to produce pasteurised and packaged camel milk for local and down-country markets. (Pasteurised full camel milk sells in Uchumi Supermarkets in Nairobi for KSh 99 (US$ 1.5) per 500 ml compared with KSh 30 (US$ 0.5) for cow milk. Camel vanilla yoghurt sells for KSh 129 (US$ 2) per 500 ml compared with KSh 58 (US$ 0.9) cow vanilla yoghurt.) This activity will be accompanied by training camel milk producers and small-scale milk traders in appropriate clean production, transport, and handling techniques
8. Establishing small-scale honey refineries including packing and labelling facilities, further value addition through wax collection and refining (according to a verbal report from the Bodhai community raw honey is fetching KSh 800 per 3 litre container in the Lamu market compared with KSh 3000 for the same quantity of refined honey). This activity will be accompanied by training honey collectors and producers in appropriate clean production and handling techniques.
9. Providing supportive training in all matters pertaining to running of small businesses and industries, i.e. management, finances, legal issues, marketing etc.
10. Provision of a micro-finance and credit scheme if and where needed.

TARGETING: Terra Nuova proposes to implement this activity in towns and larger settlements in Garissa. Their inclination for Garissa has much to do with the recent success of their TEP project in Garissa and the network capital they have built. Due to the better road network that links Garissa to Nairobi and other large market centres, Garissa is indeed a logical choice. However, we would also like to recommend Turkana for this activity, especially since we believe that it can and should exploit natural synergies with the Turkana Pastoral Project that Terra Nuova and the African Medical Research Foundation (AMREF) coordinate and ALRMP is involved with (see Appendix V).

2) Management and gainful utilization of *Prosopis juliflora*

Prosopis juliflora is woody legume which is an introduced aggressive invader of degraded arid and semi-arid rangelands, roadsides, urban fallows and abandoned fields. The growth form varies from multi-stemmed bush to tall tree. It originates from Central America and has spread to virtually all dry tropics and sub-tropics during the last century. In Kenya it has colonized vast areas in the drylands during the last 30 years and is generally considered the most problematic pasture weed. Many control methods have been attempted. After decades of attempted eradication, particularly in Argentina, Australia, South Africa and the USA the aim of total eradication has been seen to have failed, and even the reduced aim of control alone has been only partially achieved. The development of sustainable agroforestry systems has been suggested as the only method for increasing productivity of invaded areas. In India, where especially the dry north-west of the sub-continent has been affected, it has been successfully harnessed in agroforestry systems, providing employment and income to numerous poor people. The most important products are firewood, charcoal and pods as animal feed. In addition there are also preparations of pods as human food, tannins and dyes from bark extracts, exudate gum like gum arabic, and medicinal uses of extracts of leaves and flowers. In Mexico seeds are used to produce a coffee substitute, flour for some kind of bread, sweet syrup, and if that syrup is fermented, also an alcoholic drink. *Prosopis* is known to enhance soil

quality and structure, can be used to control erosion and can be planted as shelter belts and live fences. In Kenya *Prosopis* is so far seen only as a pest; the project will seek to promote gainful utilization of this plant for the benefit of the population in the country's drylands.

The proposed project will modify natural stands of *Prosopis* by singling, pruning and coppicing them into managed stands with improved productivity. The project will concentrate on its use as firewood, for charcoal production and on harvesting pods as animal feed. This will generate employment in the target area and secure income for the participants through sale of the commodities produced. These activities will be carried out by members of the local communities within a pilot scheme testing several different agroforestry approaches. The work will be planned and carried out in close cooperation with local CBOs, the relevant line ministries and their local representatives, other local partners including ALRMP, NEMA, the Forest Department and KEFRI. Major aspects of the project will be raising awareness in the local communities for the inherent economic potential of *Prosopis* and transfer of knowledge and skills for successful exploitation of this plant.

TARGETING: We agree with Terra Nuova's suggestion to place the pilot scheme into or near to the defunct Bura Irrigation Scheme in Garissa. This would allow close coordination with the proposed Bura Aloe Production Project, which will be carried out by ALRMP and involves the same local and national partners allowing for considerable synergy effects between the two projects.

3) Promoting pastoralists training programmes through 'pastoralists field schools'

Farmers field schools (FFS) were introduced in Kenya about a decade ago and their use has increased with remarkable success in addressing the many problem areas encountered in the farming sector. FFS are demand driven and decentralised services aimed at the resource poor smallholder with weak market connections. The schools have dealt successfully with many subjects ranging from weed control and fertilizer use to improved seeds and better market access. So far this approach has not been applied to pastoral livestock production systems, although there is a wide range of topics which could be addressed. Herd and range management, management of watering sources, animal health observation, development of livestock based value adding activities, improved market access and marketing power for pastoralists, and NRM and conservation issues could and should be subjects in 'pastoralists field schools' (PFS).

The broad objectives of the proposed activities are to bring pastoralists together with each other and with instructors and facilitators to carry out collective and collaborative problem identification and problem solving by promoting individual and community action.

Specific objectives are:

1. To empower pastoralists with knowledge and skills to meet the emerging ecological and economic challenges in their particular environment.

2. To improve pastoralists ability to make critical and informed decisions that help to improve profitability of the pastoral enterprise.
3. To sensitise pastoralists in new approaches to problem solving.
4. To enable pastoralists organize community actions.

There should be four types of training:

- discovery based learning by groups of pastoralists in the field situation guided by trained facilitators
- pastoralist to pastoralist training within the communities
- in-service training for extension workers/facilitators
- seminars on particular subjects for researchers, for administrators and local and national decision makers and for personnel of the various agencies involved in development programmes.

Initially PFS programmes should be developed in:

- livestock production, i.e. herd management, feeding and nutrition and breeding management
- day-to-day animal health monitoring and care
- range and water management, adaptation to ecological changes
- improved product collection and handling of milk, meat, hides and skins
- product quality, improved market access and collective marketing
- other income generating activities.

This list is not exhaustive and will be adjusted in communication with the pastoralists' groups concerned as they identify their problems and shortcomings.

TARGETING: We view this as an overarching project that can support, enhance and collaborate with several of the other interventions that we propose, including community based climate risk management efforts that require an extension infrastructure, extracting biodiesel from *Jathropha* and gum arabic from acacia, and the myriad other activities that ALRMP is already involved in. As indicated, the training components are not cast in stone and can flexibly encourage newly identified opportunities for productivity enhancement. We feel strongly about the importance of this component. Well developed and adequately resourced and staffed, it has the potential to improve the returns to all other community investments and to increase the adoption rate of any innovative technologies or services that are enhanced.

As such, we recommend that such an initiative be implemented in all five pilot districts, and that the training programmes are carefully selected to exploit synergies with other KACCAL interventions, and where possible, other ALRMP activities. While the focus here is on PFS which are more relevant for Garissa, Marsabit and Turkana, all that has to be tweaked is the focus of the training for application to other districts. Indeed, the concept comes from FFS which would be very relevant in Mwingi and particularly so in Malindi where technology adoption is surprisingly low as are returns to agricultural production.

The action will be concentrated in North Eastern Province. By nature of the approach there will be no sedentary institution but mobile units facilitating the field training programmes. The Farmers Training Centre in Garissa and the Pastoralists Training Centre in Wajir could probably serve as focal points for the preparation of the programmes and as service units for the field activities. The action could also be usefully replicated in Turkana (Rift Valley Province) and Marsabit (Eastern Province).

8.5. Overarching issues

There are certainly other areas in which well targeted and designed interventions can and would likely increase the space of productive livelihoods by which ASAL communities can improve their welfare and diminish their vulnerability to climate and other shocks. Astute observers will note that we did not, for example, explicitly recommend interventions targeting high value agricultural crops or more climate robust staples. This does not mean we do not see potential in such efforts. Indeed we do, and some of our recommended interventions such as the propagation of acacia expressly incorporate intercropping with staples and other agricultural products in their design. Moreover, our continuous emphasis on extension services (as noted in our promotion of learning and capacity building modules such as the pastoralist field schools or the climate risk management units) serves to create an infrastructure that can flexibly encourage the adoption of a range of innovative and promising activities. As mentioned before, we selected our priority interventions by relevance to KACCAL's objectives, expressed community demand, estimated livelihood and resilience returns to investments and feasibility. We were also particularly conscious of not spreading KACCAL's resources too thinly across numerous investments.

8.5.1. Distributing KACCAL resources across recommended interventions

This section deals with how to distribute the available US$ 6.5 million across the recommended interventions for KACCAL. The precise estimates that will be required when concrete and final decisions are being made on how much, which activity and by which implementing agency, are critical but beyond the scope of this report. First, such decisions are based on multiple concerns that include identified priorities by other stakeholders and partners to which we are not privy. Second, after the project team and KACCAL agree on which interventions to pursue and how to follow our targeting recommendations, they face the challenge of identifying the implementation partners. Third, once the partners are identified (or in the process of identifying partners), it is quite a process to actually cost a project. It is not possible to know how much it will cost to build and maintain a water piping infrastructure from Logologo to central Marsabit that has multiple outlets distributed across the town until the tendering firms visit the site, confirm the condition of the aquifer and the ease of tapping its resources, map out the terrain to identify potential piping routes etc.

We highlight this because we think that fundamental to the success of KACCAL, and to assuring that its investments achieve maximum impact, the intermediate step of identifying the right implementation partners should be prioritized and sufficient time and financing resources should be allocated to it. In Ivory Consult, NGARA and Terra Nuova

we have identified partners that we would highly recommend. However, these only represent possible implementation agencies for a few of the total suite of interventions. Furthermore, while we do have good reason to champion these organizations, it may be wise to invite them to tender in competition with other organizations that offer similar services.

With these caveats in mind, we nonetheless present a rough resource distribution range across the various interventions that we recommended (Table 8.1). Our estimates are largely based on the importance we attach to the various interventions as determined both by our analyses and by our understanding of KACCAL's objectives. The estimated impact of the various programmes, the range of activities that can be offered within the programme, and back of the envelop calculations of likely costs were also factors.

