ASSESSMENT OF THE IMPACTS OF THE DROUGHT RESPONSE PROGRAM IN THE PROVISION OF EMERGENCY LIVESTOCK AND WATER INTERVENTIONS IN PRESERVING PASTORAL LIVELIHOODS IN NORTHERN KENYA

Program implemented by Consortium of NGOs (COOPI, VSF-SUISSE, VSF-BELGIUM & TERRA-NUOVA) and Funded by ECHO of the EU

Report of an ILRI Multidisciplinary Scientific Team of Consultants Assessing the Emergency Drought Response Project in Northern Kenya

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EXECUTIVE SUMMARY

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In conjunction with the International Livestock Research Institute (ILRI), a consortium of international NGOs mooted the emergency Drought Response Program (DRP) to instigate coordinated water and livestock interventions in Northern Kenya aimed at salvaging human livelihoods during prolonged droughts of 2004/2005. With COOPI as the lead partner, four NGOs consisting of COOPI itself, VSF-Suisse, VSF-Belgium and Terra-Nuova, and ILRI came together and submitted a well documented project proposal (ECHO, 2003), to the European Commission's Humanitarian Aid Office (ECHO), to support emergency drought interventions in nine arid districts spanning three administrative provinces in Northern Kenya, namely; Turkana and Samburu districts in Rift Valley Province, Marsabit, Moyale and Isiolo in Eastern Province, and Mandera, Wajir, Garissa and Ijara in North Eastern Province.

The emergency response program had 2 major components, a veterinary intervention and a water intervention. The main element of the veterinary intervention was a mass treatment and vaccination campaign that reached about 3 million animals or a third of the total livestock population. This veterinary action was relatively evenly spread over the nine project districts, covering 75% of the locations and reaching more than a third of the pastoralist households. A smaller portion of the veterinary intervention was delivered through Community Animal Health Workers. Training, drugs and equipment was provided to them and used for a smaller number of targeted treatments. On the other hand, the water component of the programme undertook the rehabilitation of 36 water sources; increasing water availability by 617,400 litres/day, thereby improving the livelihoods of 15,000 pastoralist households.

A small portion of the overall project money was dedicated to the assessment of the likely impacts of the emergency interventions. ILRI staff, and associated consultants, undertook research in five key areas, namely; drought coping strategies, water and environment, epidemiology, spatial and economic analysis. Two broad research approaches were utilised. First, as it was only possible to generate one-off field-level data during the actual livestock and water intervention process, both the drought coping strategies and epidemiology research components focused on both perceived and projected impacts respectively. Second, the water and environment, spatial and economic research components focused on an assessment of the efficiency and effectiveness of the livestock and water interventions.

The following sections present the key findings in these five areas. More detailed descriptions of methodologies used and results achieved can be found in the separate chapters. It is important that the findings in the technical areas be interpreted within the context of an emergency response program, as opposed to a development project.

(a) Drought coping strategies:

Interviews with 160 pastoralist households in the nine districts, 155 of which benefited from the project, yielded significant insights into both the field-level context of the veterinary intervention and, based on the pastoralists' past experiences of drought and drought-initiated interventions, an enhanced understanding of the appropriateness of the veterinary component of the intervention, and its likely impact on pastoralists' drought coping mechanisms and short-term livelihoods. This research component had two specific objectives. These were, with specific reference to the poorest households, determine whether or not the project's activities were likely to: 1) Enhance the robustness of current drought coping strategies/mechanisms, and; 2) Decrease pastoralists' vulnerability to future drought-related shocks. The component is broken down into nine sections: 1) Key livelihood challenges faced by pastoralists in the study areas; 2) Major problems encountered during drought; 3) Traditional drought coping strategies; 4) Current drought preparation; 5) Key livelihood interventions; 6) Key livestock interventions; 7) Expected short-term impacts of veterinary interventions; 8) Expected livelihoods impacts of veterinary interventions, and; 9) District-level summaries and recommendations for future drought interventions

Given the prevailing conditions during the project's implementation, it is not surprising that drought and diseases (both human and livestock) were the key livelihood challenges faced by pastoralists across the nine districts. In order of importance, other key livelihoods challenges include: raids and general insecurity; lack of permanent water near by; lack of livestock markets and poor prices, and; livestock predation. It must be noted that, the importance of these livelihood challenges varied considerably between districts. In order of importance, major problems encountered during drought include: lack of food; lack of water; lack of pasture; increased livestock fatalities; increased occurrence of disease (both human and livestock); accessibility/availability of livestock markets and low livestock prices, and; the need to migrate to insecure areas. Again, the prioritisation of the above problems varied by district, and often by age and gender. Traditional drought preparation also tended to vary by district, gender and age. In order of importance, traditional drought mitigation strategies identified include: migrating to pasture and water; selling livestock to purchase food stuff; slaughtering animals and preserving the meat for future use, and; doing nothing or praying. Drought preparation at the time of the veterinary intervention, in order of importance, include: selling livestock to purchase food and water for human and animal consumption; doing nothing or praying; purchasing, conserving, and/or growing food and fodder for human and animal consumption, and; destocking. Drought preparation activities also tended to vary between districts, and by age and gender.

Once the context for intervention was set, pastoralists were asked to identify what they viewed as the most appropriate forms of livelihood interventions during times of drought. In order of importance, pastoralists identified a range of preferred interventions, including: food relief; livestock healthcare, and; water provision. In order of importance, pastoralists identified the following as key livestock interventions: animal healthcare; water provision; provision of livestock fodder, and; the assurance of access to markets

and fair livestock prices. Calls for the different types of livestock-based interventions also varied by district, age, and gender.

The expected short-term and livelihoods impacts of the veterinary intervention also varied by district, age, gender and health status. In order of importance, expected short-term impacts of the intervention were: improved animal health and condition; improved marketability and livestock prices; improved animal productivity; reduced livestock mortality, and; enhanced rate of reproduction/herd growth. In order of importance, expected livelihoods impacts of the intervention were: increased income due to improved livestock sales and better terms of trade; improved living standards due to improved livestock productivity, and; increased household income due to reduced expenditure on animal drugs.

Key conclusions to be drawn from this component of the research are as follows. First, with regard to whether or not the project's activities were likely to enhance the robustness of current drought coping strategies/mechanisms, the research findings suggest that both the veterinary and water interventions are supportive of current drought coping strategies of most of the households interviewed. The provision of livestock healthcare and strategic provision of water resources address key livelihoods challenges and major problems encountered during drought both directly and indirectly. The provision of livestock healthcare directly helps to redress livestock losses during both normal and drought conditions. The indirect benefits of livestock healthcare include; an enhanced capacity of livestock to trek further in search of water and pasture, as well as enabling livestock to trek to market and attain higher prices once they get their due to their healthier condition. Livestock healthcare and strategic water interventions are also in-line with what pastoralists deem as key livelihoods and livestock interventions. However, with regard to whether or not the project's activities will decrease pastoralists' vulnerability to future drought-related shocks, the intervention is likely to have mixed results. For example, the provision of strategic water resources will help to bolster the water component of pastoralists' drought coping strategies during both the current and, hopefully, future droughts. However, whilst the provision of livestock healthcare can greatly assist the drought coping and livelihoods strategies of pastoralists in the short to medium-term, unless it is part of an integrated system-based approach to enhancing pastoralists' drought coping strategies, the unilateral provision of livestock healthcare is unlikely to have a significant long-term impact.

Key recommendations from this component of the ILRI research are as follows. The success of emergency or development-focused interventions in pastoralist systems in drought prone areas depend on whether or not the intervention is part of an integrated multi-agency system-based approach. Future interventions should bolster existing drought coping strategies, and, where appropriate, endeavour to enhance them. Future interventions should seek to promote the development and institutionalisation of the market economy. Properly functioning livestock markets and the emergence of a more market oriented culture among pastoralist communities could serve to secure the livelihoods of many currently vulnerable pastoralists in the nine districts. Attention should also be turned to enhancing and broadening the general livelihood strategies of

pastoralists, particularly those with few livestock assets, whose livestock-based livelihood is often on the edge of total collapse during severed droughts. Lastly, whether or not interventions into pastoralists' systems are emergency or development-based, it is imperative that future interventions are guided by high quality systems-based research.

Finally, on a cautionary note, whilst the district-level summaries, and the data provided in this report, provide significant insights into the perceived appropriateness of the aforementioned project, it must be remembered that the general conclusions and recommendations drawn from this research are based on very small sample sizes, which can in no way be taken as fully representative of the districts in which the household surveys were conducted, and has been collected by individuals with little or no training in household survey techniques. Further research is required to validate the findings over time and space.

(b) Water and Environment:

During the project implementation period, several meetings took place between the ILRI's water and environment specialist and the COOPI hydrologists, geologists and engineers, during which the water facilities to be rehabilitated were identified. The selection criteria was meant to capture water sources used by large herds of livestock, those that yielded large quantities of water during very dry seasons, and those that were strategic spatially, and required some level of rehabilitation to be fully operational. The water and sanitation component was implemented in four districts; Samburu District in Rift Valley Province and Marsabit, Isiolo and Moyale Districts in Eastern Province. The water and sanitation improvement works reached 14 intervention sites at which 36 water sources were rehabilitated and/or constructed, surpassing the 20 originally targeted. Most of the rehabilitation works improved permanent water sources, which included nine boreholes and 22 shallow wells. During the intervention, three shallow wells and two sand dams were also constructed. These are; Lesirkan, Marti and Masikita boreholes in Samburu, Bulbisa and Bulgab boreholes and Khorr shallow wells in Marsabit, Rawana Dabel and Amballo boreholes in Moyale, and Mlango borehole, Daaba shallow wells and Longopito sand dams in Isiolo. Rehabilitation work varied in line with the specific problem being tackled at each water source. Problems ranged from the replacement of pipes, gensets, pumps, to the construction of new tank, well heads and housing, and the construction of animal drinking troughs and re-lining of well shafts. Overall, rehabilitation activities achieved a cumulative increase of **617,400** litres per day.

The impact on livelihoods was also assessed. At least 15,000 pastoralist households were reached through the activities in the water and sanitation sector, of which 450 households directly benefited from the construction of two sand dams. These activities specifically targeted women and children as it improved access to domestic water. Moreover, positive impacts on livestock communities were achieved, as the distances to water along migratory routes were reduced by 20% to 70%. However, the actual reduction in distances between water resources was highly dependent on site location, especially in Isiolo and Samburu Districts. The functionality of existing strategic water systems was improved by re-equipping the water sources with facilities such as construction of water storage tanks, increased number of troughs, specific distribution facilities for human and

animal consumption; thereby reducing the waiting times for livestock watering and improving hygienic and environmental conditions. There were no negative impacts on the environment due to the rehabilitation/construction of the water facilities. Overall, the rehabilitation of water facilities contributed to drought mitigation, livestock survival and improved livelihoods of pastoralists in the target districts.

(c) Epidemiology:

This emergency project was novel in that it dedicated a portion of its resources to impact assessment. In the view of the consultant, several lessons on impact assessment resulted from this undertaking. The current emphasis on logical framework approach to measuring impact detracts from projects ability to assess the evidential links between project interventions and positive changes on the ground. The assessment activity, which should be a tool for learning about how to create positive change, degenerates into a dubious exercise for proving project impact.

In this case the impact assessment revealed that the project was well targeted and implemented, but that a one time mass intervention strategy that focuses directly on saving animal lives has limited impact. Despite correct targeting, the reduction in annual mortality resulting from the project interventions was 1.8% when all interventions were considered as mass interventions. Of this, 1.07% resulted from the vaccination program and 0.73% from the treatment program.

When individual treatments with antibiotics or trypanocidal drugs delivered by community animal health workers were analyzed from the perspective of the increased benefit of targeting clinically ill animals, the overall impact of the project treatment program on the reduction of the population annual mortality rate was increased by 0.08% to 0.81%.

(d) Spatial analysis:

The veterinary intervention worked on more than three million animals of which about 1.8 million were treated and almost 2.7 million vaccinated. There were about 54,000 livestock owners who presented animals during the operation. In the assumption that a livestock owner represents only one household, about 17% of all households in the whole project area were reached.

Not all households in the project district pursue pastoralist livelihoods, however. The pastoralist population actually only accounts for between 70 and 85% of the total population. Therefore, the number of pastoralist households based on the percentages of the districts' population that are pastoralists was estimated. It was observed that 22% of all pastoralist households sent a representative to one of the interventions sites during the period of the project.

Livestock owners from 423 different sub locations were reached; this is 59% of the 714 sub locations in the project area. The sub location areas range from less than 1 km^2 to

more than 2000 km^2. Three quarters of the sub locations are smaller than 400 km^2. If administrative units of one level higher were considered, it was found that livestock owners of 75% of all locations presented animals during the drought response program. Livestock owners from 266 different locations were therefore reached, which is 71% of the locations in the project area.

Out of the 152 locations for which poverty figures exist, 90 have more than half of their population living below the poverty line. Interventions were thus carried out in 59 "poor" locations and in 49 "less poor" locations. Thereby reaching 12,464 livestock owners from 75 different "poor" locations, and 14,478 livestock owners from 49 different "less poor" locations.

(e) Economic analysis:

A key objective of the economic analysis is to illustrate general trends that may determine the relative returns to investments from alternative animal health intervention strategies in an emergency situation or in situations that are prone to emergencies. The insights generated provide broad guidelines for prioritizing animal health interventions in emergency situations on the basis of economic performance resulting from alternative investment strategies.

The method used for assessing the economics of animal heath interventions undertaken by the NGO consortium is based on a benefit-cost methodology that compares discounted costs and benefits using a discount factor for an 18 year period. The present value of the income streams generated from alternative animal health investment strategies are assessed under a "with" and "without" project scenario.
The first one refers to a situation where there are no animal health interventions, while the selected scenarios represent i) one animal health intervention during an emergency which correspond to the strategy implemented by COOPI, ii) targeted animal health interventions after every drought.

We used a deterministic bio-economic model to represent the dynamics of animal populations and changes in primary productivity in the economic analysis of animal health interventions for the conditions of Northern Kenya. The model comprises three sub-models: the primary productivity sub model provides an estimate of the carrying capacity of the system and changes in grass availability based on rainfall values obtained from satellite images. The herd sub model, relates the dynamics of four different species cattle, goats, sheep, and camel to i) the primary productivity of the system, ii) a set of population and market parameters collected from PRA in northern Kenya, complemented with experts' consultations and published information, and iii) the effect of animal health interventions, i.e. mortality reductions due to vaccinations and treatments provided by community animal health workers (CAHWS). Finally the economic sub model using field data and secondary sources i) quantifies in monetary terms the benefits of livestock production for each species considering the market sales, the production of milk and the consumption of animals within the household, ii) quantifies the costs of different

interventions per drought event and iii) develops a cost benefit analysis of the animal health interventions.

The results of simulate different scenarios for the nine districts of intervention considering a period of 18 years and a discount rate of 12% shows that for the one vaccination and treatment scenario, the net present value of the intervention is 4.8 million euros with a break even point occurring between year three and four. The results of repeated vaccination and treatment scenario show a net present value of 12.1 million euros with a break even point occurs between year three and four. Based on the estimated present value of income streams generated by these investments, the results suggest that vaccination and treatment are valid strategies to reduce negative impacts of droughts in the study area. The returns to investments in targeted animal health interventions following every drought are higher than the one time intervention in an 18 years period. However, in the context of an emergency intervention like the one implemented in Northern Kenya, investment in vaccination and treatment represents good money value since the return of the investment is positive for the overall level of mortality reduction achieved.