Table 8.1. Estimates of resource allocation across interventions

Intervention category ($\times 10^3$)	**Proposed project**	**Proposed resource allocation distribution** ($\times 10^3$)
EWS for the external client (US$ 800–1000)	Management information system	US$ 600– 800
	Streamlining data collection efforts	US$ 100
	Processes to improve climate data infrastructure	US$ 100
Community based climate risk management (US$ 800–1000)	Synergizing community based efforts	US$ 800–1000
Water management (US$ 1800–2200)	Logologo-Marsabit piping infrastructure	US$ 600–800
	Upgrading extant water projects	US$ 1000–1200
	Development of standards for ALRMP water projects	US$ 200
Dryland commodities (US$ 700–1000)	*Jathropha* biodiesel	US$ 100–200
	Gum arabic	US$ 600–800
Enhancing livelihood productivity (US$ 700–1000)	Value adding to livestock	US$ 200–300
	Prosopis management	US$ 100–200
	Pastoralist field schools	US$ 400–500
KACCAL operational requirements (US$ 300–500)	Tendering, consulting, distribution, follow-up, conferences etc., MIS	US$ 300–500

8.6. Final comments of note

There are two central issues that we feel are important to highlight, even though we do not recommend any specific action on them under the context of KACCAL as they are beyond the project's mandate. These are mainly targeted at ALRMP and the World Bank

KACCAL project team. The first issue we wish to flag is the importance of the DSGs. In the DSG, ALRMP has an enviable structure for coordinating both emergency relief and development at the community level by bringing together the key stakeholders in government, civil society and religious groups that are actively involved in the promotion of welfare improving activities at the community level. The centrality of this coordinating function cannot be overstated. As a result of increasing extremities and uncertainty, one of the key consequences of climate change will be the added pressure on limited resources for relief, recovery and development efforts.

Consequently, resource distribution and targeting efforts will have to drastically increase in effectiveness. Overlapping efforts must be minimized, low-impact projects must be quickly identified and scrapped, and opportunities to exploit synergies in disparate efforts must be tapped. This can only be achieved if the different players are well coordinated. In steering the DSG, ALRMP is well poised to play this role. Indeed, it already does. However, in many districts, the DSGs are not operating as effectively as they can. They are constrained by the lack of a legal mandate. Members are not required to present their accounts or reveal all the activities they are engaged in. There is no clear division of labour or responsibilities. And while there are indeed attempts to improve the functioning of the DSG in the mentioned direction, we feel that the pace and intention of the efforts are not consistent with the catalytic role that a fully effective DSG can play.

The second issue we wish to highlight is the importance of coupling KACCAL interventions with a rigorous M&E component. We are encouraged by conversations with ALRMP coordinators and the KACCAL project team indicating their intention to intimately integrate M&E components within their interventions. We leave M&E out of our budgeting simply because it is our understanding that external resources will be allocated to this activity. However, especially given that KACCAL activities are pilot in nature and are intended to be scaled up depending on their impact, we feel that M&E is critical enough to deserve this final emphasis.

References

Alwang, J., Siegel P., and S. Jorgensen. 2002. Vulnerability as viewed from different disciplines. Paper presented at the International Symposium for Sustaining Food Security and Managing Natural Resources in Southeast Asia, January 2002.

Ashmore, R.H. 1997. Local-level data for use as early warning indicators. Internet *Journal for African Studies* 1(2). (Available from www.bradford.ac.uk/research/ijas/ijasno2/ashmore.html)

Barrett, C.B. 2005. Poverty traps and agricultural research: Improving policies, institutions and technologies to support sustainable poverty reduction. Paper presented at the CGIAR Science Forum: Science for the Poor. Marrakech, Morocco, 6 December 2005.

Barrett, C.B. and Maxwell, D.G. 2006. Food aid after fifty years: Recasting its role. Routledge, Canada and USA.

Bekele, N. and Omolo, A. with contributions from Orindi, V., Otiende, B., Ochieng, A., Bhadwal, S., Anantram, K., Nair, S., Kumar, V. and Kulkar, U. 2006. Mapping climate vulnerability and poverty in Africa. Report to the Department for International Development (DFID), London, UK.

Benson, T. 2003. *Applications of poverty mapping to World Food Programme activities in Malawi: Assessing the poverty targeting efficiency of a public works program and vulnerability to food insecurity*. IFPRI (International Food Policy Research Institute), Washington, DC, USA.

Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R. and Yanda, P. 2007. Climate change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II. , In: Parry, M.L., Canziani, O.F. Palutikof, J.P. van der Linden P.J. and Hanson, C.E. (eds), *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK, and New York, USA. pp. 433–467.

Buchanan-Smith, M., Davies, S. and Petty, C. 1994. *Food security: Let them eat information*. Institute of Development Studies Bulletin 25(2). IDS (Institute of Development Studies), University of Sussex, Brighton, UK.

Carter, M. and Barrett, C. 2006. The economics of poverty traps and persistent poverty: An asset-based approach. *The Journal of Development Studies* 42(2):178–199.

Christensen, J.H., Hewitson, B., Busuioc, A., Chen, A., Gao, X., Held, I., Jones, R., Kolli, R.K., Kwon, W.-T., Laprise, R., Magaña Rueda, V., Mearns, L., Menéndez, C.G., Räisänen, J., Rinke, A., Sarr, A. and Whetton, P. 2007. Climate change 2007: The physical science basis: Regional climate projections. In: Solomon, S., Qin, D., Manning,

M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. and Miller, H.L. (eds). Contribution of Working Group I. *Fourth Assessment Report of the Intergovernmental Panel on Climate Change* . Cambridge University Press, Cambridge, UK, and New York, USA.

Fischer, G., Shah, M., and Velthuizen, H. 2002. *Climate change and agricultural vulnerability*. IIASA (International Institute for Applied Systems Analysis), Laxenburg, Austria. (Available from http://www.eldis.org/static/DOC10242.htm)

GoK (Government of Kenya). 2005. *Arid Lands Resource Management Project II Strategic Plan (2005–2009)*. ALRMP (Arid Lands Resource Management Project), Office of the President, Nairobi, Kenya.

Hansen J.W. and Indeje, M. 2004. Linking dynamic seasonal climate forecasts with crop simulation for maize yield prediction in semi-arid Kenya. *Agricultural and Forest Meteorology* 125**:**143–157.

Hansen, J.W., Dilley, M., Goddard, L., Ebrahimian, E. and Ericksen, P. (2004) Climate variability and the Millennium Development Goal hunger target. IRI Tech. Rep. 04-04. IRI (International Research Institute for Climate and Society), Palisades, New York, USA.

Hijmans, R.J., Cameron, S. and Parra, J. 2004. WorldClim climate surfaces. (Available from http://biogeo.berkeley.edu/worldclim/worldclim.htm)

Hulme, M., Doherty, R.M., Ngara, T., New, M.G. and Lister, D. 2001. African climate change: 1900–2100. *Climate Research* 17:2:145–168.

ICRAF (World Agroforestry Centre). 2006. *Towards biodiesel production in Kenya: Jathropha as a tool to combat energy poverty*. 1st National *Jathropha* Conference, ICRAF, Nairobi, Kenya, 26–28 July 2006. ICRAF, Nairobi, Kenya.

Indeje, M., Semazzi, F.H.M. and Ogallo, L.J. 2000. ENSO signals in East African rainfall and their prediction potentials. *International Journal of Climatology* 20**:**19–46.

Indeje, M., Ward, N.M., Ogallo, L.J., Davies, G., Dilley, M. and Anyamba, A. 2005. Predictability of the normalized difference vegetation index in Kenya and potential applications as an indicator of Rift Valley fever outbreaks in the Greater Horn of Africa. *Climate* 19:1673–1687.

Ingram K.T., Roncoli, M.C. and Kirshen, P.H. 2002. Opportunities and constraints for farmers of West Africa to use seasonal precipitation forecasts with Burkina Faso as a case study. *Agricultural Systems* 74:(33):331–349.

IPCC (Intergovernmental Panel on Climate Change). 2000. Emission scenarios: Summary for policy makers. Cambridge University Press, Cambridge, UK, and New York, USA. (Available from http://www.grida.no/climate/ipcc/spmpdf/sres-e.pdf)

IPCC (Intergovernmental Panel on Climate Change) (2007). The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, USA.

ISDR (International Strategy for Disaster Reduction) and FFO (Federal Foreign Office) 2006a. Developing early warning systems: A checklist. Early Warning—From concept to action. Bonn, Germany, 27–29 March. UN/ISDR and DKKV. (Available from www.unisdr-earlywarning.org)

ISDR (International Strategy for Disaster Reduction) and FFO (Federal Foreign Office) 2006b. The conclusions of the Third International Conference: Early Warning—From concept to action. Bonn, Germany, 27-29 March. UN/ISDR and DKKV. (Available from http://www.ewc3.org/upload/downloads/Early_warning_complete2.pdf)

Jones, P.G., and Thornton, P.K. 2000. MarkSim: software to generate daily weather data for Latin America and Africa. *Agronomy Journal* 92(3):445–453.

Jones, P.G. and Thornton, P.K. 2003. The potential impacts of climate change in tropical agriculture: the case of maize in Africa and Latin America in 2055. *Global Environmental Change* 13:51–59.

Kariuki, G. 2006. Improved access to information on livestock early warning. Arid Lands Information Network 47. (Available from http://www.alin.or.ke/_imagedata/baobabs/baobab%2047.pdf)

KNMI (Royal Dutch Meteorological Institute). 2007. *Climate change in Africa. Changes in extreme weather under global warming*. Royal Netherlands Institute of Meteorology. (Available from http://www.knmi.nl/africa_scenarios/)

Kurukulasuriya, P., Mendelsohn, R., Hassan, R., Benhin, J., Deressa, T., Diop, M., Eid, H.M, Yerfi Fosu, K., Gbetibouo, G., Jain, S., Mahamadou, A., Mano, R., Kabubo-Mariara, J., El-Marsafawy, S., Molua, E., Ouda, S., Ouedraogo, M., Sene, I., Maddison, D., Seo, N. and A. Dinar. (2006). *Will African agriculture survive climate change?* The World Bank Economic Review. The World Bank, Washington, DC, USA.

LEWS (Livestock Early Warning System). 2003. *Early warning system for monitoring livestock nutrition and health for food security of humans in East Africa*. GL-CRSP (Global Livestock Collaborative Research and Support Program), Texas A&M University, College Station, Texas, USA.

LINKS (Livestock Information Network and Knowledge System). 2005. *Annual Report*. GL-CRSP (Global Livestock Collaborative Research and Support Program), Texas A&M University, College Station, Texas, USA.

McPeak , J., Gebru, G., Lemunyete, R., and Kristjanson, P. 2007. Perspectives on development in arid and semi-arid areas: Results of a ranking exercise. ILRI and PARIMA Working Paper. ILRI (International Livestock Research Institute) and PARIMA (Pastoral Risk Management Project), Nairobi, Kenya.

Mude, A., Barrett, C. and McPeak, J. 2006. *Empirical forecasting of slow-onset disasters for improved emergency response: an application to Kenya's arid north*. Cornell Food and Nutrition Policy Program, Cornell University, Ithaca, New York, USA.

Mutai, C.C., Ward, M.N. and Colman, A.W. 1998. Towards the prediction of the East Africa short rains based on sea-surface temperature-atmosphere coupling. *International Journal of Climatology* 18:975–997.

Ngugi, R.K. 2002. *Climate forecast information: The status, needs and expectations among smallholder agropastoralists in Machakos District, Kenya*. IRI 31. IRI (International Research Institute for Climate and Society), Columbia Earth Institute, New York, USA.

O'Brien, K., Sygna, L., Naess, L.O., Kingamkono, R. and Hochobeb, B. 2000. Is information enough? User responses to seasonal climate forecasts in southern Africa. Report to the World Bank, AFTE1-ENVGC. The World Bank, Washington, DC, USA.

Dube, P.O. and Sekhwela, M.B.M. 2007. Coping strategies in semiarid Limpopo Basin part of Botswana: Enhancing adaptation capacity to climate change. AIACC Working Paper No. 47. AIACC (Assessments of Impacts and Adaptations to Climate Change), Wahsington, DC, USA, and Nairobi, Kenya.

Orindi, V.A., Nyong, A. and Herrero, M. 2007. Pastoral livelihood adaptation to drought and institutional interventions in Kenya. In preparation.

Osbahr, H and Viner, D. 2006. Linking climate change adaptation and disaster risk management for sustainable poverty reduction. Kenya. Country Study. A study carried out for the Vulnerability and Adaptation Resource Group (VARG) with support from the European Commission.

Oxfam International. 2006. Making the case: A national drought contingency fund for Kenya. Oxfam Briefing Paper 89. Oxfam International, Oxford, UK.

Ryan, Z. 2004. *Establishment and evaluation of a livestock early warning system for Laikipia, Kenya*. A thesis. Texas A&M University, College Station, Texas, USA.

Sivakumar, M.V.K., Das, H.P. andBrunini, O. (2005) Impacts of present and future climate variability and change on agriculture and forestry in the arid and semi-arid tropics. Climatic Change (2005) 70: 31–72

Sommer, F. 1998. Pastoralism, drought early warning and response. ODI Pastoral Development Network. ODI (Overseas Development Institute), London, UK. (Available from http://www.odi.org.uk/pdn/drought/sommer.pdf)

Sperling F. and Szekely, F. (2005). Disaster risk management in a changing climate. Discussion paper prepared for the World Conference on Disaster Reduction on behalf of the Vulnerability and Adaptation Resource Group (VARG). Reprint with Addendum on Conference outcomes. Washington, DC, USA.

Tarhule, A. and Lamb, P.J. 2003. Climate research and seasonal forecasting for West Africans: Perceptions, disseminations, and use? *Bulletin for the American Metrological Society* 84:1741–1759.

Thornton, P.K., Jones, P.G., Owiyo, T., Kruska, R.L., Herrero, M., Kristjanson, P., Notenbaert, A., Bekele, N. and Omolo, A., with contributions from Orindi, V., Otiende, B., Ochieng, A., Bhadwal, S., Anantram, K., Nair, S., Kumar, V. and Kulkar, U. 2007. *Mapping climate vulnerability and poverty in Africa*. Report to the Department for International Development. ILRI, Nairobi, Kenya..

UNEP/GoK (United Nations Environment Programme and Government of Kenya). 2000. *Devastating drought in Kenya. Environmental impacts and responses*. UNEP/GoK, Nairobi, Kenya.

UNECOSOC (United Nations Department of Economic and Social Affairs). 2007. Small-scale Production and Use of Liquid Biofuels in Sub-Saharan Africa: Perspectives for sustainable development. Report prepared by the Energy and Transport Branch, Division for Sustainable Development, United Nations Department of Economic and Social Affairs DESA/DSD/ 2007/2.

UNDP (United Nations Development Programme). 2002. A climate risk management approach to disaster reduction and adaptation to climate change. Paper presented at the UNDP Expert Group Meeting, Integrating Disaster Reduction with Adaptation to Climate Change Havana, Cuba, 19–21 June 2002.

Usher, P.E.O. 2000. Kenya and ENSO: An observation and La Niña prediction. Columbia University Press, New York, USA. (Available from http://www.earthscape.org/r1/ucar04/usher.html)

World Bank. 2003a. Updated project information document. Report number AB39. The World Bank, Washington, DC, USA

World Bank. 2003b. Project performance assessment report, Kenya Arid Lands Resource Management Project (Credit No. 2797-Ke). The World Bank, Washington, DC, USA.

World Bank. 2005. Project performance assessment report, Kenya Arid Lands Resource Management Project (Credit No. 2797-Ke). The World Bank, Washington, DC, USA.

WRI (World Resources Institute), DRSSRS (Department of Resource Surveys and Remote Sensing), CBS, (Central Bureau of Statistics) and ILRI (International Livestock Research Institute). 2007. *Nature's benefits in Kenya. An atlas of ecosystems and human well-being*. WRI, Washington, DC, USA, and DRSSRS, Ministry of Environment and Natural Resources, CBS, Ministry of Planning and National Development, and ILRI (International Livestock Research Institute), Nairobi, Kenya.

Ziervogel, G. 2004. Targeting seasonal climate forecasts for integration into household level decisions: The case of small holder farmers in Lesotho. *The Geographical Journal* 1701:6–21.

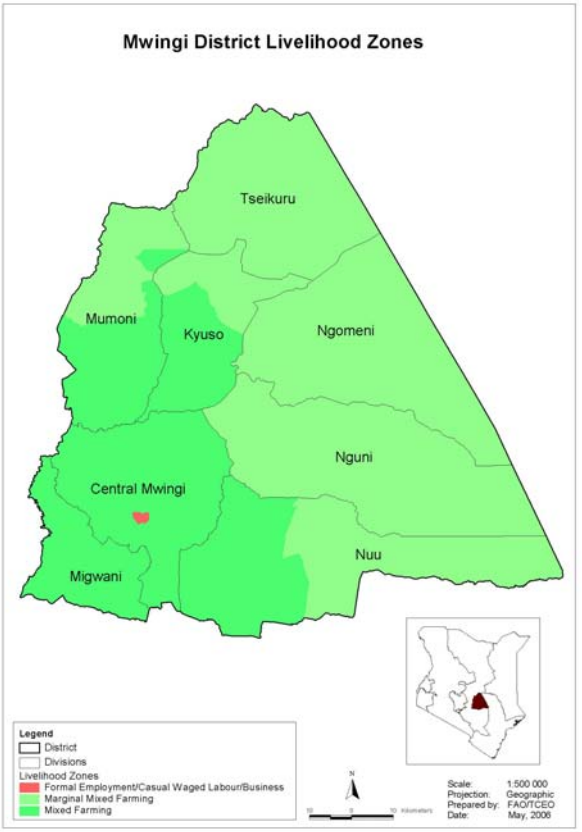
Appendices

Appendix I: Profiles of KACCAL pilot districts

MWINGI DISTRICT

Position and size: Covering an area of 10,030.30 km², Mwingi is one of the 13 districts in Eastern Province. The district has nine administrative divisions. These are Central, Migwani, Kyuso, Mumoni, Nguni, Ngomeni, Nuu, Mui and Tseikuru. The divisions are further sub-divided into 38 locations and 127 sub-locations. The district has 2 constituencies, namely Mwingi North and Mwingi South, and two local authorities, namely Mwingi Town Council with 28 wards and Mwingi County Council with 6 wards.

Physical and natural conditions



Climate: Mwingi District is hot and dry for the greater part of the year. The maximum mean annual temperature ranges between 26ºC and 34ºC. The minimum mean annual temperature in the district varies between 14ºC and 22ºC. The district has two rainy seasons: March–May (long rains) and October–December (short rains). Rainfall ranges between 400 and 800 mm per year, but is erratic. The short rains are more reliable than the long rains.

Topography: The highest point of the district is Mumoni Hill, with an altitude of 1747 m above sea level. The landscape is generally flat, with plains that gently roll down towards the east and northeast where altitudes are as low as 400 m. The highlands, namely Migwani, Mumoni, Central and Mui divisions receive more rainfall than the lowland Nguni, Kyuso and Tseikuru divisions do. The drier areas experience severe droughts, which have led to livestock deaths and food shortages.