This report provides useful insights into emergency program interventions to enhance household livelihoods in a drought situation. The technical reports focussed on specific aspects of these interventions and their associated livelihoods impacts. This information is important to assess the livelihoods impacts of coordinated water and livestock interventions in the target areas. However, it is equally important to learn lessons from the study that could help development practitioners implement relevant and effective interventions in emergency situations. This includes lessons on how such interventions can be used to address chronic vulnerability and poverty in areas that are prone to emergency situations. An important next step is therefore to synthesize lessons learnt from the study to identify recommendations on best practices for future livestock interventions in emergency situations.

GENERAL INTRODUCTION

S. O. Nyamwaro, D. J. Watson, B. Mati, A. Notenbaert, J. Mariner, L.C. Rodriguez and A. Freeman

ILRI, in collaboration with the COOPI consortium (VSF-Suisse, VSF-Belgium and Terra nuova) and the Government of Kenya, implemented a project entitled "*to preserve pastoral livelihoods in Northern Kenya during emergency drought situations*". The Drought Response Program (DRP) was implemented in nine arid districts (Turkana, Samburu, Marsabit, Moyale, Isiolo, Mandera, Wajir, Garissa and Ijara) of Northern Kenya. The majority of districts covered by the project are poor, with constituency poverty incidences ranging from about 40% to 71%. The DRP was responding to the emergency needs of local communities, and their livestock, that were overwhelmed by the pro-longed droughts of 2004-2005. ECHO supported the project with full financial assistance. The preservation of livelihoods was achieved by implementing emergency livestock and water interventions, including; mass vaccination and disease treatment of livestock, and the rehabilitation of selected water facilities in four districts (Isiolo, Marsabit, Moyale and Samburu). ILRI's role included the provision of scientific backstopping for the purposes of monitoring, evaluation and impact analysis. To that end, ILRI assembled a multidisciplinary team of scientists, including a sociologist, epidemiologist, water and environment specialist, a spatial analyst and economist.

It is important to understand that Kenya has 11 districts classified as arid, 19 as semi-arid and six as those with high annual rainfall but with "pockets" of arid and semi-arid conditions, giving a total of 36 districts faced with water scarcity. The arid and semi-arid lands (ASALs) cover about 467,200km^2, which is 80% of the country's total landmass of 584,000km^2. Annual rainfall is low, ranging from 150-450 mm, rarely achieving the 60% probability of occurrence. Rainfall is also highly variable in space and time, and often occurs as high intensity storms. As a result, considerable surface runoff is generated, which is exacerbated by sparse vegetation cover. Water availability and accessibility is a constraint to production and is also highly variable spatially and temporally. Normally, a drought is defined as the failure of three consecutive rainy seasons. In the past, a major drought was expected once every 10 years in Kenya but, over the past three decades, major droughts have recurred after every 5-7 years. This means that ASAL livelihood systems do not adequately recover to withstand the next drought. As a result, a small shock, such as a prolonged dry spell, has a much greater impact on people's livelihood strategies than in the past. This situation is aggravated by insecurity, rising poverty and declining asset levels (natural, human, social, financial and physical assets). Furthermore, the ASALs are fragile eco-systems that require protection from environmental degradation and desertification.

Poor infrastructure in the ASALs, characterized by few rough roads, makes transaction costs of interventions exorbitantly expensive. ASALs also suffer from disorganized markets and inadequate market information. The Kenyan Government provides limited services such as policing, health clinics, and local governance. ASALs are

predominantly inhabited by pastoral communities, with a few permanent settlements scattered across a sparsely populated land. In these areas, markets, abattoirs, food storage, educational facilities, and transport facilities are poorly developed. The proposed Strategic Plan for Kenyan ASAL areas visualizes three issues that need to be addressed in order to improve livestock production; 1) the improvement of natural pasture and water management; 2) disease control, and; 3) improving livestock productivity, marketing and trade. The DRP is fully compatible with, and highly complementary, to the proposed Strategic Plan.

It is common practice for donors to place considerable onus on logical frameworks as a tool to structure project interventions in relation to desired outcomes and impacts. The conventional approach to project impact assessment is to define quantitative indicators and then measure progress against them. The principal indicators of the DRP were the maintenance of animal mortality below 20%. This required the project to measure mortality levels by disease in all the major livestock species. Although, it would seem logical that animal health interventions should reduce animal mortality, animal mortality is, in practice, difficult and costly to accurately measure. For example, a variety of factors, external to the project, influence animal mortality and, as a consequence, make it difficult to accurately attribute changes in mortality rates to specific causes. This means that if changes in mortality rates were detected before and after project interventions, it would be difficult to determine to what extent these changes were due to project interventions. The only way to do that would be to collect information on a series of intermediate indicators to establish a clear evidential link between changes in mortality levels and project interventions.

The epidemiological component of ILRI's DRP impact assessment adopted a participatory epidemiology approach to assess baseline mortality rates for all diseases identified by pastoralist beneficiaries as having a major impact on their livelihoods. Rather than measuring changes, the impact assessment sought to project impact from baseline mortality estimates and conservative estimates of the efficacy of the interventions delivered. Although projecting impact is not the same as measuring impact, it avoids the problem of attribution of impacts to specific causes.

The spatial analysis component of the ILRI assessment relied on the use Geographical Information Systems (GIS) technology in its contribution to the DRP planning and evaluation process. During the planning stage of the project, the implementing NGOs were provided with detailed maps. These were utilised to select areas where the most vulnerable pastoralists were located, and where veterinary and water interventions were likely to have the greatest pro-poor impacts. Furthermore, all intervention sites were spatially referenced, in order that the geographical extent of the interventions, and the ultimate beneficiaries, could be assessed.

Another important aspect of the ILRI project assessment was to carry out an impact assessment of the DRP. Thus, in addition to epidemiological assessment, an economic analysis of the project was also undertaken. Normally, economic analysis is undertaken towards the end of the project cycle. Consequently, in order to summarise the overall

results, benefit/cost analysis was undertaken using a combination of herd, carrying capacity and economic models in order to show the potential / actual impact of the project. Benefit cost analysis is used widely in assisting development partners and stakeholders in making decisions on development projects. It therefore remains one of the most practical tools for analysing the impacts of projects and ranking them according to their benefit and cost relationships.

Chapter 1

Assessing the likely impacts of drought-induced veterinary and water interventions on the human and social capital and livelihood coping strategies of pastoralists in Northern Kenya

David J. Watson

1. Introduction

The goal of the social component of the Drought Response Programme (DRP) was to assess the likely impacts of drought-induced veterinary and water interventions on the human and social capital and livelihood coping strategies of pastoralists in the nine districts of Northern Kenya. This component had two specific objectives. These were, to determine whether or not the project's activities were likely to: 1) enhance the robustness of current drought coping strategies, and; 2) decrease pastoralists' vulnerability to future drought-related shocks. This component is broken down into nine sections: 1) Key livelihood challenges faced by pastoralists in the study areas; 2) Major problems encountered during drought; 3) Traditional drought coping strategies; 4) Current drought preparation; 5) Key livelihood interventions; 6) Key livestock interventions; 7) Expected short-term impacts of veterinary interventions; 8) Expected livelihoods impacts of veterinary interventions, and; 9) District-level summaries and recommendations for future drought interventions.

2. Methodology

2.1 Literature review

A literature review of countries in the Horn of Africa was undertaken to contextualise the sociological research component of the DRP and to aid in the development of empirical tools to assess the human and social capital and drought coping mechanisms of pastoralists in the nine districts. The analysis of social capital is based on the approach developed by the World Bank in 1999.

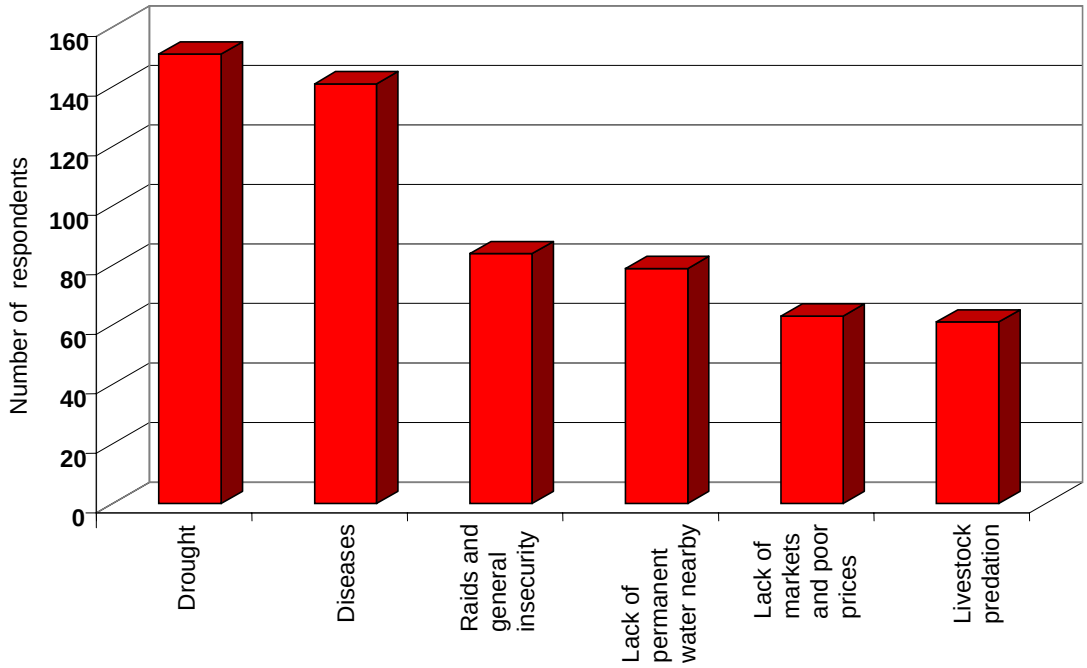
2.2 Empirical methodology

The empirical methodology was designed to generate contemporary insights into the livelihood challenges, specifically drought-related challenges, faced by pastoralists and to gauge the perceived impacts of the veterinary interventions on the livelihoods of pastoralists across the nine districts. The empirical methodology was also designed to be flexible enough to be used successfully by veterinary and NGO field staff, with little or no social science training, and to generate rigorous and credible data. Field data was generated using semi-structured household interviews and a series of key informant interviews. The semi-structured household interviews (Appendix 4) were undertaken in tandem with the epidemiological household-level interviews. A total of 160 semi-structured interviews took place in 16 locations across the nine districts. At each location

(*manyatta*), 10 households were interviewed. Between one and three key informants were interviewed in an attempt to triangulate, and validate, the information generated during the semi-structured household interviews (Appendix 5). One key informant from each district was interviewed in Nairobi by the ILRI sociologist and economist. Field staff also received guidance on the selection of households, household members and key informants. As time, field expertise, and resources were in short supply, the initial semi-structured household interview format needed to be revised. Ultimately, the number of questions targeting social and human capital was reduced. Indeed, virtually all questions aimed at the direct assessment of human capital were removed; leaving only an implicit assessment of changes in human capital through the livelihoods impact question. Unfortunately, due to time and financial constraints, it was only possible to interview 160 households. Whilst this number was able to generate significant insights, a much larger sample, from a broader cross-section, would have been required to generate a truly representative picture. Statistical analysis was performed using chi-square tests.

3. Key livelihood challenges

Figure (1a) Key external drivers over which individuals have little or no control that negatively affect livelihoods (major responses)



3.1 Drought and disease

Not surprisingly, drought was perceived by 94% of the sampled population to be the principal livelihoods challenge. Diseases (both human and livestock) were perceived by 88% of the sampled population as the second most important challenge. Because virtually everybody sampled expressed drought and diseases as key challenges, there were no significant differences between districts, age groups, gender, or health status.

3.2 Raids and general insecurity

Raids and general insecurity was perceived by 53% of the sampled population as the third most important livelihoods challenge. Unlike drought and disease, the prioritisation of raids and general insecurity by respondents varied significantly by district, age, gender, and health status. For example, in Marsabit, Turkana and Moyale an average of 96% of respondents suggested that raids and general insecurity was a key livelihoods challenge; whereas in Garissa and Ijara only 5% perceived raids and general insecurity as a challenge. To some extent, this marked difference is explained by the results of both key informant interviews and social capital data generated during household interviews. First, key informant interviews revealed that trust in people from other tribes was very low in Marsabit, Turkana and Moyale. This was in stark comparison to Ijara, and the Somali Abudwak in Garissa where trust in people from other tribes was high. Follow-up work is required to explain the existence of high-levels of social capital possessed by the Somali Abudwak in Ijara and Garissa and the Somali Abdala in Ijara in respect to trust in people from outside their immediate communities. However, high levels of social capital in both Ijara and Garissa and low levels of social capital in Marsabit, Turkana and Moyale do seem to influence their perceptions of security. Again, 56% of elderly respondents ($\geq$61) indicated that raids and general insecurity was a key livelihoods challenge compared to only 21% of young respondents ($\leq$30). Follow-up work is required to explain this phenomenon.

Likewise, 65% of males indicated that raids and general insecurity were key livelihood challenges compared to only 29% of females. While it is impossible at this stage to provide a definitive explanation for these gender differences, it is likely that males gave a higher importance to raids and general insecurity compared to females because the men are generally more exposed to cattle raids and general unrest than women.

Lastly, 75% of respondents with some kind of infirmity indicated raids and general insecurity as a key livelihoods challenge compared to 46% of able bodied respondents. Whilst follow-up work is required to explain this phenomenon, it is likely that infirm respondents feel even more vulnerable to aggressive acts by other tribes, or even clans in their own tribes, than the able bodied. Furthermore, the household questionnaires revealed that feelings of insecurity were high in Marsabit, Turkana, and Isiolo and low in Garissa, Ijara and Samburu. One interesting point to note is that, feelings of insecurity were also low in Moyale; something that runs contrary to both the household surveys and key informant interviews. Follow-up work is required to explain this anomaly.

3.3 Lack of permanent water near by

Lack of permanent water near by was cited by 49% of respondents. However, as with raids and general insecurity, responses varied significantly between districts. In Wajir, the 80% of the Somali Ogaden mentioned the lack of permanent water near by as a key livelihoods challenge. Similarly, this was also a key concern of the Somali Abudwak in Ijara (68%) and the Turkana tribe in Turkana (65%). In comparison, lack of permanent water near by was not a key challenge to the Rendille in Marsabit and Somali Ajuran in

Wajir (5.5%). Key informant interviews revealed that pastoralists in Ijara, Turkana, Samburu and Isiolo have problems with related to accessing water. In addition, household survey data revealed that respondents in Ijara, Turkana, Isiolo, Garissa, Moyale and Mandera viewed access to water as problematic.

3.4 Lack of livestock markets and poor prices

Lack of livestock markets and poor livestock prices was mentioned by 39% of respondents. However, this also varied by district. In Turkana and Garissa, for example, 80% and 55% of respondents respectively mentioned lack of livestock markets and poor prices as a key livelihoods challenge. This was in stark contrast to respondents in Samburu, Moyale and Marsabit where none of the respondents perceived the lack of markets and poor prices as a key livelihoods challenge.

3.5 Livestock predation

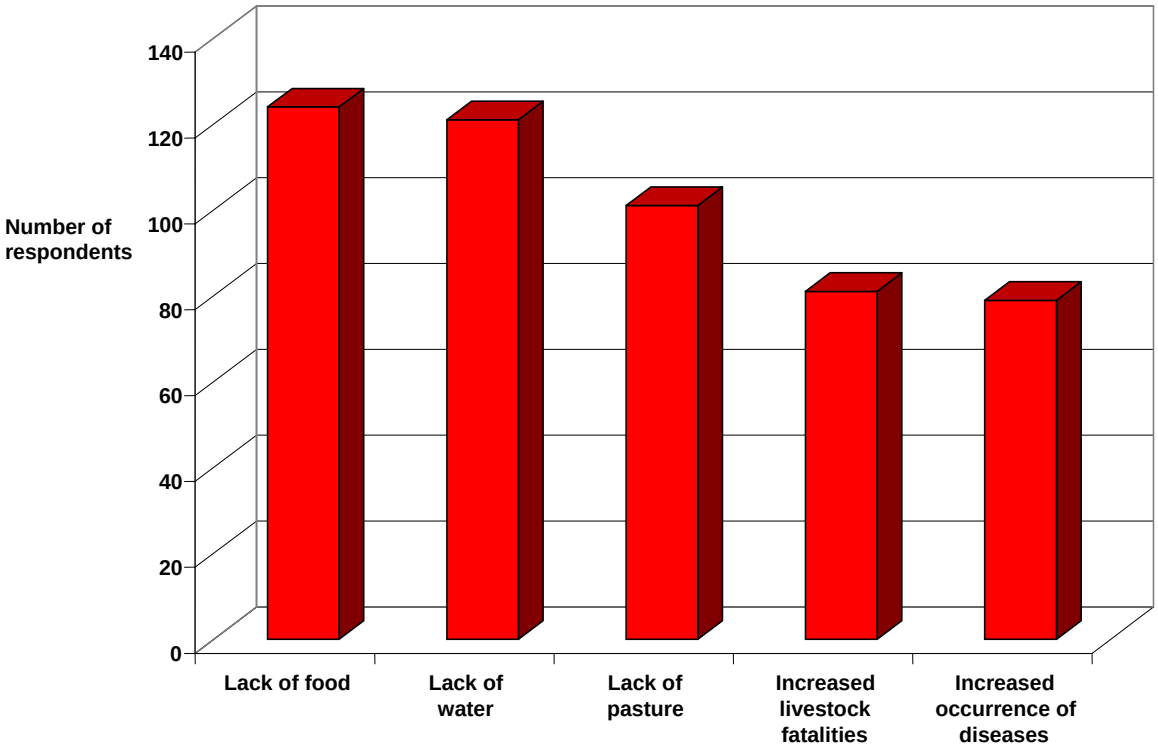
Livestock predation was mentioned by 38% as a key livelihoods challenge. However, concerns over livestock predation tended to be concentrated in three districts; Mandera, Wajir and Garissa where it was mentioned by 78% of respondents. Interestingly, only one out of five key informants from these districts mentioned livestock predation as a key livelihoods challenge.

3.6 Minor responses

Other key livelihood challenges mentioned by a minority of respondents include: Poverty and food insecurity (16%); poor roads (9%); lack of educational facilities (8%); lack of health care facilities (6%), and; lack of key machinery inputs (4%). It must be noted however that, the lack educational facilities was mentioned by a few Borana in Isiolo and Moyale and Somali Abudwak in Ijara and Garissa, and one respondent from Turkana. Likewise, the lack of healthcare facilities was only mentioned by a few Somali Abdala (Ijara) and Somali Abudwak (Ijara and Garissa). Lastly, the lack of key machinery inputs was only mentioned by respondents from Garissa.

4. Major problems encountered during drought situations

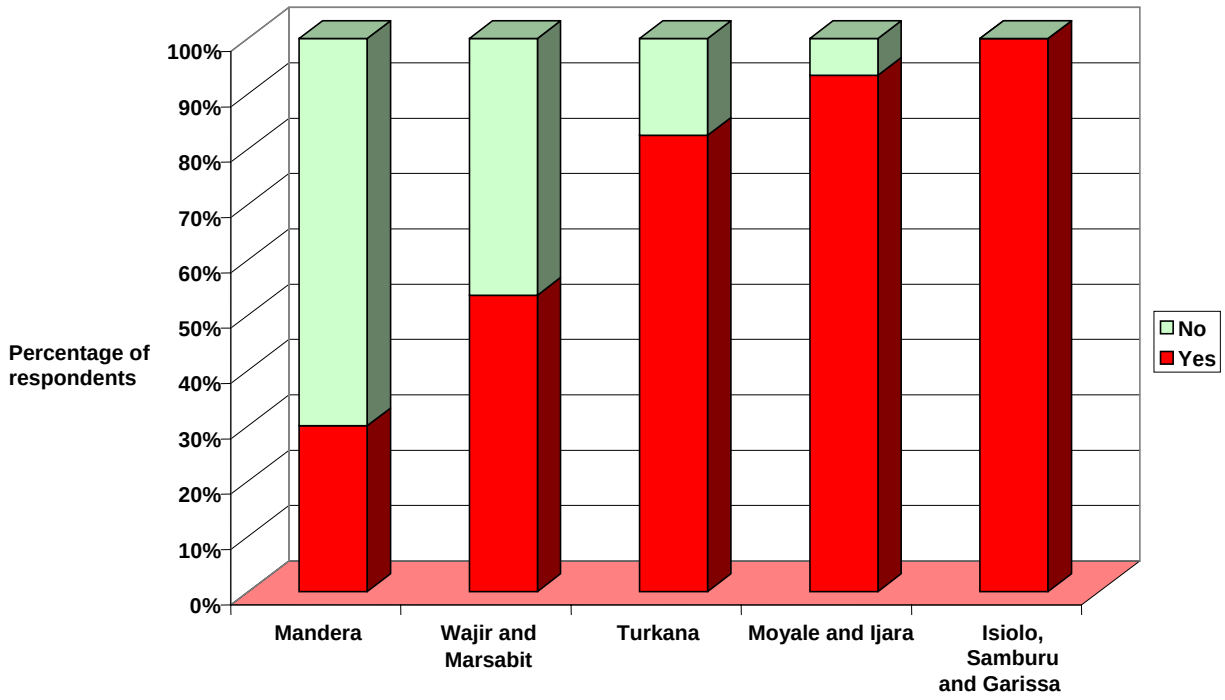
4.1 Figure (2) Major problems encountered during drought situations (a)



4.1.1 Lack of food

A lack of food was mentioned by 78% of respondents and was the principal problem associated with drought. However, responses varied widely between districts (Figure 3). For example, a lack of food during drought was flagged up by 100% of respondents in Isiolo, Samburu and Garissa, and was also one of the principal responses in Ijara (95%), Moyale (90%), Turkana (82.5%), Marsabit (62.5%), and Wajir (50%). Whilst on 30% of respondents from Mandera indicated the lack of food as a major problem during drought, they did, however, mention problems with factors that underpin food security, such as lack of water and lack of pasture etc. Responses also varied by gender; 90% of females indicated that lack of food was a major problem during drought compared to 69% of males. The gender variation is probably due to women having the responsibility to feed the family.

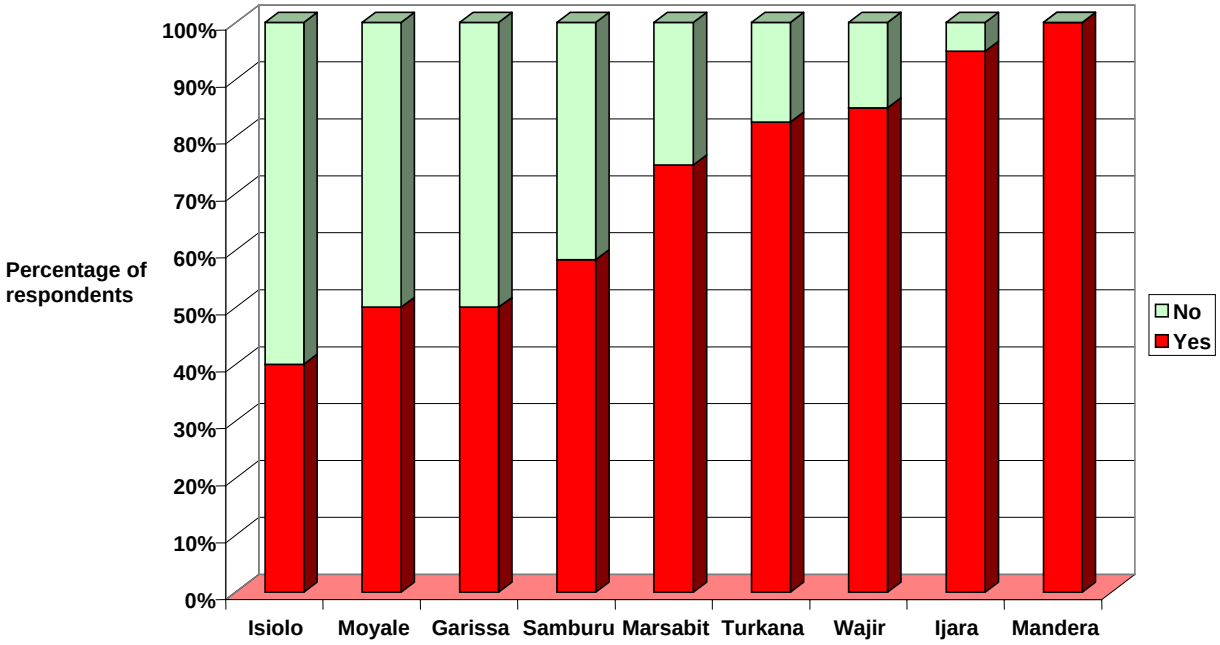
Figure (3) Lack of food as a major problem during drought (by district)



4.1.2 Lack of water

A lack of water was identified as a major problem during drought by 76% of respondents (Figure 4). Again, this varied markedly by district with 100% of respondents in Mandera, 95% in Ijara, 85% in Wajir, 82.5% in Turkana, 75% in Marsabit and 58% in Samburu flagging up a lack of water as a major problem during drought. Conversely, only 50% of respondents from Garissa and Moyale, and 40% of respondents from Isiolo mentioned a lack of water as a major problem during drought. However, in the case of Isiolo, 100% of respondents mentioned a lack of food as a major problem during drought.

Figure (4) Lack of water as a major problem during drought (by district)



4.1.3 Lack of pasture

A lack of pasture was mentioned by 63% of respondents as a major problem during drought (Figure 5). In line with both food and water, responses varied by district. In Marsabit, for example, 87.5% of respondents mentioned the lack of pasture as a major problem during drought. Marsabit was followed closely by the districts of Ijara and Garissa (75%), Wajir (70%), Mandera (65%), Turkana (62.5%), Samburu (58%) and Moyale (50%). Conversely, none of the respondents in Isiolo mentioned the lack of pasture as a major problem during drought.

Figure (5) Lack of pasture as a major problem during drought (by district)

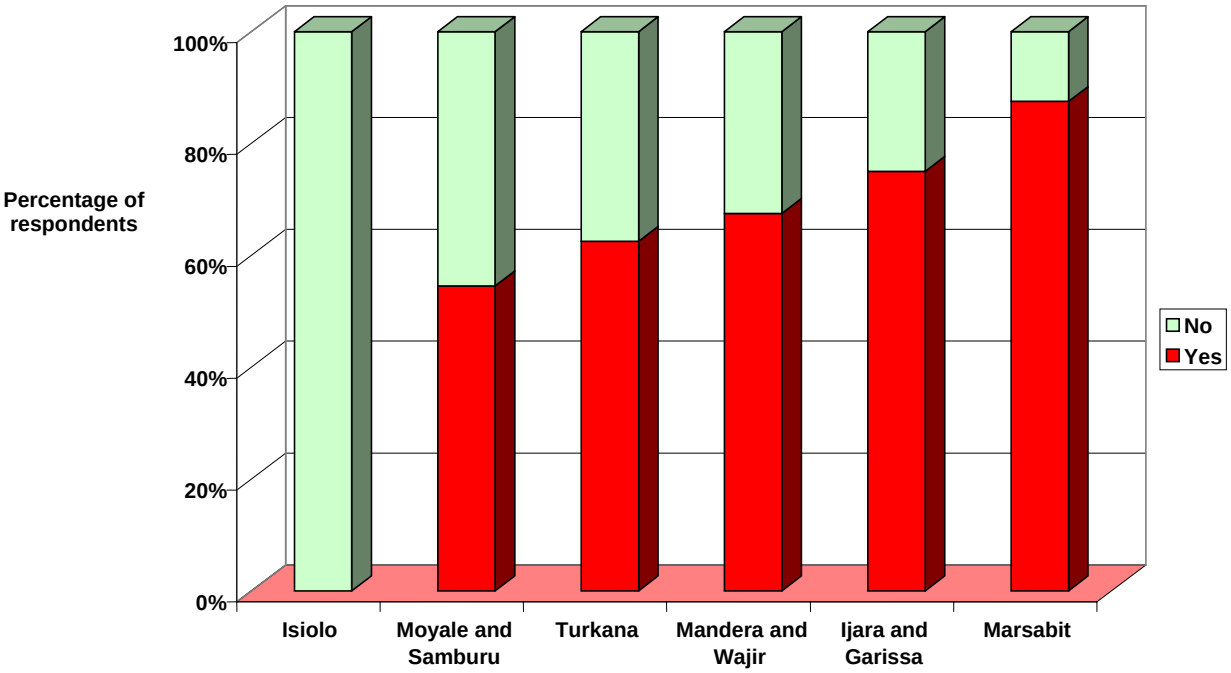
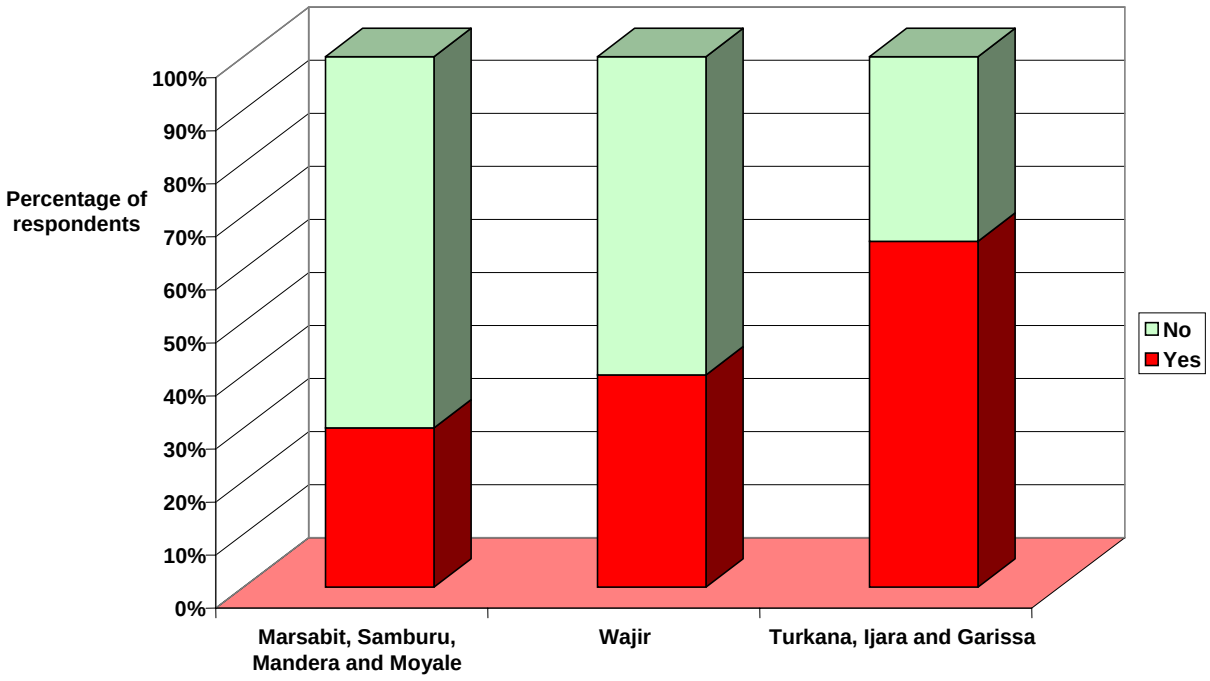