Mwingi has red sandy soils, loamy sand soils and patches of black cotton soils. The river valleys have saline alluvial soils of moderate to high fertility. Otherwise, soils are of low fertility and prone to erosion. Most hills are covered by shallow and stony soils unsuitable for crop farming.

Population: Mwingi District has a population of 303,828 (1999 population census) that is projected to rise to 377,081 people by 2008 with an annual growth rate of 2.4%. It has an average population density of 30 persons per km². Migwani is the most densely populated division (101 persons per km²), followed by Central, Kyuso, Mui, Nuu, Mumoni, Tseikuru, Nguni and finally Ngomeni being the least densely populated (7 persons, per km²). Mwingi District is a homogeneous district inhabited mainly by the Kamba ethnic group.

The district shows a very high prevalence of poverty, which is estimated at 60% with the poor residing in the driest divisions in the district (Tseikuru, Kyuso, Ngomeni, Nguni and Nuu divisions). Migwani, Central and Mui have the least poverty prevalence.

Settlement patterns: Patterns are dictated by livelihoods. Over 95% of Mwingi's population is rural based while 5% is the urban population of which, Mwingi Town has 4% while the rest is distributed across other trading centres.

Livelihoods: Mixed farming is the more dominant livelihood with 69% of the population engaged in such activities.

Table 1. Livelihood zones of Mwingi District by division and population distribution

Livelihood zone	Divisions covered	Population	% population
Mixed farming	Central Mwingi, Kyuso, Migwani, Mumoni, and Nuu	210,912	69
Marginal mixed farming	Nuu, Tseikuru, Nguni, Ngomeni, Mumoni, Kyuso	83,858	28
Formal employment/casual labour/business	Central Mwingi	9,058	3
Total		303,828	100

MARSABIT DISTRICT

Position and size: Marsabit District is located in the Eastern Province and is the second largest district in Kenya accounting for approximately 11% of the country's total area; the district covers an area of 66,000 km^2. The district is divided into six administrative divisions: Central Marsabit, Gadamoji, Laisamis, Maikona, Loiyangalani and North Horr.

Physical and natural conditions

Climate: Marsabit District is located in one of the driest regions of the country characterized by low rainfall and fairly high temperatures. On average, annual temperatures are recorded as approximately 20.5°C. Per annum the district receives between 200 and 1000 mm of rainfall.

Topography: Most of the district is an extensive plain lying between 300 and 900 m above sea level, which slopes gently towards the southeast. The plains are surrounded by hills and mountain ranges to the west and north. The hill masses that characterize Marsabit District are tertiary and quaternary volcanoes Mt Kulal (2355 m) and Hurri Hills located in the northern plains. The area around Lake Turkana is rifted and forms part of the Great Rift Valley system. Marsabit District has two gazetted forests: the tropical rain forests of Mt Marsabit which covers about 15,280 ha and Mt Kulal biosphere conservation which covers about 45,729 ha. Hurri hills are woodlands under the administration of the County Council.

Population: Marsabit District has a population of 121,478; population density varies between 1 to 20 persons per km^2. Gadamoji Division is the most densely populated (20 persons per km^2), while Maikona, Loiyangalani and North Horr divisions are the least populated (1 person per km^2). Income levels are low with approximately 88% of the district's rural inhabitants living below the poverty line. Education levels are very low, with 20% of the male and 10% of the female population being literate.

Settlement patterns: Patterns are dictated by livelihoods and access to natural resources. High population densities are found in permanent and semi-permanent settlements mainly on Mt Marsabit and other high elevation areas where agropastoralism is practised, and around permanent water sources where markets and other social amenities are found. Most of the people who have lost their livestock due to droughts and other causes migrate to these areas in search of employment and other sources of livelihoods.

Livelihoods: Agricultural production is an important activity mainly practised on Mt Marsabit where the soils and climate are favourable; there are also some crop production activities in the hilly areas of the district.

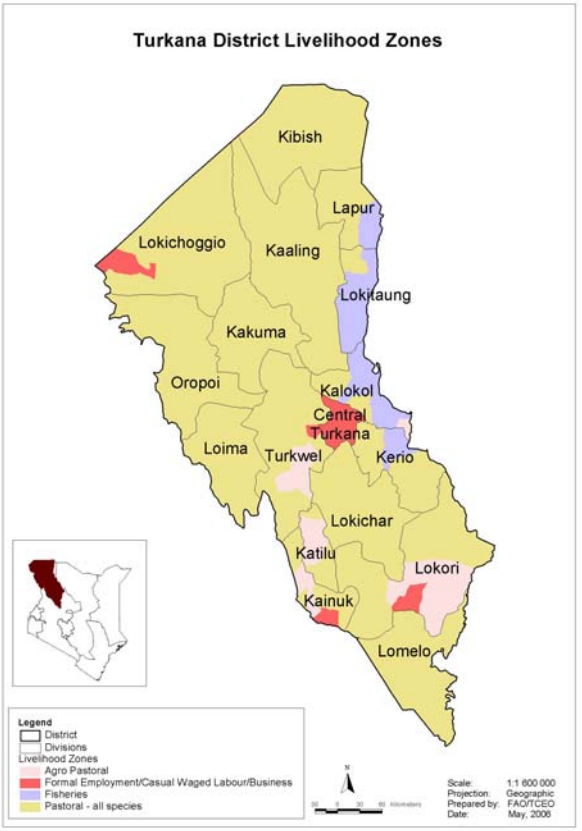
Table 2. Livelihood zones of Marsabit District by division and population distribution

Livelihood zone	Divisions covered	Population	% population
Pastoral: All species	North Horr, Maikona, Loiyangalani, Laisamis, Central Marsabit	82,605	68
Agropastoral	Central Marsabit, Loiyangalani, Gadamoji	25,510	21
Formal employment/business/trade	Central Marsabit	13,363	11
Total		**121,478**	**100**

TURKANA DISTRICT

Position and size: Turkana District, classified as arid, is located in Rift Valley Province. The district was recently split into two, however, for the purposes of KACCAL, we consider the larger Turkana District which occupies an area of approximately 68,388 km^2. The district is divided into 17 administrative divisions: Lokichoggio, Kaaling, Lopur, Lokitaung, Kibish, Lokichar, Oropoi, Lokori, Lomelo, Katilu, Kainuk, Central, Kerio, Kalokol, Turkwel, Loima and Kakuma.

Physical and natural conditions:



Climate: The climate in Turkana is very hot with temperatures of between 24^{o}C and 38^{o}C and an annual average of 30^{o}C. The rainfall is bimodal, erratic and unreliable. Typically, short rains are expected between April and July while the long rains are usually due between October and November. Annual rainfall averages 300–400 mm. The rain falls in brief, violent storms resulting in floods. The surface runoff and potential evaporation rates are extremely high. However, Turkana experiences frequent droughts that often extend over months and years resulting in perennial food insecurity.

Population: The district has a population of 450,860 with a population density of 7 persons per km^2. The Central Division has the highest density of 11.9 persons per square kilometre.

Topography: Turkana District is characterised by low-lying plains scattered with isolated mountains and hills. Most of the rivers are seasonal except Turkwel and Kerio. One-third of the District is covered by volcanic rocks and in several hills and mountains there are outcrops from the basement. Poor and shallow soils combined with low vegetation cover, leads in rapid runoff when it rains. The altitude ranges from 369 m at the shores of Lake Turkana to the Koilongoi peak at 2067 m.

Settlement patterns: Settlement patterns are dictated by the livelihoods and the environment. Nomadic pastoralists, who migrate in search of pasture and water or to escape from conflicts constitute about 70% of the population. The very poor are mainly found in the northern parts and central plains and are usually immigrants in search of relief food and assistance. An increasing number of sedentary pastoralists live around urban centres engaging in casual labour or petty business.

Income levels are very low in Turkana and about 74% of the district's population live below the poverty line.

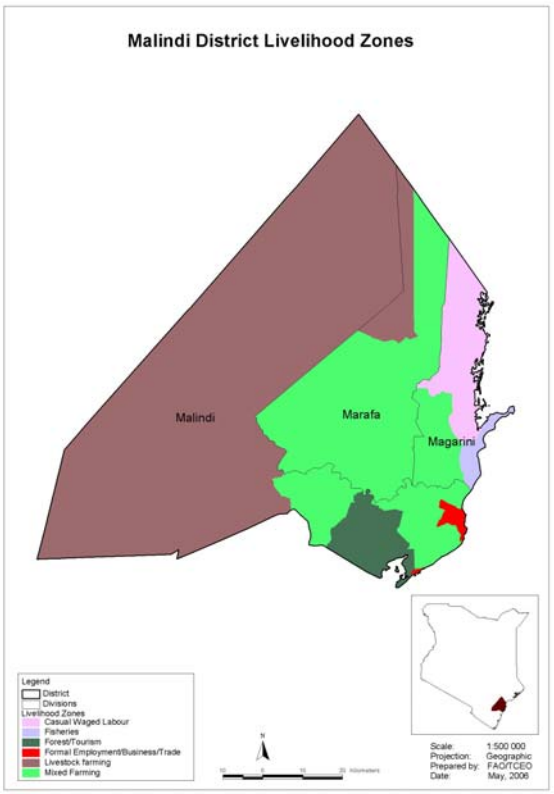
Table 3. Livelihood zones of Turkana District by division and population distribution

Livelihood zone	Divisions covered	Population	% population
Pastoral: All species	Kaaling, Kainuk, Kakuma, Kalokol, Katilu, Kerio, Kibish, Lopur, Loima, Lokichar, Lokichoggio, Lokitaung, Lokori, Lomelo, Oropoi, Turkwel	319,263	70
Formal employment/casual waged labour/business	Central Turkana, Kainuk, Lokichoggio, Turkwel	53,963	12
Fisheries	Kalokol, Kerio, Lopur, Lokitaung	47,516	11
Agropastoral	Kainuk, Kalokol, Katilu, Lokori, Turkwel	30,118	7
Total		450,860	100

MALINDI DISTRICT

Position and size: Malindi District is located in the Coast Province. It covers an area of approximately 7,751 km^2. The district is sub-divided into three administrative divisions: Magarini, Malindi and Marafa. Malindi Township is the administrative seat of Malindi District and the Local Authority Municipal Council of Malindi.