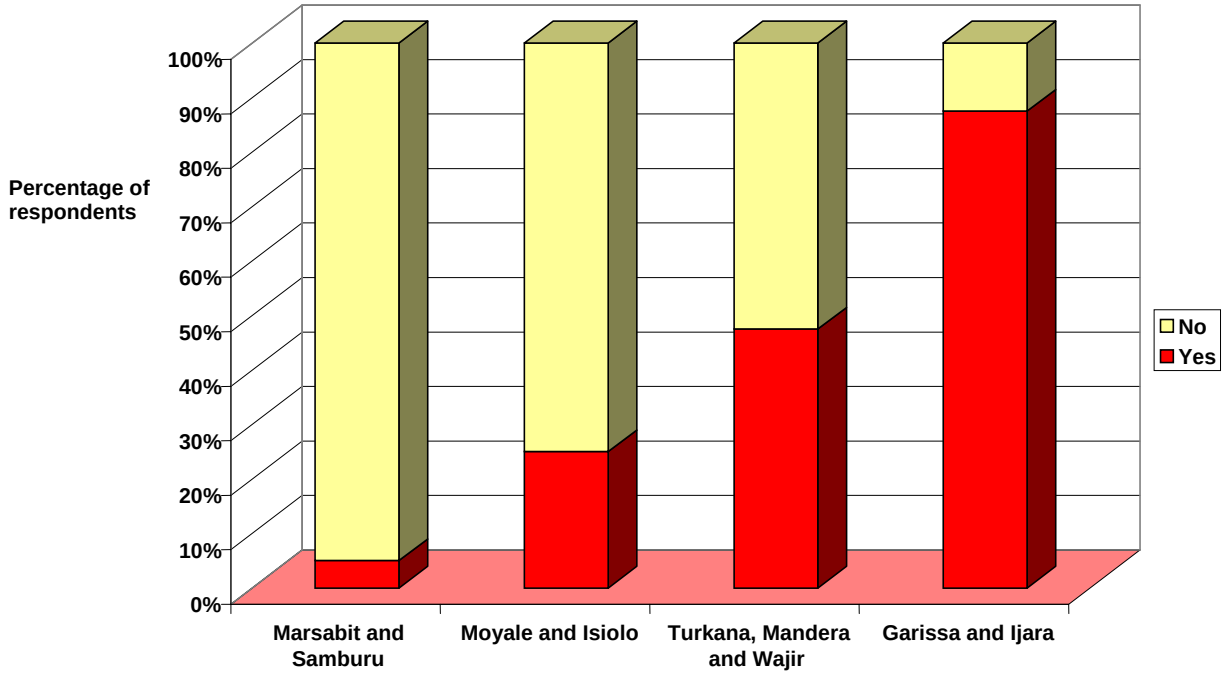
Figure (6) Increased livestock fatalities as a major problem during drought (by district)



4.1.4 Increased livestock fatalities

Increased livestock fatalities were mentioned as a major problem during drought by 51% of respondents. Again, this varied significantly by district (Figure 6). In Garissa and Isiolo, 70% of respondents identified increased livestock fatalities as a major problem during drought; followed by Ijara 65%, Turkana 60%, Moyale 50%, and Wajir 40%. Conversely, only 25% of respondents from Mandera, Marsabit and Samburu identified this concern.

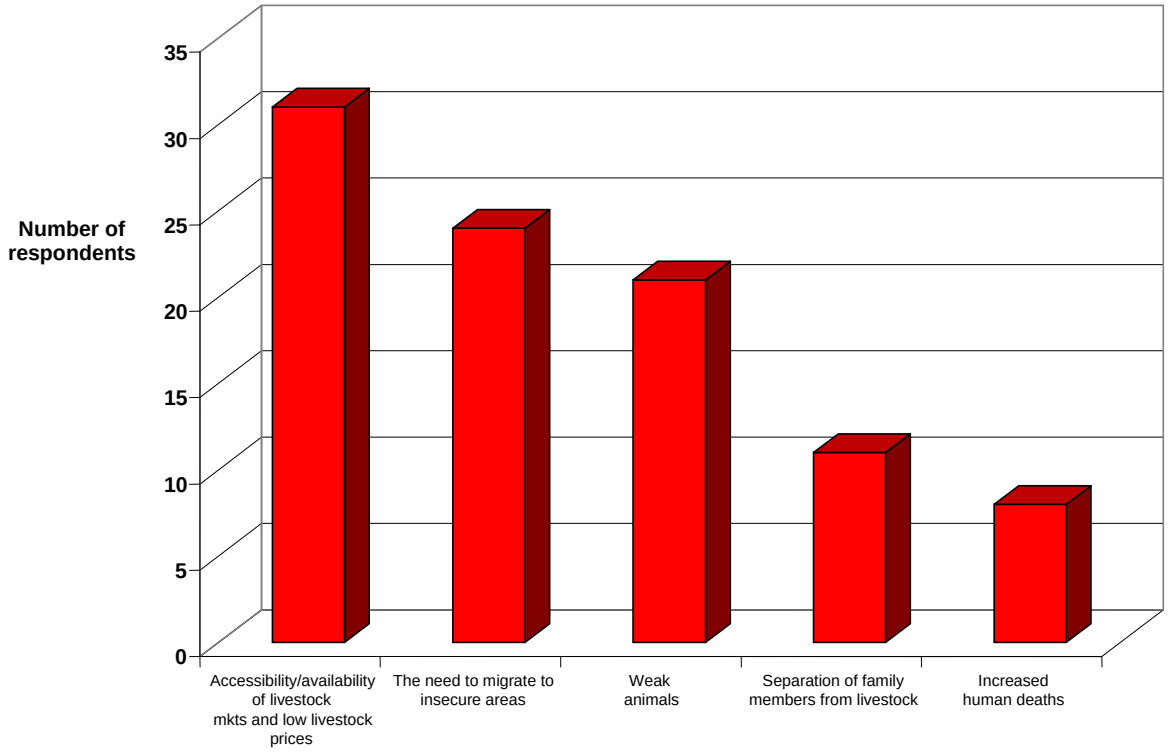
Figure (7) Increased occurrence of disease as a major problem during drought (by district)



4.1.5 Increased occurrence of disease

Increased occurrence of disease was mentioned by 49% of respondents as a major problem during drought. This also varied significantly by district (Figure 7). In Ijara, for example, 90% of respondents mentioned the increased occurrence of disease as a major problem during drought; followed by Garissa (85%) and Mandera and Wajir (50%). In contrast, disease was only mentioned by 45% of respondents from Turkana, 30% from Isiolo, 20% from Moyale, and 8% from Samburu. None of the respondents from Marsabit identified the increased occurrence of disease as a major problem during drought. Responses also varied by age. In the age category ≤30, 68% of respondents identified the increased occurrence of disease during drought compared to just 24% of the >61 age category.

4.2 Figure (8) Major problems encountered during drought situations (b)



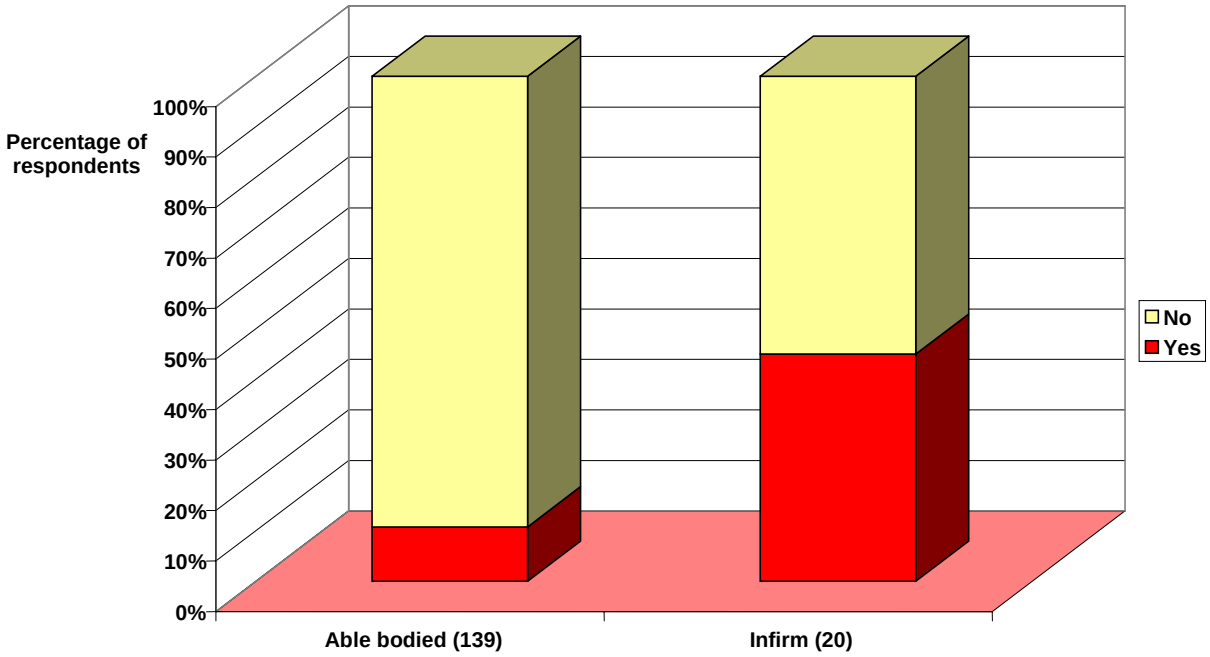
4.2.1 Accessibility/availability of livestock markets and low livestock prices during drought

Accessibility/availability of livestock markets and low livestock prices was mentioned by 19% of respondents as a major problem during drought. Again, this varied considerably between districts. In Marsabit, 37.5% of respondents mentioned the weakness of markets as a major problem during drought; followed by Garissa (35%), Wajir (35%), Ijara (30%) and Mandera (25%). In Isiolo and Moyale, only 10% of respondents mentioned this particular concern, followed by Turkana (2.5%) and Samburu (0%). Interestingly, 80% of respondents from Turkana mentioned a lack of markets and poor prices as a general livelihood challenge but did not prioritise markets during drought. Conversely, Marsabit expressed significant concern over markets during drought but nobody mentioned it as a key livelihoods challenge.

4.2.2 The need to migrate to insecure areas

Concern over the need to migrate to insecure areas during drought was expressed by 15% of respondents. There was significant variation by health status. Figure 9 illustrates the concern expressed by the infirm (45%) regarding the need to migrate to insecure areas; compared to the able bodied of which only 11% identified this as a problem. The concern expressed here corresponds with the concern expressed in the key livelihood challenges section.

Figure (9) Migration to insecure areas as a major problem during drought



Appendix (1) lists major problems associated with drought as expressed by a minority of respondents.

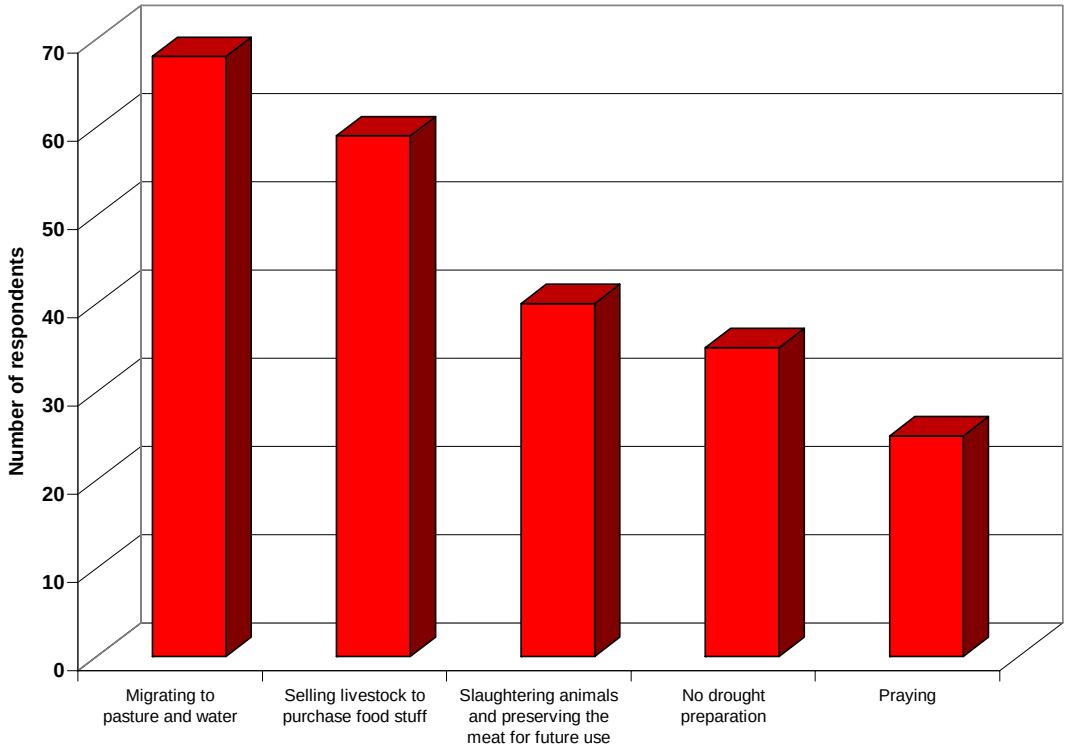
5. Traditional drought preparation

5.1 Migrating to pasture and water

Figure (10) illustrates the most important elements of community drought preparation in the nine districts. It clearly demonstrates that migrating to pasture and water, expressed by 43% of respondents, is the most important strategy. However, deployment of this strategy varied by district. In Samburu, for example, 100% of the pastoralists surveyed migrated in search of pasture and water; followed by Moyale (60%), Mandera (55%), Turkana (52.5%), Wajir (45%) and Marsabit (37.5%). Only 25% of respondents from Garissa, 5% from Ijara and 0% from Isiolo traditionally migrated to pasture and water in response to drought. Interestingly, respondents from Ijara and Garissa expressed little concern over raids and insecurity and indicated high levels of trust of people from different tribes. The fact that, at least for the household surveyed in these districts, they do not traditionally migrate in search of pasture and water, and therefore are not faced with potentially confrontational situations while trying to gain access to other clans/tribe's grazing areas and water, may explain why they apparently seem to have few

security concerns. However, key informant interviews from Garissa, Ijara and Isiolo indicated that access to grazing was often problematic and that grazing access issues had led to violence. Follow-up work is required to explain this phenomenon.

Figure (10) Major traditional drought mitigation strategies



5.2 Selling livestock to purchase food stuff

Selling livestock to purchase foodstuff was mentioned by 37% of respondents as a traditional drought mitigation strategy. Again, this response varied by district. In Mandera, 85% of respondents indicated this particular strategy; followed by Turkana (60%) and Wajir (55%). Other districts did not prioritise the sale of livestock to purchase food. Indeed, only 15% of respondents from Ijara identified this particular strategy compared to 10% from Garissa, 8.3% from Samburu and 0% from Isiolo and Marsabit. Responses also varied by gender with 47% of males indicating this strategy compared to only 23.5% of females.

5.3 Slaughtering animals and preserving the meat for future use

Slaughtering animals and preserving the meat for future use was identified by 25% of respondents. However, it was a key response from Mandera, Wajir and Turkana. It was not mentioned in other districts

5.4 No drought preparation and prayer

Thirty five percent of respondents indicated that they had no traditional drought mitigation strategies. Again, responses varied significantly by district (Figure 11). In Isiolo for example, all of the respondents indicated that traditionally their communities had not developed strategies to mitigate the effects of drought. In other districts, such as Ijara and Garissa, between 40 – 50% of respondents indicated that they implemented drought mitigation strategies. This was in stark comparison to respondents from Moyale, Samburu, Mandera and Wajir, where 100% of respondents identified at least one, if not several drought mitigation strategies.

Identification of drought mitigation strategies also varied by gender and age; 29% of females and 43% of respondents aged ≤30 indicated that they did not implement drought mitigation strategies. This was in stark comparison to just 15% of males and 16% of respondents >31. Figure 12 illustrates the significant gender differences and the use of prayer as a drought mitigation strategy. Here, only 4% of males used prayer as an answer to oncoming drought compared to 29% of females.

Figure (11) Existence of drought mitigation strategies (by district)

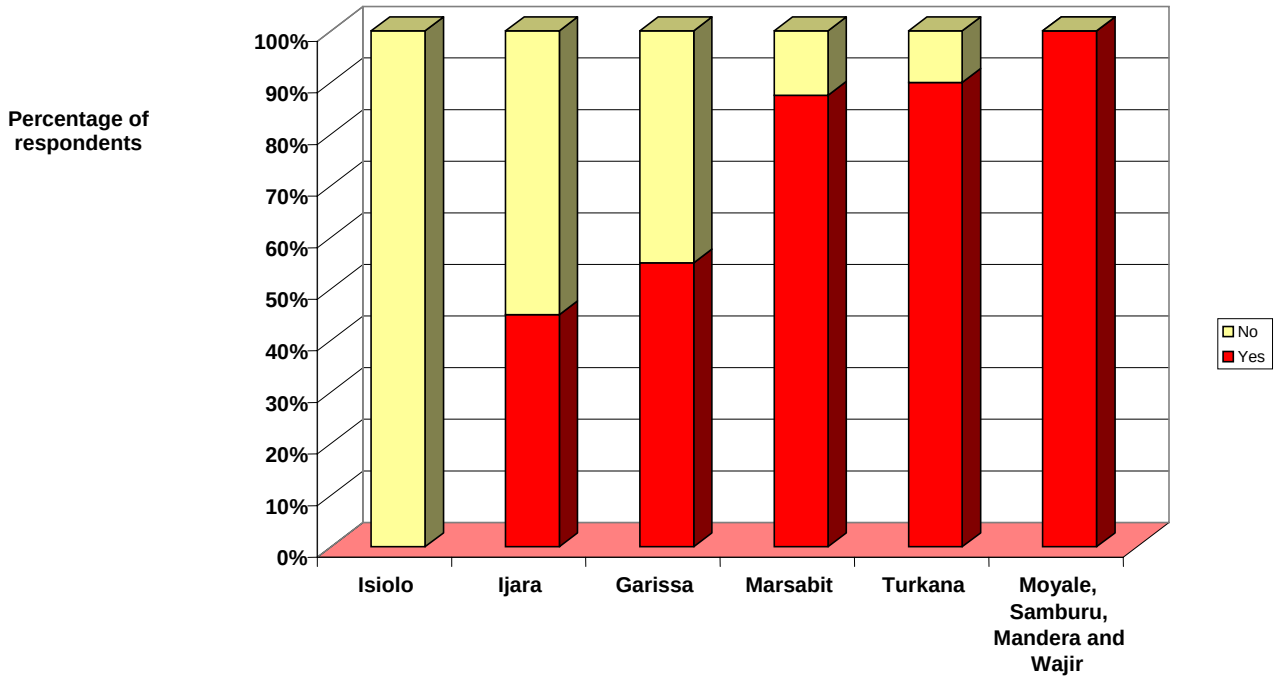


Figure (12) Prayer as a drought mitigation strategy (by gender)

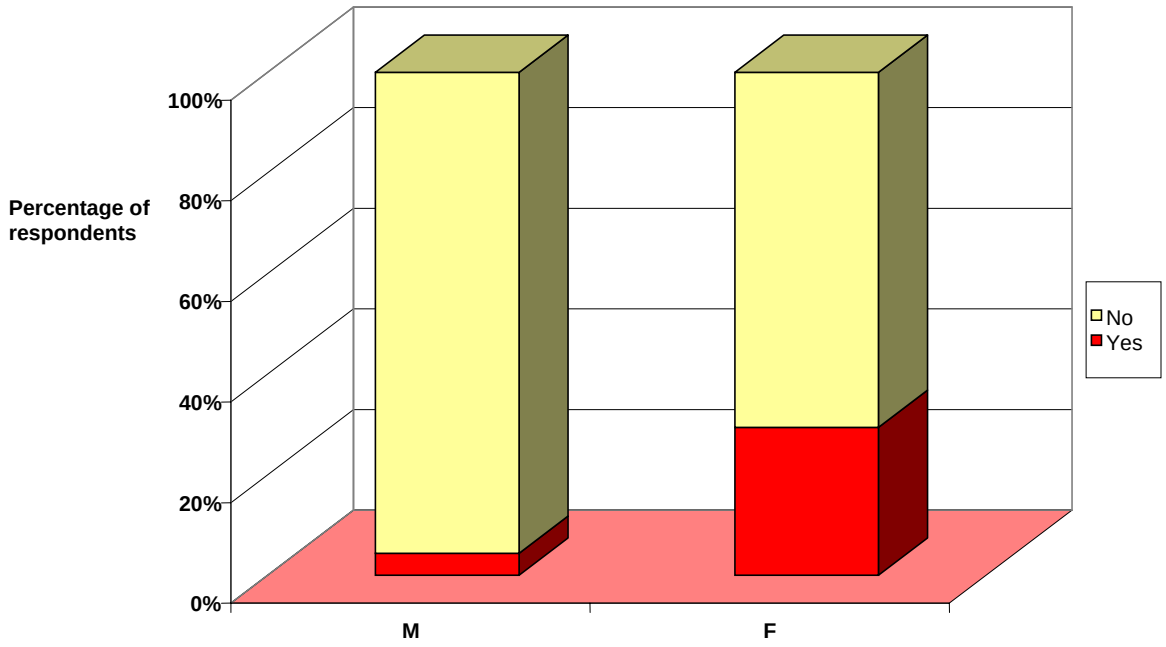
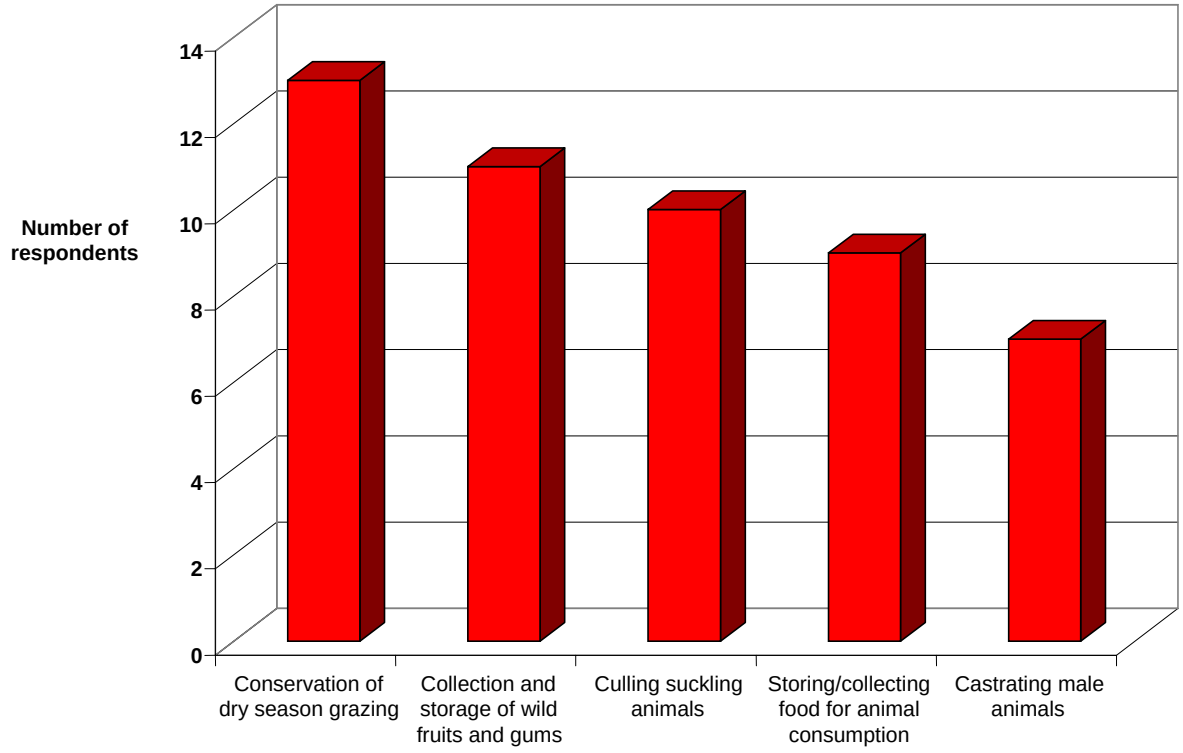


Figure (13) Minor traditional drought mitigation strategies

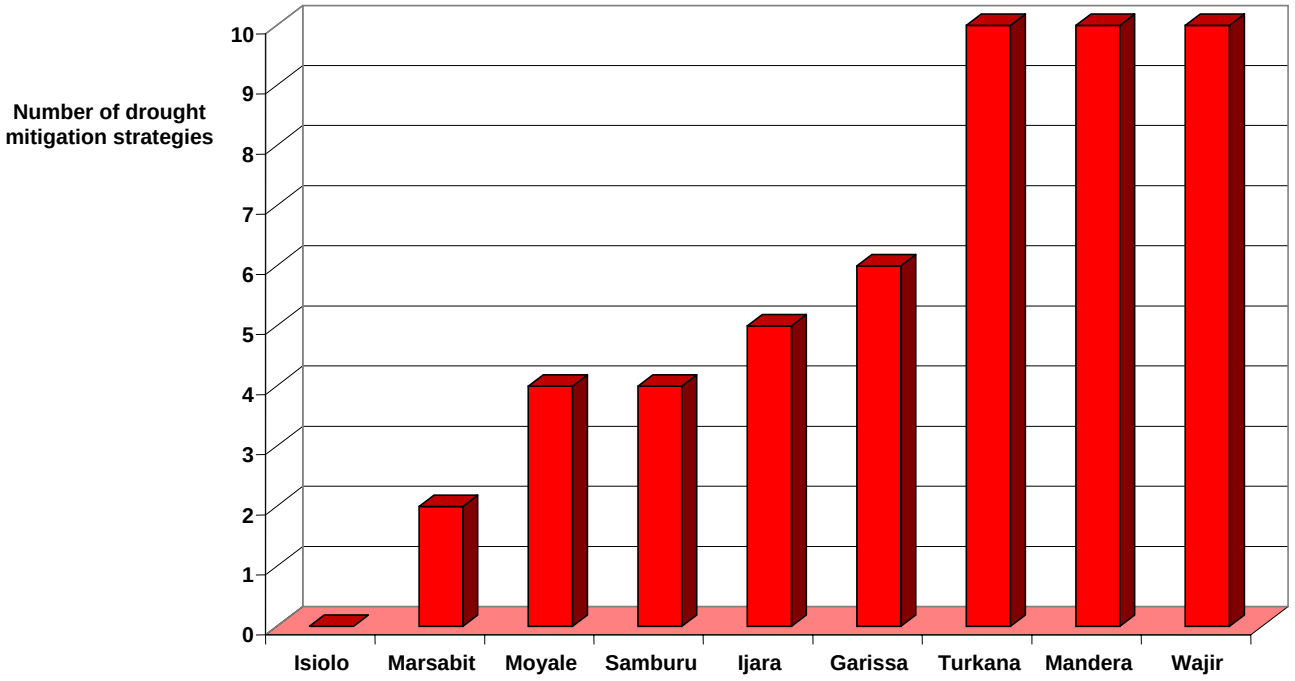


5.5 Minor responses

Figure 13 illustrates drought mitigation strategies indicated by a minority of respondents. Conservation of dry season grazing was indicated as a drought mitigation strategy by 8%, followed by the collection and storage of wild fruit and gums (7%), the culling of suckling animals (6%), storing/collecting food for animal consumption (6%), and the castration of male animals (4%). The complete list of minor drought mitigation strategies can be found in Appendix 2.