Physical and natural conditions



Climate: Malindi District is generally hot and humid all year round. The mean daily temperature ranges between 22ºC and 29.5ºC maximum. Average relative humidity along the coastal belt is 65% but decreases towards the hinterland. The lowest temperature is experienced during the long rainy seasons.

Malindi has two annual rainy seasons. The long rains fall between April and July and the short rains between October and November. The average rainfall ranges from 400 mm in the hinterland to over 1200 mm along parts of the coastal belt. The coastal belt rainfall varies between 900 and 1200 mm due to the effects of monsoon winds and the topography.

Topography: The district has four major topographic features that are closely related to the existing agro-ecological zones: coastal plains, foot plateau, coastal range and Nyika plateau. The district has a 155 km long coastline.

The 'coastal plains' comprise a coastal coral limestone reef, inland of which is a sandy back-reef facies (Magarini sands). It is a narrow belt, varying in width between 3 km and 20 km. It lies below 30 m above sea level. A creek in Mida breaks the belt and gives rise to excellent marine and swamps with mangroves.

The 'foot plateau' lies west of the coastal plain with slightly undulating terrain between 60 m and 135 m altitude. The plateau characterizes as seaward sloping peneplain whose surface has been dissected by numerous dry water courses, with underlying Jurassic sediments consisting of shells, sandstones and impervious clays. It supports grassland and stunted vegetation.

The 'coastal range' consists of low range sandstone hills 150 m to 420 m high. The rest of the hinterland forms the 'Nyika plateau', which is 130 to 300 m above sea level.

Vegetation: The vegetation zones in the district range from mangroves and swamps (mainly on the sides of Mida Creek in Watamu on the Indian Ocean) to tropical monsoon forest, lowland dry forest (Arabuko-Sokoke Forest) to savannah and bush land in the hinterland.

Population: Malindi District has a population of 281,552 with an average population density of 36 persons per km^2. Magarini Division is the most densely populated (92 persons per km^2), while Marafa Division is the least populated (26 persons per km^2). Malindi Division has a population density of 32 persons per km^2.

About 56% of the district's population is literate. The literacy level is higher among the male population (76.9%), than the female population (35%). However, income levels are low, with 59.1% of the rural population and 66.3% of the urban population living below the poverty line.

Settlement patterns: The patterns are dictated by economic activities. The tourist sector is the most important industry in Malindi District with tropical water, beaches, resort hotels and the marine national parks being the key attractions. A substantial proportion of the local population benefits directly or indirectly from tourism. The most significant economy outside Malindi Township is agriculture; along the shores there are fisheries activities.

Agriculture: The district is a food deficit area mainly because of using ineffective technology over low acreage. The main food crops are maize and beans.

Livelihoods: Fishing is an important activity within Malindi District, supporting a significant number of families, especially at Malindi, Ngomeni, Watamu and Mayungu.

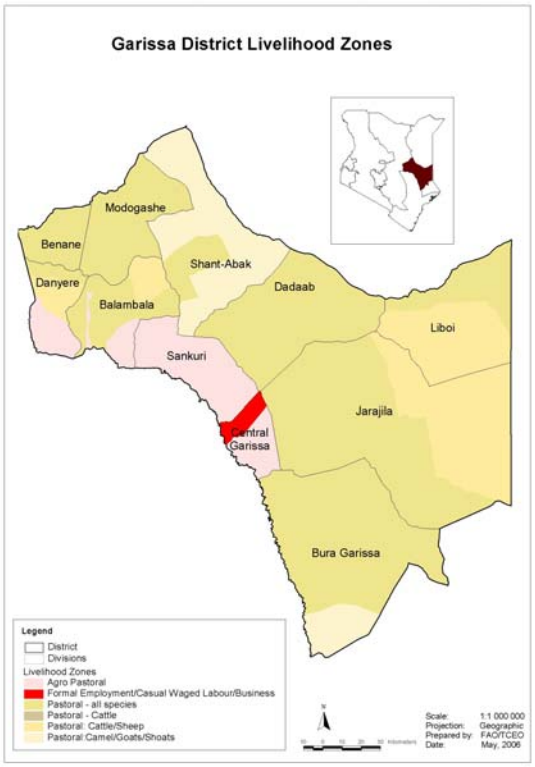
Table 4. Livelihood zones of Malindi District by division and population distribution

Livelihood zones	Divisions covered	Population	% population
Mixed farming	Magarini, Malindi, Marafa	145,841	52
Formal employment/business/trade	Malindi	65,365	23
Casual wage labour	Magarini	30,956	11
Forest/tourism	Malindi	16,413	6
Fisheries	Magarini	15,812	6
Livestock farming	Malindi, Marafa	7,165	2
Total		281,552	100

GARISSA DISTRICT

Position and size: Garissa, another of the arid districts, is in the North Eastern Province of Kenya covering an area of 34,389.7 km^2. The district is located between Tana River District to the west and Ijara District to the south at latitude 0º 58' North and 1º 30' South and longitudes 38º 34' East and 41º 05' West. Garissa is divided into 12 administrative divisions: Balambala, Benane, Bura, Central, Dadaab, Danyere, Jarajila, Liboi, Modogashe, Sankuri and Shant Abaq, with the headquarters at Garissa town.

Physical and natural conditions



Climate: The district is generally dry and hot most of the year. Temperature ranges from 20ºC to 38ºC. The district has bimodal type of rainfall, the long rains (March–April) and the short rains (October–December). The average annual rainfall is 320 mm.

Topography: Garissa is low lying with altitudes ranging between 70 and 400 m above sea level. The River Tana, which runs along the western boundary of the district, is the only permanent river. The soils range from the sandstone, dark clays in some patches, to alluvial (white and red sand) soils along the Tana River basin. The white and red sand soils are found in Balambala Division where the terrain is relatively uneven and well drained. The soils hold no water but support vegetation which remains green long after the rains. These soils have potential for farming. The rest of the district has sandy soils that support scattered shrubs and grassland. The alluvial soils occur along the shores of Tana River and along the lagha valleys. The soils are very fertile and can support increased agricultural production using irrigation.

The district has a lot of ground water potential along the Merti aquifer stretching from Shant Abaq Division to Jarajila Division. Along the aquifer, the water is fresh but some parts of Jarajila have saline water. The northern and central parts of the district have no underground water potential and therefore cannot support human habitation during the dry periods.

The vegetation in the area has been utilized for firewood leaving the area vulnerable to wind erosion, which may lead to desertification in the near future.

Population: Garissa has a population of 392,510, in addition to an outstanding 130,000 refugees, mainly from neighbouring Somalia. The district has a density of 9 persons per km^2 ranging from 2 persons per km^2 in Bura Division to 82 persons per km^2 in Central

Division. Poverty levels are very high in Garissa District, with 68% of the population living in absolute poverty. With a literacy level of 20%, the district has one of the lowest literacy levels in the country.

Settlement patterns: The district population is concentrated in small pockets surrounding water points and market centres. These are areas where basic services like hospitals, schools, health facilities and commercial activities are found. Population clusters also coincide with the location or sub-location headquarters. The major towns also attract large populations, especially Garissa town, which accounts for 20% of the district population. Dadaab and Jarajila divisions accommodate refugees in three camps, forming a temporary settlement within a radius of 13 km from Dadaab market. This population, which is 35% of the district total, has a negative impact on the environment and resources available in the vicinity.

Though it is not confined within the district's boundaries, the Tana River has a tremendous influence over the climate, settlement patterns and economic activities within the district, as it forms the single most important source of water for the fast growing Garissa town and the surrounding areas.

The rest of the population are nomadic and shift with their livestock in search for water and pasture.

Livelihoods: The main source of livelihood in the district is nomadic pastoralism; in addition there are over 130,000 refugees in the district. This exerts a high utilization pressure on the natural resources in the district, so strict environmental conservation measures must be applied for sustainable use of the natural resources especially in the eastern divisions of Liboi, Jarajila and Dadaab. The environment is fragile given the low vegetation cover; this calls for judicial use of natural resources to avoid desertification.

Table 5. Livelihood zones in Garissa District by division and population distribution

Livelihood zone	Divisions covered	Population	% population
Pastoral: All species	Balambala, Benane, Bura-Garissa, Dadaab, Jarajila, Liboi, Modogashe, Shant Abaq	165,519	50
Formal employment/casual wage labour/business	Central Garissa	65,678	20
Pastoral: Cattle/sheep	Balambala, Danyere, Jarajila, Liboi	54,845	17
Agropastoral	Balambala, Central Garissa, Danyere, Sankuri	30,477	9
Pastoral: Camel/sheep/shoats	Bura-Garissa, Shant Abaq	13,349	4
Total		329,868	100

Appendix II: Ivory Consult (water development agency)

About Ivory Consult

Ivory Consult Ltd. is a Kenyan company established in June 2005. Headquartered in Nairobi, Kenya, we at Ivory Consult have a vision which is briefly stated as *a better world for more of the world*. To this end, we have our core values which under gird all that we do: 1) the dignity and equality of every person no matter their race, sex, religion or economic and social status; 2) the right of every individual to achieve a sustainable livelihood; and 3) the importance of meaningful work as one critical means to dignity and sustainable livelihoods.

To serve its vision, Ivory Consult has two main arms: a service provider department and a consultancy department.