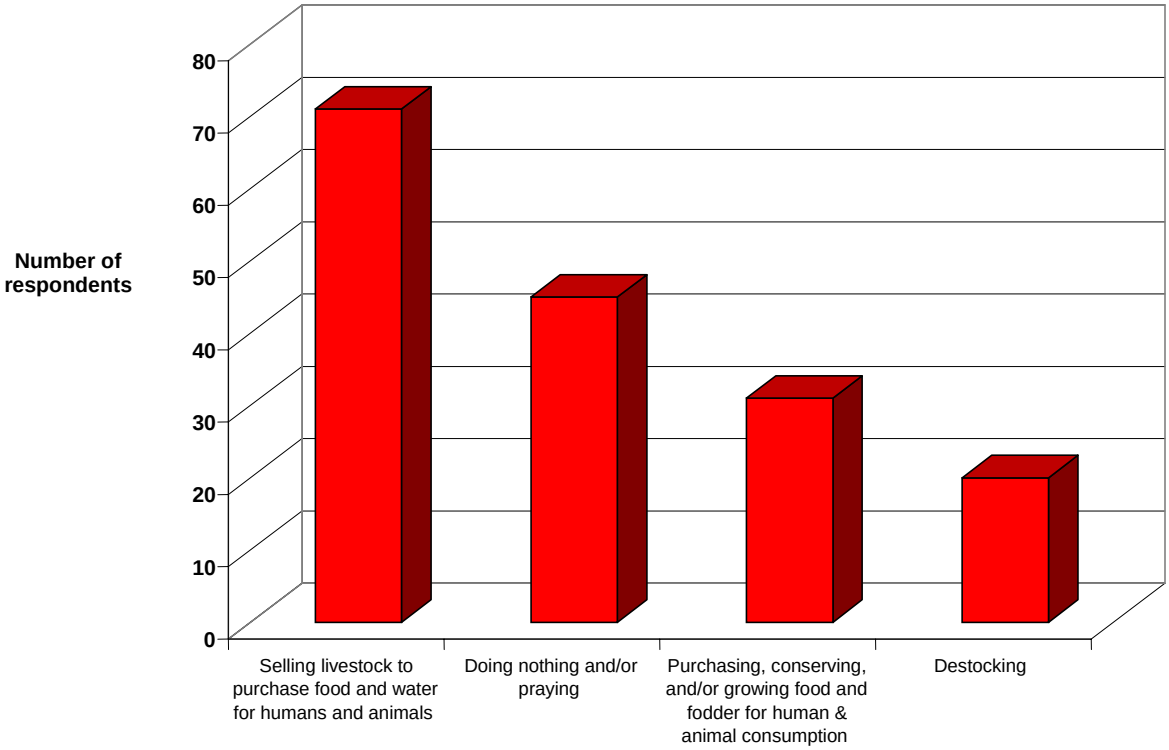
Figure 14 illustrates significant variations in the number of different drought mitigation strategies traditionally implemented by the nine study districts. While respondents from Isiolo failed to identify traditional drought mitigation strategies, on a cumulative basis, districts such as Wajir, Mandera and Turkana identified 10 different strategies.

Figure (14) Number of traditional drought mitigation strategies (by district)



6. Current drought preparation

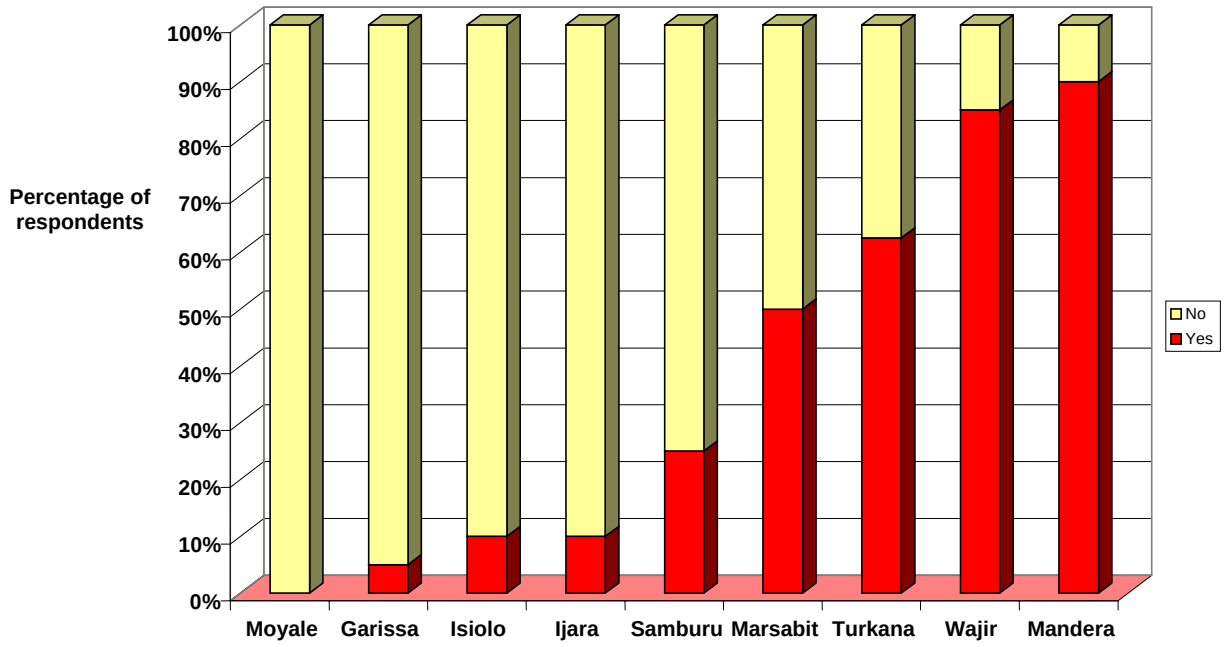
Figure (15) Current drought mitigation strategies



6.1 Selling livestock to purchase food and water for humans and animals

Selling livestock to purchase food and water for humans and animals was identified by 44% of respondents (Figure 16). This particular response was previously identified as the second most popular traditional drought mitigation strategy, only surpassed by migration to water and pasture. In many respects, this was a telling characteristic as serious drought conditions had yet to materialise in the majority of districts surveyed. Not surprisingly, this response varied significantly between districts. For example, this response was indicated by 90% and 85% of the households surveyed in Mandera and Wajir respectively. This was also a popular choice in Turkana (62.5%) and Marsabit (50%). However, this strategy was not as important in Samburu (25%), Isiolo and Ijara (10%), and Garissa (5%). Indeed, none of the respondents in Moyale indicated this strategy. There were also gender differences, with 47% of males and only 23.5% of females identifying this particular strategy.

Figure (16) Selling livestock to purchase human and animal food and water (by district)



6.2 Doing nothing and/or praying

"Doing nothing and/or praying" was the second most important response, identified by 28% of respondents. Again, this varied significantly by district (Figure 17). This response was particularly prevalent in Garissa, Ijara, and Moyale where 90%, 85%, and 66% of the households surveyed gave this response. In contrast, this response was only given by 33% of respondents in Marsabit, 20% in Samburu, and 15% in Turkana; while in Mandera, Wajir and Isiolo 0% gave this response. The response from Isiolo was particularly confusing as they had already indicated that they had no traditional drought mitigation strategies.

Responses also varied by both age and gender. Figure 18 illustrates that the younger pastoralists tend to rely more on either prayer or inaction compared to the elder pastoralists. In the case of gender (Figure 19), females tended to place more faith in praying or doing nothing in the face of drought compared to males.

Figure (17) Doing nothing or praying in response to oncoming drought (by district)

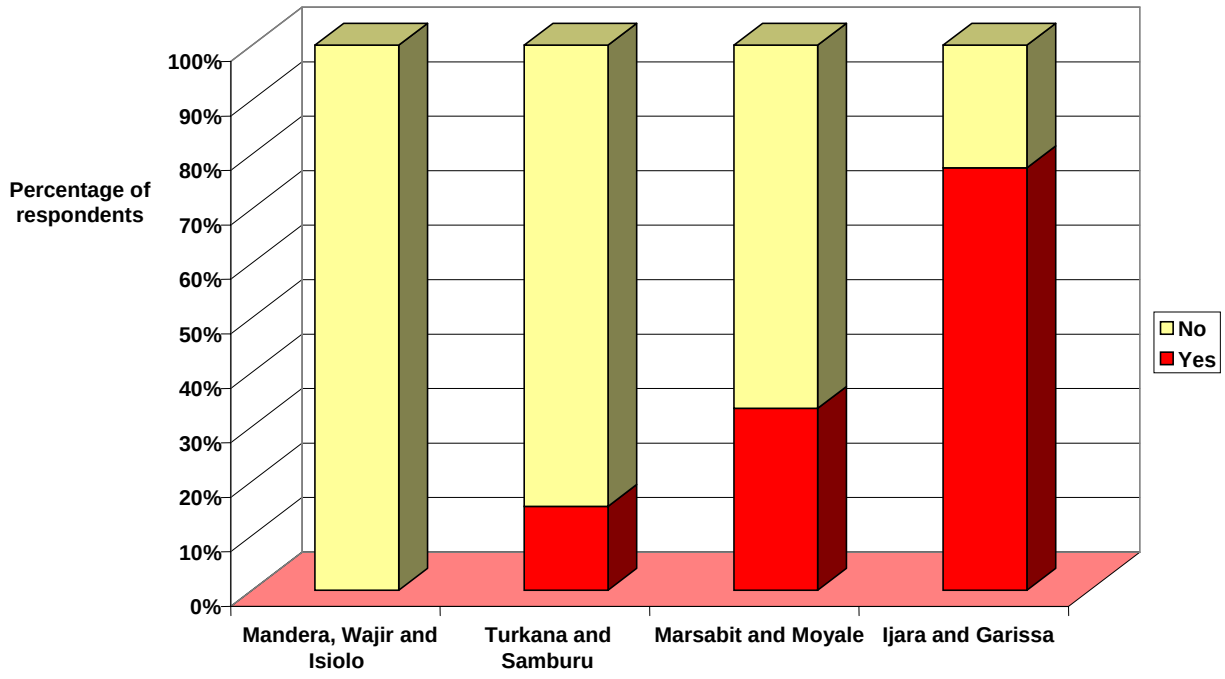


Figure (18) Doing nothing or praying in response to oncoming drought (by age)

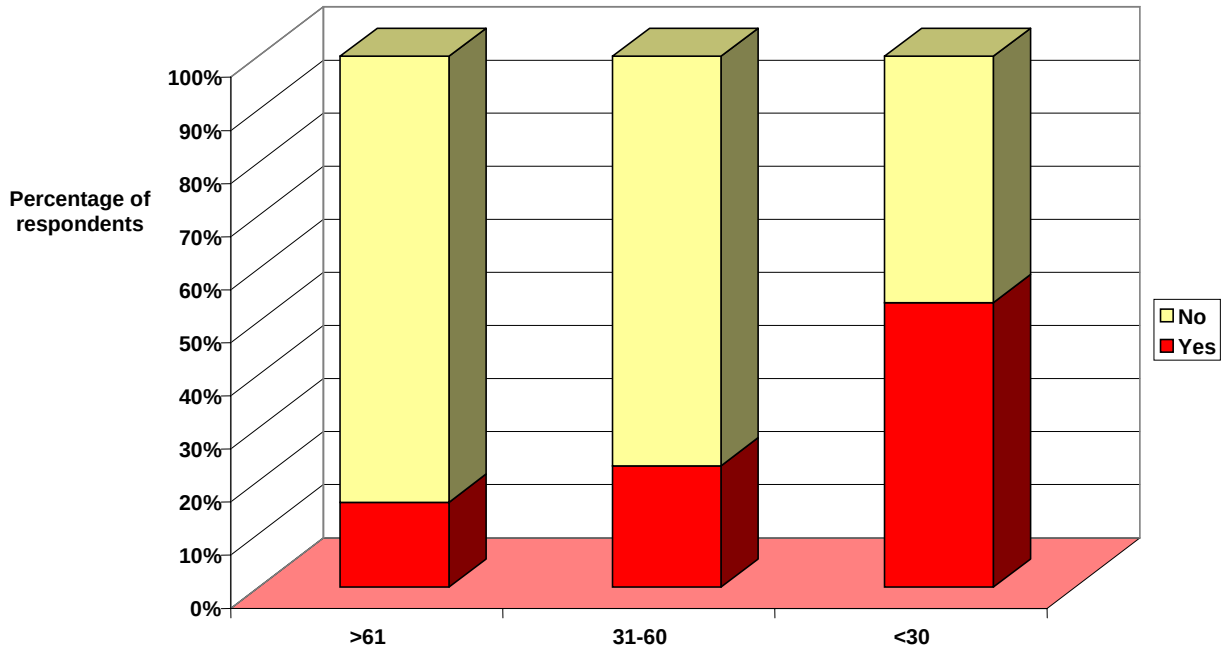
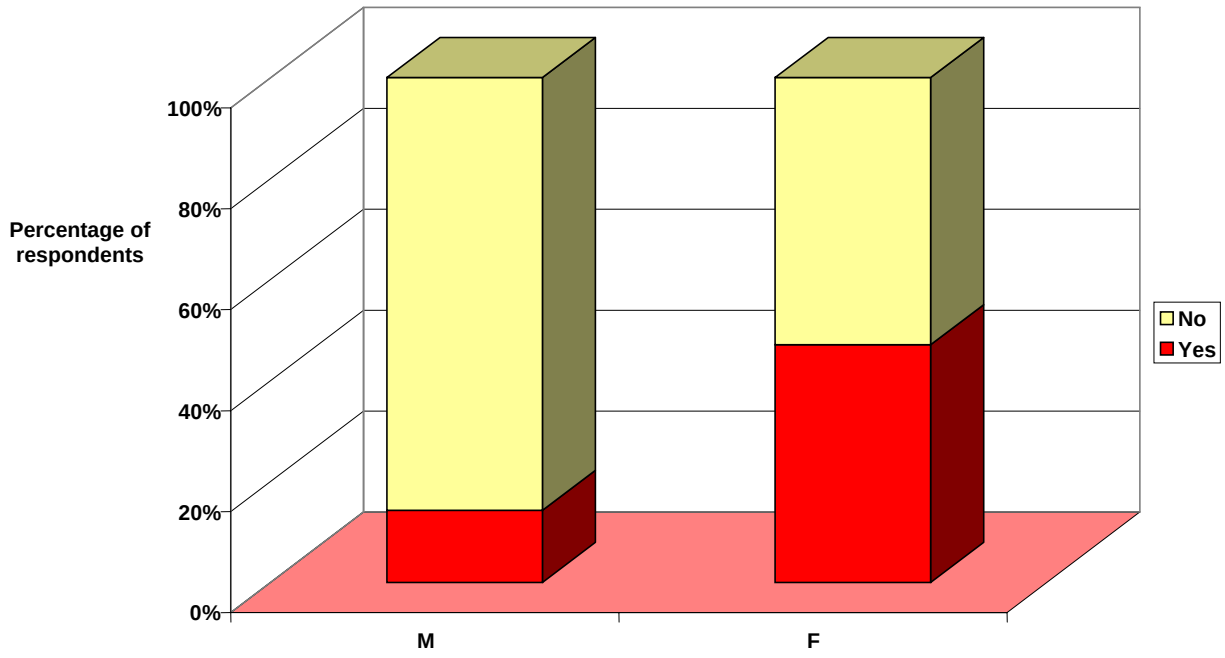


Figure (19) Doing nothing or praying in response to oncoming drought (by gender)