Service Provider Department

The core competencies of this department are:

1. We are a one-stop shop that designs, constructs, manages and supports water distribution systems in rural and urban areas.
2. We are a one-stop shop that designs, installs and provides post-installation services for water treatment systems for our residential, industrial, hospitality, public, rural and municipal clients.
3. We test the quality of drinking water using our own state-of-the art laboratory and we design solutions based on these tests.
4. We design, fabricate and install pyrolitic incinerators for public and private institutions that handle hazardous waste.
5. We collect and dispose of hazardous waste using our own incinerator plant (the latter two competencies are implemented with our sister company, Ivory Hygiene and Environmental Services Ltd.)

Consultancy Department

The core competencies of this department are:

1. We facilitate a participatory community capacity building process to achieve professional, legal, and thus, sustainable project management of community initiated solutions. Each community capacity building plan is custom designed based on an Appreciative Inquiry (AI) into the community's existing resources (that is, their land, time, past achievements, finances, institutions and ideas). Each community capacity building plan is sealed in a Memorandum of Understanding between Ivory Consult and the community. Implementation of the capacity building plan culminates in a sustainable business model under which the community steers its own development based on local priorities and realities.
2. We perform environmental impact assessments and environmental audits (Ivory Consult is registered with the National Environmental Management Authority (NEMA) as a firm of experts).
3. We conduct water audits and energy audits, and we design waste minimization programmes.
4. We design and broker carbon demand mechanism (CDM) projects.

5. We coordinate and provide training in ongoing programmes to raise the standards of leadership approaches:
    - The role and impact of religion in society
    - The management of sustainability (a conflict resolution process using a mutual gains approach)
6. We undertake research in sustainable rural land use:
    - Ethno-botanical, agricultural, forestry, animal husbandry and socio-economic considerations for sustainable economic gains
    - Land rights, land tenure, tree tenure and land use policies

A major component of our company is our corporate social responsibility, and we are active in:

- Education and educational bursaries
- National environmental policy development
- Youth mentoring
- Research and scholarship

PARTNERSHIPS

To provide effective one-stop rural and urban water distribution and treatment solutions and uphold high environmental standards, we have entered into strategic partnerships with the following organizations:

- EcoSecurities Ltd., UK
- Huisken Family Foundation, USA
- Abbey North Foundation, Canada
- Sustainability Challenge Foundation (SCF), Netherlands
- Africa Roundtable for Sustainable Consumption and Production (ARSCP), UNEP
- National Environmental Management Authority (NEMA), Kenya
- Timothy Institute (TI) of Calvin Seminary, USA

EXAMPLE PROJECTS

Ivory Consult has been involved in the provision of services for institutional support of water projects as outlined hereunder. We are therefore in a position to support water services providers (WSPs) and rural communities within the areas of participatory planning, design, construction, and pre and post implementation capacity building for technical, management, legal and governance aspects in the provision of water and sanitation supply.

Kisayani Christian Community Development Programme—Water Project

Location:	Kibwezi Division, Makueni District, Eastern Province
Cost of Project:	KSh 105 million
Beneficiaries:	12,000 people (current)
Capacity:	1332.00 m^3 per day; 70 km of pipe line; 15 selling points (kiosks)
Duration:	5 years (participatory planning began in the year 2000)
Funding Source:	Huisken Family Foundation (USA)

Since March 2006, Ivory Consult has been involved in the provision of institutional support to the water project of Kisayani Christian Community Development Programme (KCCDP) in Kibwezi Division, Makueni District, Eastern Province. This programme was established in 1992 to alleviate poverty and subsequently improve living standards of the members through the provision of constant provision of safe water, food, health facilities and involvement of its members in a micro-enterprise project.

As part of the water project, Ivory Consult has been responsible for the provision of:

1. Planning with the community leadership:
    a. Memorandum of Understanding between Ivory Consult and KCCDP
    b. Appreciative Inquiry into the social, cultural and technical dimensions of the water project
    c. Participatory planning and reviewing of action plans
2. Training and capacity building of the community leadership on operation and maintenance of the water supply using business principles in the following areas:
    a. Water project management
    b. Water project governance, inclusive of gender balance
    c. Water project legal framework and development of by-laws
    d. Water supply and maintenance—technical
    e. Accounting and financial auditing
    f. Business planning
    g. Marketing of farm produce
3. Technical assistance and technical personnel to address specific technical issues related to the water project, such as:
    a. Complete a technical audit of the water project
    b. Provide co-funding with the community through a partner trust for the completion of the water project that required:
        i. A new master water meter
        ii. A chlorine tester
        iii. Repair of storage tanks, man hole covers, sluice valves
        iv. A motorcycle
4. Monitoring and evaluation of the water project through financial, management, technical and environmental audits.
5. Capacity building in cross-cutting issues for the purpose of economic development using the sales from the water project.
6. Liaison between and advisor to the KCCDP and the Huisken Family Foundation.

Chumvi Community Water Supply Project

Location: Central Division, Laikipia District, Rift Valley Province
Cost of Programme: KSh 20 million
Beneficiaries: 17,000 people (current)
Capacity: 330 m^3 per day; 18 km of pipeline; 8 selling points (kiosks)
Duration: 3 years, starting 2007
Funding Source: Abbey North Foundation (Canada)

The Chumvi Community Water Project is located in Ethi Sub-location of Daiga Location, Central Division of Laikipia District. This is a gravity water supply project that has its source at a spring located at Thagishi near Timau Township. The spring supply is shared out among all members of the Water User Association. It requires extension into the community. Chumvi is a trading centre with a community who are primarily livestock farmers, with a few people practising subsistence farming. Since 2006, Abbey North Foundation has been working with the wider Chumvi community to reduce the HIV infection prevalence.

Ivory Consult has been involved in this water project since December 2006 on the following basis:

1. Liaison between and advisor to the community and the Abbey North Foundation.
2. Appreciative Inquiry into the social, cultural and technical dimensions of the project.
3. Provision of technical experts to provide civil/electromechanical services.
4. Detailed design, costing and construction of the water distribution system.
5. Participatory planning and design of a comprehensive capacity building programme including gender balance.
6. Environmental impact assessment.
7. Mobilizing and building capacity in the legal institutional framework for the water and other economic projects in the area to ensure sustainable, community driven, development based on local priorities and available markets opportunities.

CONCLUSION

Ivory Consult hereby is emphasizes its ability to provide the following services:

1. Training and capacity building of communities on operation and maintenance of water supply and sanitation facilities.
2. Building capacity for the management, governance and service delivery by water service providers and rural communities.
3. Monitoring performance of the delivery of services of the water supply and sanitation facilities.
4. Support of the communities in preparation of simple and actionable operational and business plans relating to their water supply and sanitation facilities.
5. Technical assistance and technical personnel in the provision of civil/electromechanical services.
6. Preparation of feasibility studies and detailed designs.
7. Implementation of water supply and sanitation projects.
8. Carry out participatory monitoring and evaluations.
9. Carry out financial and technical audits.
10. Support community water projects to be appointed as WSPs.
11. Provide procurement support services and training to WSPs and communities in line with the new procurement Act 2005.
12. Training and capacity building on information technology, corporate governance, communication and public relations and financial management.
13. Provision of human resource services such as recruitment, training needs assessment and development of human resource systems and procedures.

14. Support WSPs and the community projects in the registration as legal entities and developing their by-laws.
15. Training and capacity building in customer service.
16. Training and capacity building in cross-cutting issues such as HIV/AIDS, gender, and economic development.
17. Provision of environmental impact assessments, environmental audits and hydro-geological surveys services.

Appendix III: Terra Nuova (livelihood development NGO)

About Terra Nuova

Terra Nuova is an international non-governmental organization. Founded in 1969 and headquartered in Italy, Terra Nuova focuses on promoting equitable and sustainable socio-economic development in many African and Latin America countries. Our decentralised regional operations in Mali, Kenya, Peru and Nicaragua are run by highly skilled and locally integrated staff. There are also project hubs in numerous field locations. Our engagement is characterised by a direct knowledge of the local context and the participation of local communities in the planning and implementation of projects designed to address their needs and priorities.

To carry out our work effectively, Terra Nuova works in partnership with pastoralists, smallholder farmers, entrepreneurs in the urban and rural informal sector, and local communities to improve their socio-economic status and understanding of domestic, regional and global dynamics. To do so sustainably, we promote the participation of partner groups in those local, national and global development initiatives that deal with the sustainable management of public goods, resources and the environment.

Terra Nuova Eastern Africa

From our regional office in Kenya we have been operational in the Eastern and Southern Africa region (Somalia, Uganda, Tanzania and Mozambique) since the early 1980s and registered in Kenya since 1993. Over this period, we have developed partnerships and initiatives with local institutions and communities with the aim of accelerating long-term socio-economic growth.

In Somalia, interventions over the last 15 years have focussed on:

- Support to the livestock sector by means of: vaccination campaigns targeting the main infectious diseases; institutional strengthening and capacity building for the promotion of local veterinary services; itinerant training and higher education for a new generation of Somali livestock-related professionals.

In Kenya, interventions have focussed on:

- Promotion of the local informal economy through product design and improvement of manufacturing, management and marketing techniques.
- Sustainable agriculture and management of natural resources through the diversification of rural production, institutional building and strengthening of social networks.
- Community based environmental protection compatible with the socio-economic development of local communities.

Terra Nuova in KACCAL related-areas

In the related Kenya Adaptation to Climate Change in Arid Lands (KACCAL) area, Terra Nuova implemented two significant projects: The Trans-boundary Environmental Project, and the Rural Development and Support for Pastoral Communities in the arid Turkana zone project.

The Trans-boundary Environmental Project (TEP)

The Trans-Boundary Environmental Project (TEP), funded by the European Commission from June 2003 to September 2007 addressed the conservation of natural resources and sustainable development in the pastoral semi-arid region on the border between Kenya and Somalia. The project was carried out in partnership with ALRMP. The project area includes the Kenyan districts of Garissa, Ijara and Lamu, and the Somali districts of Afmadow, Badhade and Kismaayo. Together with seasonal wells the rivers represent an excellent resource of water for livestock and wild animal grazing.

With the overall objective of poverty alleviation of marginalised pastoral communities in arid and semi-arid areas, TEP worked in partnership with local authorities and institutions, to help develop plans for participatory programmes to maintain natural resources at both institutional and community level. Improving the management of the environment and its natural resources allows sustainable economic development for present and future generations. Raising awareness about conservation, the management of natural resources and the environment is crucial at community level, and a community based approach was thus adopted. The focus was on locally perceived issues, building on existing traditional ways. TEP encouraged the involvement of all stakeholders, promoting local ownership. Its vision was to plan realistic and practical actions, within long-term processes going beyond the lifespan of the project.

The objectives of the project were:

- to collect, analyse and disseminate environmental and socio-economic information
- to raise awareness of environmental issues amongst local communities and strengthen their environmental skills and responsibility
- to develop the community's abilities, in particular concentrating on sustainable micro-projects as alternative resources of income
- to set up agreements and regional plans for the conservation and management of the natural resources

TEP's main outcomes included eight income generating activities. In Garissa: bee keeping projects in Amuma and in Bura, and a plastic recycling project in Liboi; in Ijara: bee keeping projects in Hulugo and in Bodhai, and a community water project in Sangailu; and in Lamu: bee keeping projects in Basuba and in Mangai. The hardware and specific trainings were delivered to the local communities, with monitoring, technical support and capacity building and marketing support required as follow up.

A geographic information system (GIS) database for NRM was developed in Garissa, Ijara and Lamu districts, with considerable data collected and inserted. Capacity building for local government representatives and other agencies was done to create awareness on the use and potential of GIS. GIS equipment was handed over, with future plans being to establish a GIS office in each of the three districts, and upgrading officials (drought management officers and data analysts) with specific courses on GIS.

Rural development and support for pastoral communities in the arid Turkana zone

The Turkana Pastoral Project started in October 2002, funded mainly by the Italian Government and AMREF Italy with additional components funded by the Region of Lombardy, the Cariplo Foundation, VSF Germany, ALRMP and AMREF Netherlands. The project was managed by Terra Nuova in conjunction with AMREF Kenya.

The project represents a crucial intervention into the interaction between human health, animal health and the management of productive and natural resources. The core of the project was the construction of an abattoir (meat processing plant) for the community with the aim of creating a cash economy, mitigating the effects of drought and reducing cattle rustling. The abattoir is designed to become a successful enterprise, fully operative and able to be used as a model to be emulated by other communities in similar environments. To give the Turkana people a real opportunity to participate in the management of the abattoir business a cooperative has been formed with more than 1500 pastoralist families holding shares to date. To further guarantee sustainability, Terra Nuova, AMREF Kenya and AMREF Italy will create a non-profit company limited by guarantee to act as the oversight body, with all income reinvested into the business.

Together, the company and cooperative will establish the managerial framework to ensure the abattoir's profitably, and to build capacity among the cooperative members as it gradually buys further into the business and community development projects. As part of a participatory approach the nomadic communities will be actively involved in discussions and planning regarding all the aspects of the enterprise.

The main objective of the project is to reduce the current dependency of the local population on food aid and emergency intervention over the next 15 years, thanks to the sustainable integration of the pastoralist communities into the meat sales networks in the Karamojong Cluster region (composed of bordering areas of Kenya, Uganda, Sudan and Ethiopia) and to provide families with the financial resources necessary to support health, education and further economic development.

Appendix IV: NGARA —development of dryland commodities

A. About NGARA

The Network for Natural Gums and Resins in Africa (NGARA) was established in May 2000 with a goal of assisting 14 African gums and resins producing countries and partners to formulate a coordinated strategy for the sustainable development of gums and resins resources to improve rural livelihoods and environmental conservation. NGARA is an organization that brings together members from varied fields, including farmers/collectors, traders, governments, NGOs, exporters and importers who have a common desire to improve the production and quality of locally produced gums and resins for national, regional and international markets. The mission of NGARA mission is to position African producer countries and partners as major global players in the production, processing and marketing of gums and resins.

Since inception, NGARA's Secretariat has been hosted in Kenya by KEFRI, which is also the national focal point for the network. Projects coordinated by NGARA have focused on the ASALs in the member countries and have been implemented in the framework of KEFRI/NGARA programme in Kenya.

Some of the main contributions of the KEFRI/NGARA programme in the ASALS are:

1. Implementation of FAO funded projects

Since 2004, FAO has been supporting two projects that have been implemented within the framework of NGARA. These projects are:

1.1 Strengthening the production and quality control of gums and resins in Africa: This project is funded by the Technical Co-operation Programme of FAO and is currently being implemented in the 14 NGARA member countries. The purpose of the project was to improve the capacity of these countries to coordinate their production and marketing activities to leverage improved returns from their export of gums and resins.

1.2 Acacia operation project (AOP)

This is a regional pilot project, funded by Italian Cooperation through FAO and implemented in six African countries. The six countries are: Burkina Faso, Chad, Kenya, Niger, Senegal and Sudan. In Kenya, KEFRI/NGARA is the lead institution and key partners include: KARI, Kenya Forest Service (KFS), Arid lands Resources Ltd and local communities represented by project management committees. The purpose of this project is to improve food security, alleviate poverty and fight soil degradation and desertification in these countries.

One of the outputs of the project is the development of agro-silvo-pastoral systems in ASALs and improved propagation of gum and resins producing trees through a mechanized water harvesting technology (The 'Vallerani' System). Although the technology is relatively new in Kenya, and is already showing great potential, it has been successfully implemented in the Sahelian countries to rehabilitate degraded areas and to improve land productivity.

An important innovation of the Vallerani System is that it uses specialized tractors to develop micro-water catchments that allow for the production of staples and other agricultural crops in the ASALs. The Vallerani System is used by the AOP to create intercropping systems by which acacia seedlings are interspaced with traditional food crops. This increases the returns and incentive to growing Acacia whose long maturation length of 5 years may otherwise serve to discourage its adoption. Interestingly, food crops that are grown under the Vallerani System have been shown to be more productive than those without it within the same agro-ecological and biophysical zone.

Five districts (Garissa, Marsabit, Turkana, Samburu and Kibwezi) were selected by the project steering committee for pilot project activities in Kenya. However, the pilot phase activities concentrated only in Marsabit, Samburu and Kibwezi districts due to logistics. The pilot phase ended in December 2006; an evaluation, consolidation and up scaling preparation phase has been prepared and approved for 10 months before moving into a 10-year programme.

The key achievements for Kenyan components of the two projects:

- Biophysical and socio-economic benchmarking for the project sites have been carried out.
- About 300 ha of land have been ploughed and planted with *Acacia senegal*, other dryland trees and agricultural crops; performance has been variable depending on site and has been largely classified as fair to good. Lessons learned show that incorporating certain management technologies improves performance substantially.
- In Kibwezi, the mechanized water harvesting system gave statistically significantly higher maize grain yields (2073 kg/ha) than the traditional oxen ploughing system did (1322 kg/ha)
- Enhanced appreciation by local communities for environmental conservation and management and crop farming. A number of individual community members and CBOs have embraced the project and established their own nurseries and small agroforestry farms. Establishment of producer associations has helped local communities start various nature based enterprises. Producer associations have been established in Mandera, Garissa, Wajir, Ijara, Samburu, Marsabit and Turkana districts.
- New partnerships have been established and existing ones strengthened through the project. New partnerships include; Food for the Hungry International (FHI), Ewaso Ng'iro North Development Authority (ENNDA), WFP and Kenya Red Cross (KRC). Through partnerships, it has been possible to initiate and nurture synergy with other projects in the pilot areas. Some of the projects being: Desert Margins Project, Boswelia Project, ALRMP, Lake Turkana Community Development Project , Ewaso Ng'iro North Environment Conservation Project and Food for Asset Creation.
- Soil, gum arabic and DNA samples have been collected from four sites and are being analysed for improving quality of gum arabic in the country.

- Experimental plots have been established and geo-referenced for monitoring of sites.
- Two checklists with local and botanical names of local species have been produced.
- A total of 1046 people have been trained in various aspects of conservation, farming and utilization of various crops as food.
- A map showing coverage of gums and resin tree resources in Kenya has been produced for improved targeting (see Figure A1).

2. Development and implementation of EU INCODEV funded programme

The KEFRI/NGARA programme participated in the development the project, 'Innovative management of *Acacia senegal* trees to improve resource productivity and gum arabic production in arid and semi-arid sub-Saharan Africa'. This project which is funded by EU-INCODEV is under the overall coordination of CIRAD Forêt of France. Participating countries are Cameroon, Kenya, Niger and Senegal. The project is being implemented in the framework of NGARA whose role is to lead the work package on information dissemination

3. Ewaso Ng'iro North Environment Conservation Project

Collaboration is ongoing with ENNDA in the framework of KEFRI-ENNDA Memorandum of Understanding and training on production, processing and marketing of gums and resins is being provided for trainer of trainers (ToTs) from nine ASAL districts (Marsabit, Samburu, Isiolo, Laikipia, Meru North, Moyale, Wajir, Garissa and Mandera). The ToTs are in turn to train producers and collectors at the community level under the supervision of KEFRI/NGARA programme. The programme will also help ENNDA organize for international study tours to Ethiopia and Sudan for the trainees.

4. World Food Programme's Food for Asset (FFA) Project

A three year FFA project is being developed by WFP and partners. The KEFRI/NGARA programme has been identified as a key player in this initiative with WFP to support the communities in ASALs through the Food for Assets Programme. Piloting of this initiative is ongoing using communities living at AOP sites.