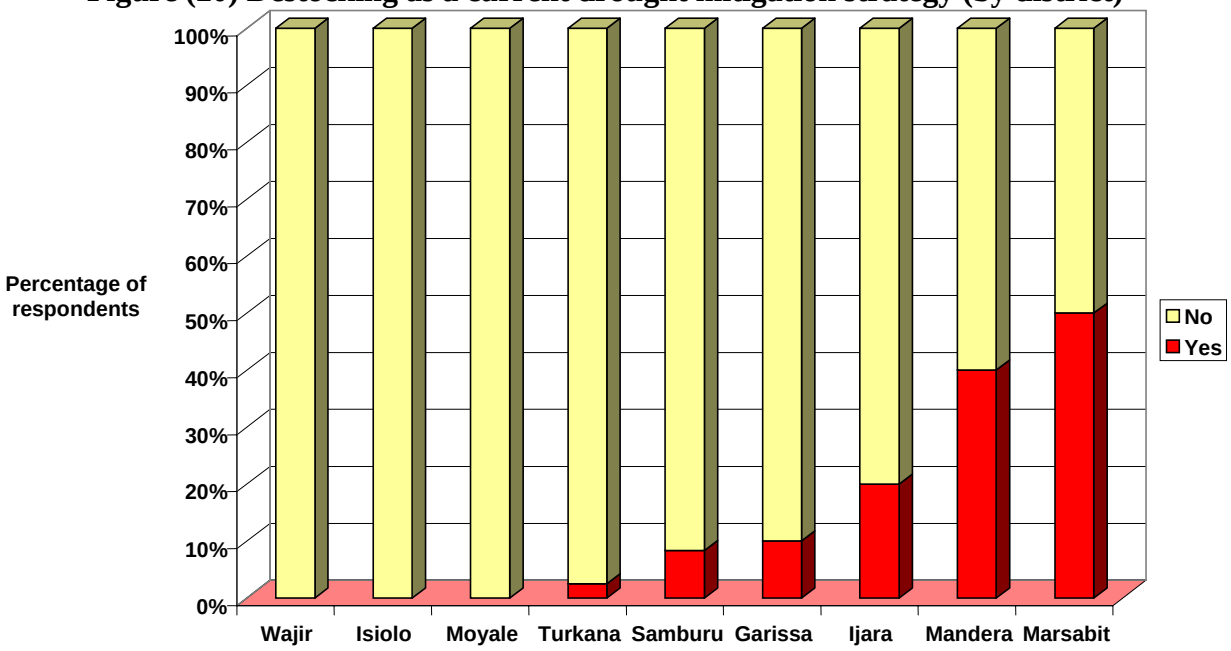
6.3 Purchasing, conserving, and/or growing food and fodder for human & animal consumption

Purchasing, conserving, and/or growing food and fodder for human and animal consumption was identified as a current drought mitigation strategy by 19% of respondents. Again, this response varied by district. Over half the respondents in Wajir (60%) and Garissa (55%) offered this response compared to only 37.5% in Moyale, 15% in Ijara, 12.5% in Marsabit, 5% in Mandera and 0% in Turkana, Samburu and Isiolo. There were also significant differences in response by gender; 28% of females indicated this particular strategy compared to only 13% of males.

6.4 Destocking

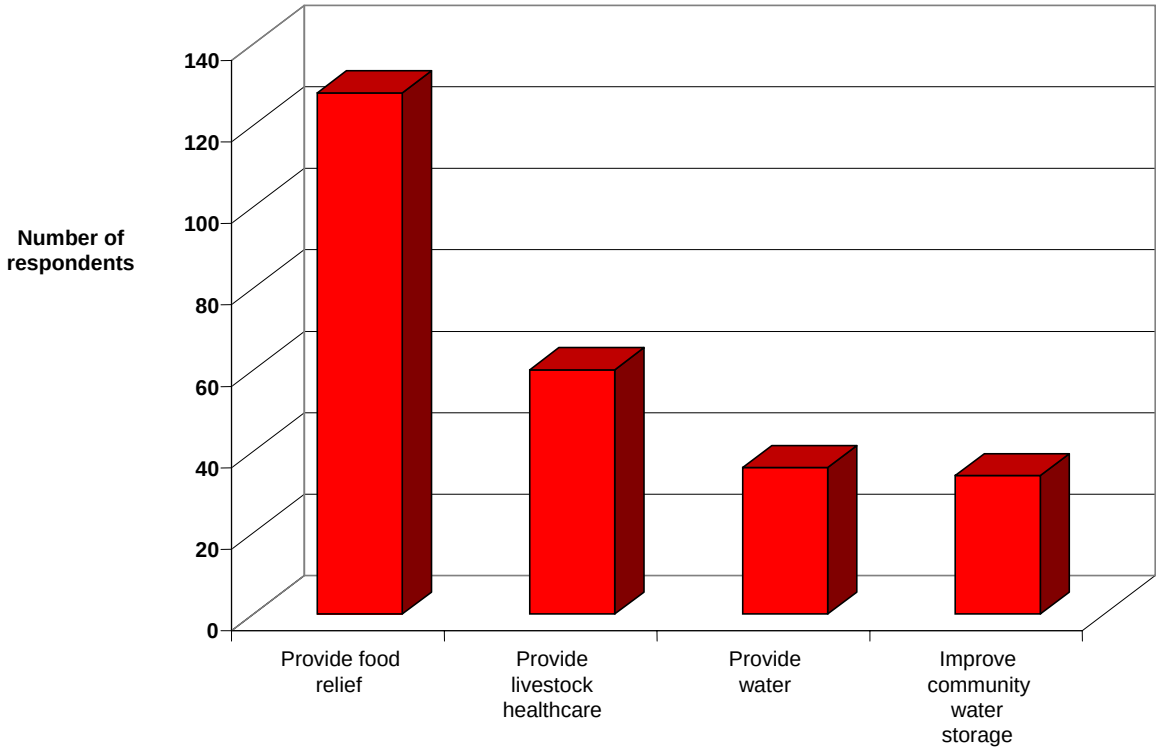
Destocking was identified by 13% of respondents as a current drought mitigation activity. Again, this varied by district and gender. In Marsabit and Mandera, this response was identified by 50% and 40% of respondents respectively; compared to just 25% in Ijara, 10% in Garissa, 8% in Samburu, 2.5% in Turkana and 0% in Wajir, Isiolo and Moyale.

Figure (20) Destocking as a current drought mitigation strategy (by district)



7. Key livelihood interventions in times of drought

Figure (21) key livelihood interventions in times of drought



7.1 Food relief

Overall, 80% of respondents indicated that the provision of food relief was a key assistance to their livelihoods during droughts. This corresponds well with the responses given to the question regarding major problems during drought in which 78% mentioned the lack of food. However, the frequency of this response varied significantly between districts. In Marsabit for example, 100% of respondents flagged up the provision of food relief, followed by 90% in Garissa and Wajir, 85% in Mandera, 80% in Isiolo and Moyale, and 75% in Ijara and Samburu. Only 67.5% mentioned food relief in Turkana (possibly due to suspected urban bias in household sample).

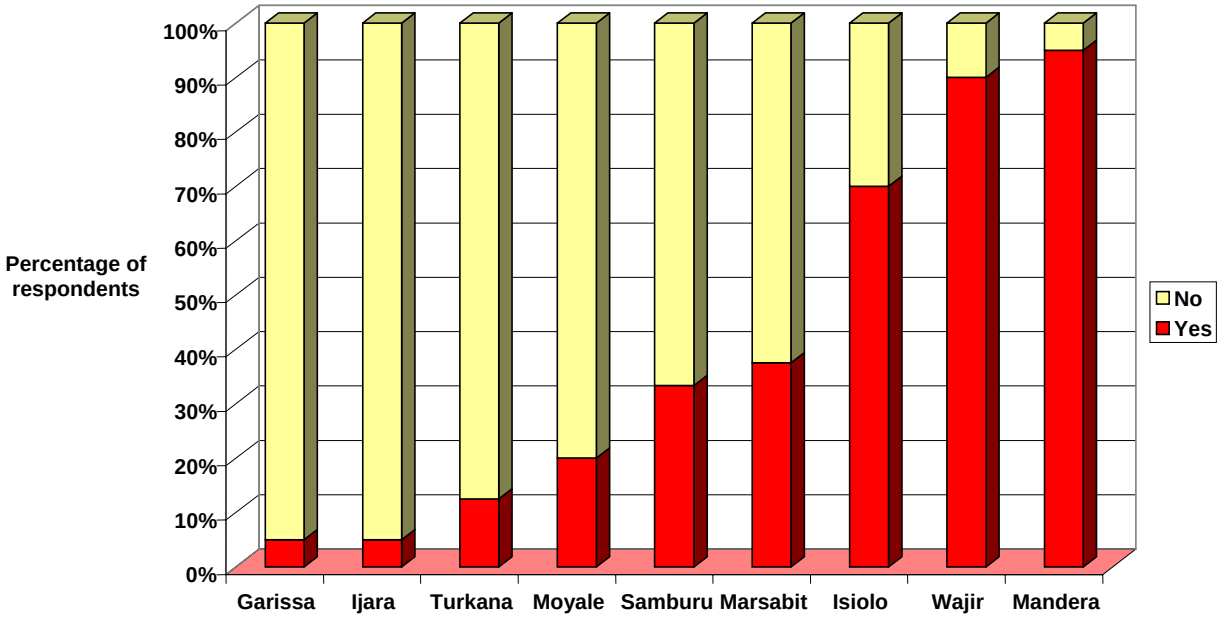
However, answers given in response to this question in Wajir, Marsabit and Mandera do not correspond well with the responses given to question 11 (major problems encountered during a drought). In response to this question, only 62.5% of respondents from Marsabit indicated that lack of food was a major problem during drought compared to 100% of the respondents indicating that they required food relief as part of a drought-induced livelihoods intervention. This phenomenon was also witnessed in Wajir where 50% of respondents indicated that the lack of food was a major problem during drought, yet 90% of respondents called for food relief. Conversely, only 30% of respondents from Mandera indicated a lack of food as a major problem during drought situations compared to 85% requesting food relief in answer to question 15. However, as mentioned previously, whilst not stating the lack of food directly, respondents indicated a range of problems such as lack of pasture, lack of water, and livestock fatalities in response to question 11.

In relation to question 15, food security concerns are addressed by requesting food relief (80%), providing livestock healthcare (38%), the provision of water 23% and improved community water storage (21%). It addresses the second, third and fourth most important concerns, lack of water (76%), lack of pasture (63%), and increased livestock fatalities (51%) by providing livestock healthcare (38%), the provision of water 23% and improved community water storage (21%).

7.2 Livestock healthcare

Across the districts, 38% of those surveyed identified the provision of livestock healthcare as a key livelihood assistance required (Figure 22). Again, this varied considerably between districts with 95% of respondents in Mandera, 90% in Wajir and 70% of respondents in Isiolo indicating the importance of livestock healthcare as a key livelihood assistance required. This was compared to only 5% of respondents in Garissa and Wajir. Not surprisingly, 48% of males prioritised the provision of livestock healthcare, compared to only 23% of females.

Figure (22) The provision of livestock healthcare as a priority livelihoods assistance in response to drought (by district)



7.3 Water

Overall, 23% of respondents identified the provision of water as a key livelihoods intervention during drought. Again, this varied significantly between districts with 65% of respondents in Mandera, 62.5% of respondents from Marsabit, and 50% of respondents from Wajir indicating the provision of water as a key livelihood assistance compared to Moyale and Isiolo (20%), Samburu (17%), Ijara (10%) and 0% of respondents from Turkana and Garissa (Figure 23).

Whilst respondents were not asked to differentiate between the lack of water in the form of rainfall for grazing and the lack of available surface or accessible sub-surface water, interesting insights can be generated by making comparisons between drought as a livelihoods challenge, lack of water as a major problem during drought, lack of permanent water near by and requests for the provision of water by external agencies. While most districts, with the exception of Samburu, prioritised drought as a key livelihoods challenge, particularly Mandera, Turkana, Ijara, and Wajir 100%, only Mandera, Turkana, Ijara, Wajir, and Marsabit also identified it a major problem during drought. Given that Mandera, Marsabit and Wajir asked for the provision of water as part of livelihoods assistance, and also expressed concern over the lack of pasture, it can be assumed that these three districts were concerned about both the lack of rainfall and pasture growth as well as surface and sub-surface water for humans and livestock.

Interestingly, whilst respondents from Turkana were concerned over the lack of pasture, lack of water during drought, and lack of permanent water near by, they did not ask for

the provision of water as a key livelihoods assistance. This could be due to the assumed urban bias in the households sampled. Responses from Samburu are consistent with the fact that pastoralists generally have access to permanent water supplies and reasonably reliable dry season grazing. Given that respondents from Ijara and Garissa didn't ask for water provision as a key livelihoods assistance, it can be assumed that they referred to the lack of rainfall and subsequent pasture growth when they expressed concerns over drought and the lack of water (see Table 1). This assumption is supported by data that demonstrated concerns over the lack of pasture during drought by the vast majority of respondents from Ijara, Garissa and Wajir. Responses from Moyale and Isiolo are somewhat inconsistent and require follow-up work. For example Moyale failed to indicate the lack of permanent water near by as a livelihoods challenge but 40% of respondents asked for assistance in improving community water storage (see Table 2).

Figure (23) The provision of water as a priority livelihoods assistance in response to drought (by district)

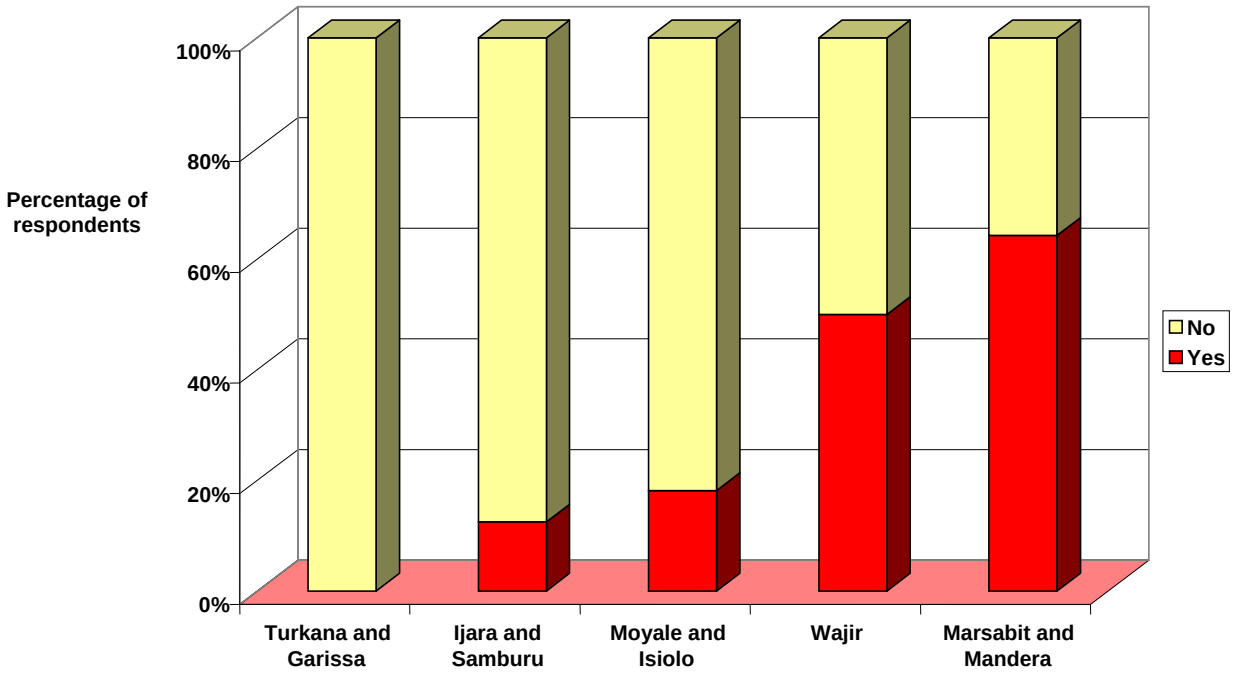


Table (1), Comparison of water-related concerns in relation to key livelihood challenges and major problems during drought