B. Participation of KEFRI/NGARA programme in the KACCAL initiative

From the aforesaid, KEFRI/NGARA programme has a wealth of experience in working in a collaborative framework in the drylands of Kenya. There are also a lot of useful lessons that have been learnt from the projects already implemented in these areas which could be useful in scaling up the activities in other districts. The KEFRI/NGARA programme also has experience, capacity and infrastructure to mobilize, appraise and train local communities. The programme therefore can offer significant contributions to enhancing adaptation options of local communities in the five pilot districts to climate change for improved livelihoods and environmental conservation. To realize this objective the following three activities have been proposed:

i. Selection and rehabilitation of degraded lands using appropriate methods and technologies in collaboration with the communities and other key partners and projects.
ii. Supporting local community initiatives for increasing productivity, value addition, marketing and trade opportunities.
iii. Strengthening the capacity of key partner institutions/projects and producers to effectively improve land rehabilitation, productivity and livelihoods in the pilot sites.

C. Activities and budget estimate

Activity	**District**	**Package**	**Other partners**	**Budget US$**
1. Rehabilitation of degraded sites and production of dryland commodities	Mwingi	Establishment of *Acacia senegal*, *J. curcus* and aloe plantations integrated with crop/fodder	KARI, KFS	450,000
	Malindi	Establishment of *A. indica* (neem), *J. curcus* and aloe plantations integrated with crop/fodder	KFS, KARI,	
	Garissa	Establishment of *Acacia senegal*, J. *curcus* and aloe plantations integrated with crop/fodder	Millennium Village	
	Marsabit	Establishment of *Acacia senegal*, *J. curcus* and aloe plantations integrated with crop/fodder	KARI, WFP, KFS	
2. Improvement of trade and marketing of gums and resins and other dryland commodities	Marsabit, Garissa, Malindi, Mwingi and Turkana	• Establishment of market infrastructure and marketing information system • Mapping the trade chain. • Establishment and strengthening of community institutions • Development of databases	KFS, KARI	250,000
3. Training and capacity building for local communities and partners	Marsabit, Garissa, Malindi, Mwingi and Turkana	• Training of ToTs in production, processing , quality control and marketing of commodities • Training of local communities by ToTs • Exchange visits and study tours (local and international)	KFS, KARI	100,000

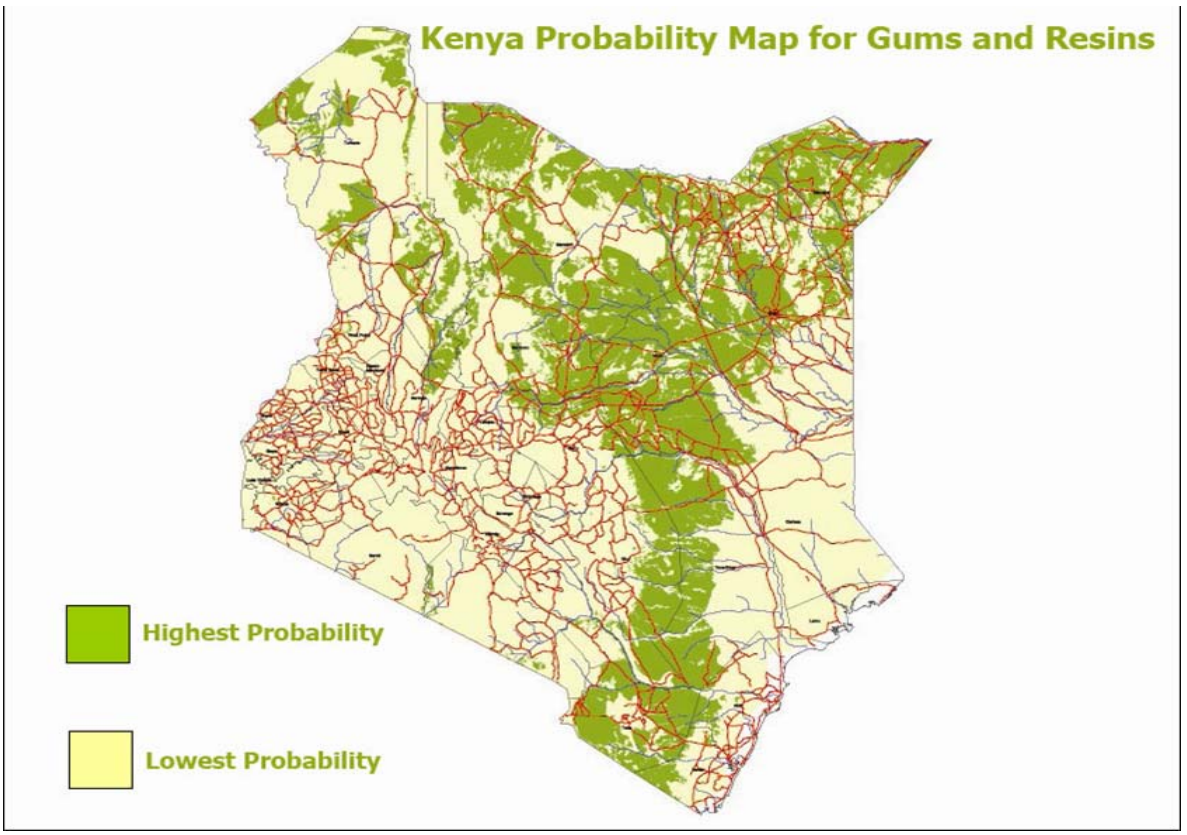


Figure A1. Coverage of gums and resin tree resources in Kenya.

Appendix V: Directory of contacts

Key informants

	Name	District	Organization and/position of responsibility	Contacts
1	Geoffrey Kaituko Mark Ekai Lokiato	Turkana	DMO ALRMP	ALRMP Offices, Lodwar
2	Jeremiah Rodgers Kiruaye	Turkana	DOW Ministry of Water	DOW Ministry of Water
3	Vincent Morara (crop) Paul Njuguna (extension)	Turkana	DOA Department of Agriculture	Tel: 054-21420 Email: daoturkana@yahoo.com
4	Wilfred Wafula	Turkana	Animal Production Officer	
5	Bishop Joseph Patrick Harrington	Turkana	Catholic Diocese of Lodwar	Diocese of Lodwar P.O. Box 101 Lodwar. Kenya
6	Bashir Abdulahi	Garissa	DAO District Agricultural Officer	c/o Provincial Director of Agriculture, PO Box 34, Garissa
7	Abdi Mohamed Ali	Garissa	Deputy Livestock Production Officer	
8	Ahmed Hassan Ali	Garissa	Transboundary Environmental Project	Tel: 0722-288 241/046-2336
9	Yassin Farah	Garissa	ALRMP- DMO	
10	Abdi Noor	Garissa	Garissa Regional Manager Red Cross	
11	Mwangangi Bernard	Malindi	DAO Deputy District Agricultural	Tel: 0727-037680

			Officer	
12	Monica Kasichana	Malindi	Catholic Diocese	Tel: 042-30767 PO Box 1573, Malindi
13	Mukuria	Malindi	DOL District Animal Production Officer	Telephone: 042 20505 0733 312 772
14	Prof Ali Shaibu Shekue	Malindi	Chairman, Kenya Coast Fishers	PO Box 1627, Malindi
15	Mr Wafula	Malindi	Deputy Fisheries Officer	Tel: 0727-502760
16	Did Boru	Marsabit	ALRMP Support to Livestock Development Officer (SLDO)	ALRMP Support to Livestock Development Officer (SLDO)
17	Nathaniel B. Boriaya Mr Loboyo Mr Hussein Wario	Marsabit Marsabit	DOW District Water Coordinator Deputy District Water Water Resource Management Coordinator	DOW District Water Coordinator Deputy District Water Water Resource Management Coordinator
18	Forole Jarso	Marsabit	Red Cross Branch Coordinator	Red Cross Branch Coordinator
19	Mr Mbuvi	Marsabit	FFH Food for the Hungry International	FFH Food for the Hungry International
20	Simon Waweru	Marsabit	DAO Ministry of Agriculture (Environment)	DAO Ministry of Agriculture (Environment)

Partner Organizations

	Name	Nature of work	Contacts
1	CB-LEWS	Community based livestock early warning via contingency planning and capacity building	Joseph Matere PO Box 30709, 00100 Nairobi Kenya
2	GL-CRSP LINKS	Livestock marketing and information systems	Gatarwa Kariuki Joseph Ndungu

			PO Box 30709, 00100 Nairobi Kenya
3	Ivory Consult	Sustainable environmental management consultants specializing in water management	Clive, W. Wafukho Anja Oussoren Buwalda Tel: +254-20-550 631 +254-20-550 622 +254-20-550 930 P. J. Place, Enterprise Road Industrial Area PO Box 76604 00508 Nairobi Email: inquiries@ivoryconsult.com
4	KACE	Provide market information on agricultural commodities	James Kundu Tel: +254-20 444 1829 +254-20 444 8485 Brick Court Building 2nd Upper Floor Mpaka Road Westlands PO Box 59142 00200 Nairobi Kenya. Email: kace@kacekenya.com
5	NGARA	Carry out initiatives on the processing and marketing of gums and resins as means of improving local community livelihoods	Sheila Mbiru PO Box 64636-00620 Mobil Plaza Nairobi Kenya Tel: +254-20 2020623

6	Terra Nuova	Italian NGO that works closes with the Kenya Government, University of Nairobi, East African Wildlife Society, and numerous communities in Eastern Africa. Expertise includes Natural Resource Management, Micro-enterprise development, ecotourism.	Lucy Wood Tel: +254 20 4445511 +254 20 4445512 PO Box 74916 00200 Nairobi Kenya Email: lucy.wood@tnea.or.ke

Kenya

Email:

6	Terra Nuova	Italian NGO that works closes with the Kenya Government, University of Nairobi, East African Wildlife Society, and numerous communities in Eastern Africa. Expertise includes Natural Resource Management, Micro-enterprise development, ecotourism.	Lucy Wood Tel: +254 20 4445511 +254 20 4445512 PO Box 74916 00200 Nairobi Kenya Email: lucy.wood@tnea.or.ke

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