District	%age of respondents identifying drought as a key livelihoods challenge	%age of respondents identifying lack of permanent water near by as a key livelihoods challenge	%age of respondents identifying water as a major problems during drought
Mandera	100	55	100
Turkana	100	65	82.5
Garissa	85	65	50
Ijara	100	55	95
Wajir	100	45	85
Samburu	66	25	58
Isiolo	90	60	40
Marsabit	87.5	0	75
Moyale	90	0	50

Table (2), Comparison of water-related concerns in relation to key livelihood interventions

District	%age of respondents identifying the provision of water as a key area for livelihoods assistance	%age of respondents identifying the provision of water tracking as a key area for livelihoods assistance	%age of respondents identifying the provision of water in dry season grazing areas as a key area for livelihoods assistance	%age of respondents identifying improving community water storage as a key area for livelihoods assistance	%age of respondents identifying the provision of water as a key livestock intervention
Mandera	65	10	0	15	90
Turkana	0	0	10	60	50
Garissa	0	0	0	0	10
Ijara	10	0	0	0	0
Wajir	50	50	10	5	95
Samburu	16	0	0	16	8
Isiolo	20	0	0	0	80
Marsabit	62.5	0	0	0	25
Moyale	20	0	0	40	30

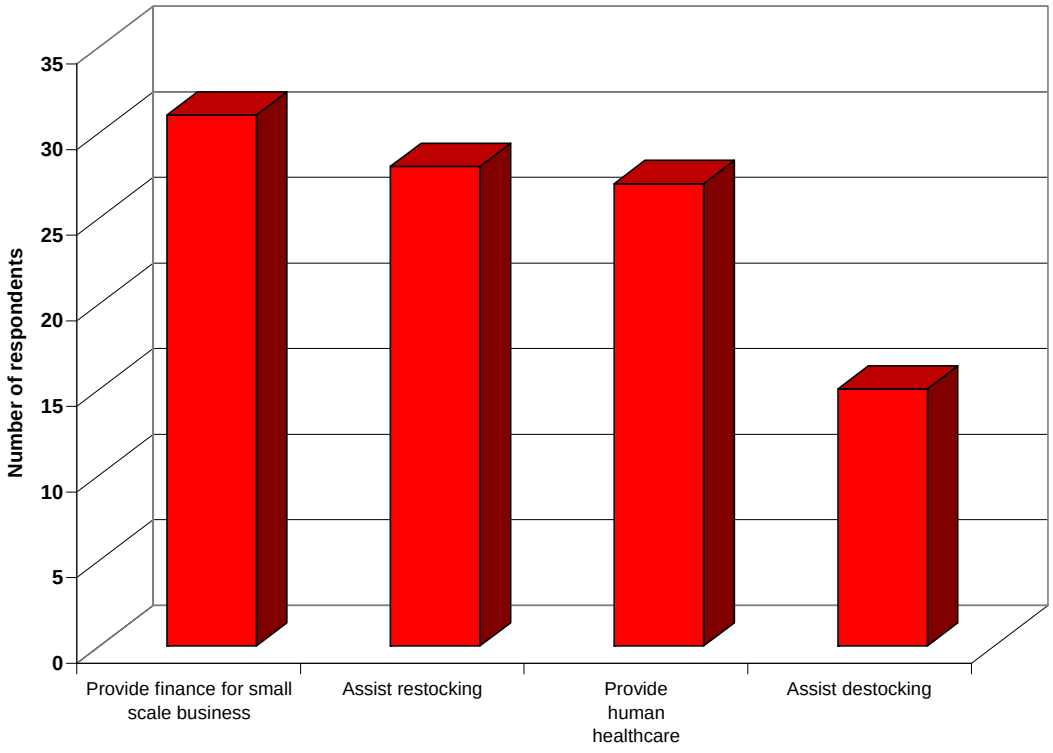
Table (2) is a comparison of the percentage responses to the range of water-related challenges and calls for assistance. It can be seen in Table (2) that Mandera continues its

focus on livestock, and respondents from Turkana reveal a key interest in enhancing community water storage. This is consistent with respondents' earlier concerns over the lack of permanent water near by. Responses from Garissa and Ijara are difficult to explain and require follow-up research. Wajir is possibly the most consistent district as it continues its focus on securing pasture and water for and animals. Samburu continues to play down water concerns, again, possibly due to their access to permanent water and dry season grazing.

7.4 Community water storage

Overall, 21% of respondents identified the external assistance to improve community water storage. Again, this varied considerably by district. In Turkana, 60% of the respondents and 40% of respondents from Moyale indicated the need for assistance in improving community water storage.

Figure (24) key livelihood interventions in times of drought (minor responses)



7.5 Finance for small-scale business development

Overall, 19% of respondents identified the need for finance to pump-prime small-scale business ventures. However, as 67.5% (27 of the 31) of the respondents from Turkana gave this response, this may have been influenced by what seems to be an urban bias in the household survey.

7.6 Restocking

Assistance in restocking was mentioned by 18% of respondents across the districts. However, as with the provision of finance, a high number (23 out of 28) 57.5% of responses came from Turkana. It is likely that successful restocking activities have occurred in the recent past in this district.

7.7 Human healthcare

The provision of human healthcare was mentioned by 17% of respondents. Again, this response varied quite markedly by district. In Isiolo and Wajir, 40% of respondents mentioned this particular intervention, where as no one mentioned human healthcare as a key intervention in Garissa, Moyale and Samburu.

Table (3), the most important things that external organisations/institutions could do in order to safeguard livelihoods (expressed by a minority of respondents)

Problems	**Number of respondents**
Assist in water and pasture tracking	12
Provide education	11
Provide water in dry season pasture	10
Assist livestock marketing	8
Provide farm equipment and assist agricultural development	4
Provide cash for work	4
Provide animal fodder	3
Provide donkey carts	2
Provide medical and veterinary training	2
Assist with the utilization of flood water	1
Assist the control of predators	1

Table (3) lists the most important things that external organisations/institutions could do in order to safeguard livelihoods as expressed by a minority of respondents. Key issues to note are: The provision of farm machinery was only mentioned in Turkana but no one mentioned it as a key livelihoods challenge. Interestingly, it was the opposite case in Garissa, where the lack of key machinery inputs was mentioned as a key livelihoods challenge but was not mentioned as key livelihoods assistance.

Table (4), Comparison of livestock marketing concerns in relation to livelihood challenges, livelihoods interventions and livestock interventions

District	%age of respondents identifying livestock marketing opportunities as a key livelihoods challenge	%age of respondents identifying livestock marketing opportunities as a key area for livelihoods assistance	%age of respondents identifying livestock marketing opportunities as a key area for livestock intervention
Mandera	25	25	20
Turkana	80	5	0
Garissa	55	0	0
Ijara	35	0	0
Wajir	30	0	0
Samburu	0	0	8
Isiolo	20	10	10
Marsabit	0	37.5	12.5
Moyale	0	0	0

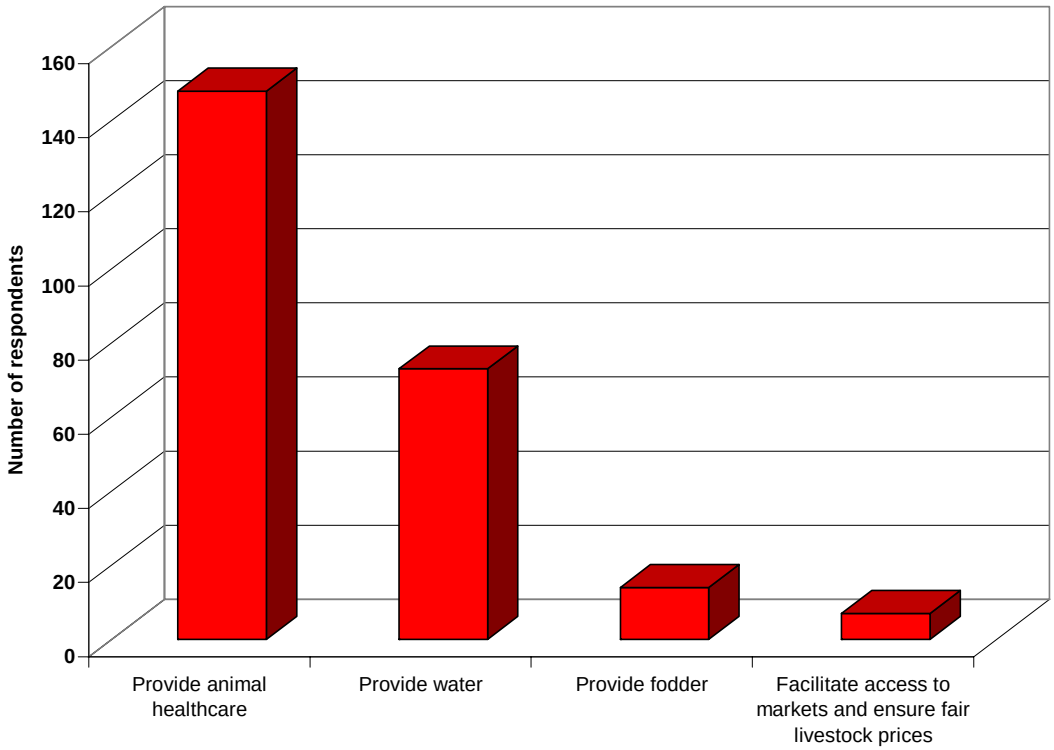
Table (4) compares the livestock market-related responses to questions 10, 15 and 16. There are several interesting and very relevant issues that can be teased from the table. First, only Samburu, Marsabit and Moyale failed to raise livestock market-related concerns in response to the livelihood challenges question (No.10). All the remaining districts scored livestock market-related issues moderately important; with the exception of Turkana where 80% of respondents indicated this concern. Second, whilst livestock market-related concerns were an important response to question 10, only respondents from Mandera, Moyale, Isiolo, and Samburu demonstrated consistency in this regard in their responses to question 15, in as much as their identification of livestock market interventions as key livelihoods assistance need was comparable to their indication of livestock market-related concerns in question 10.

There were inconsistencies in responses from districts such as Garissa, Ijara and Wajir, which identified livestock market-related concerns as key livelihood challenges but then omitted livestock market-related livelihoods interventions in their responses to question 15. Indeed, Turkana was the most spectacular turn-around as 80% of respondents indicated livestock market-related concerns as key livelihood challenges compared to only 5% including livestock marketing as a key livelihoods intervention. Marsabit was another surprise, but for the opposite reason, as no-one identified livestock market-related concerns in answer to question 10 but 37.5% raised livestock market-related interventions in response to question 15. Third, in response to required livestock-related interventions prompted by question 16, only respondents from Mandera and Isiolo demonstrated consistency in their responses with their answers to questions 10 and 15. Turkana respondents' concern with livestock markets was completely absent in their answers to

question 16, and Marsabit's sudden concern with livestock market assistance in question 15 dwindled to only 12.5% (one person) in answer to question 16. Likewise, 8% of respondents from Samburu, equal to one person, flagged up the need for livestock market-related assistance in their answer to question 16 but did not mention livestock market-related concerns or interventions in their answers to questions 10 and 15 respectively. There are no easy explanations of these unusual phenomena. However, it is likely that these spurious inconsistencies are due to the translation of both questions and answers, and the quality of interviewing techniques, during execution of the household questionnaires.

8. Key livestock interventions in times of drought

Figure (25) key livestock interventions in times of drought



8.1 Animal healthcare

The provision of animal healthcare was mentioned by 93% of respondents. However, even this response varied by district. In Garissa, Marsabit and Turkana, 100% of respondents indicated this intervention, compared to just 40% of respondents in Isiolo. When asked, 95% of the pastoralists surveyed assigned a high level importance to avoiding/controlling disease.

8.2 Water

The provision of water was mentioned by 46% of respondents. However, in Wajir this intervention was mentioned by 95% of respondents, and in Mandera by 90%. By contrast, only 8% of respondents mentioned the provision of water in Samburu and only 5% in Ijara.

Figure (26) The provision of water as a key livestock interventions in times of drought (by district)

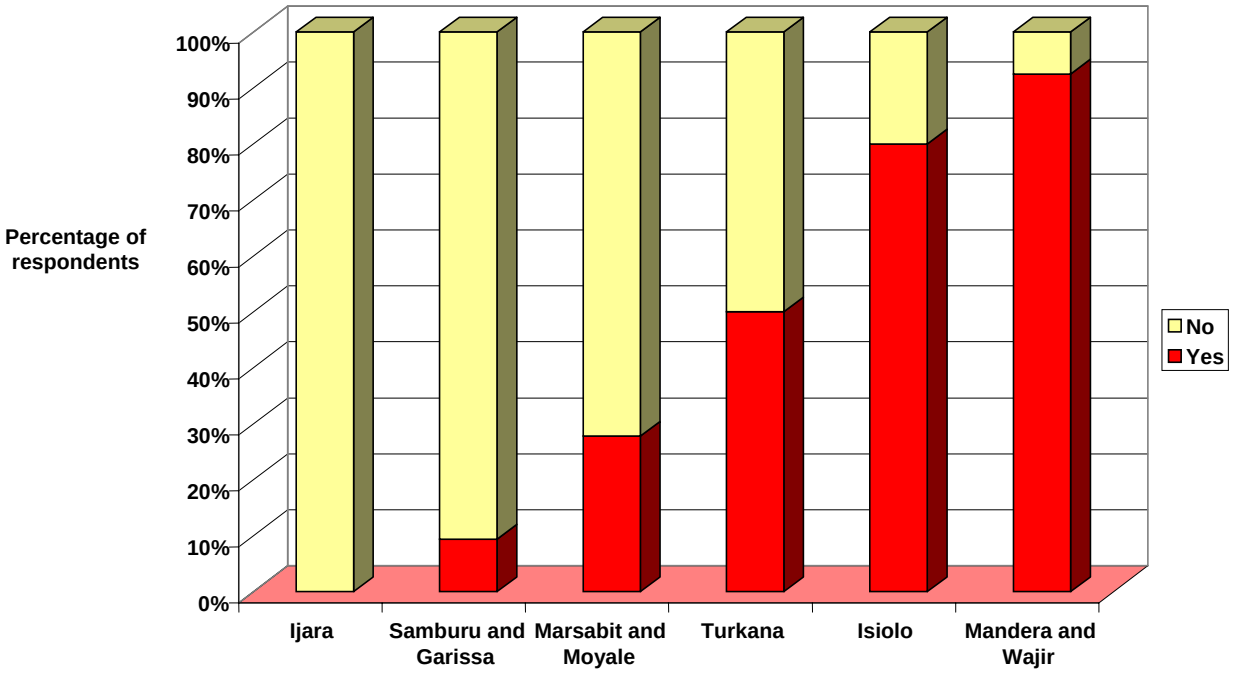


Figure (27) The provision of water as a key livestock interventions in times of drought (by age)

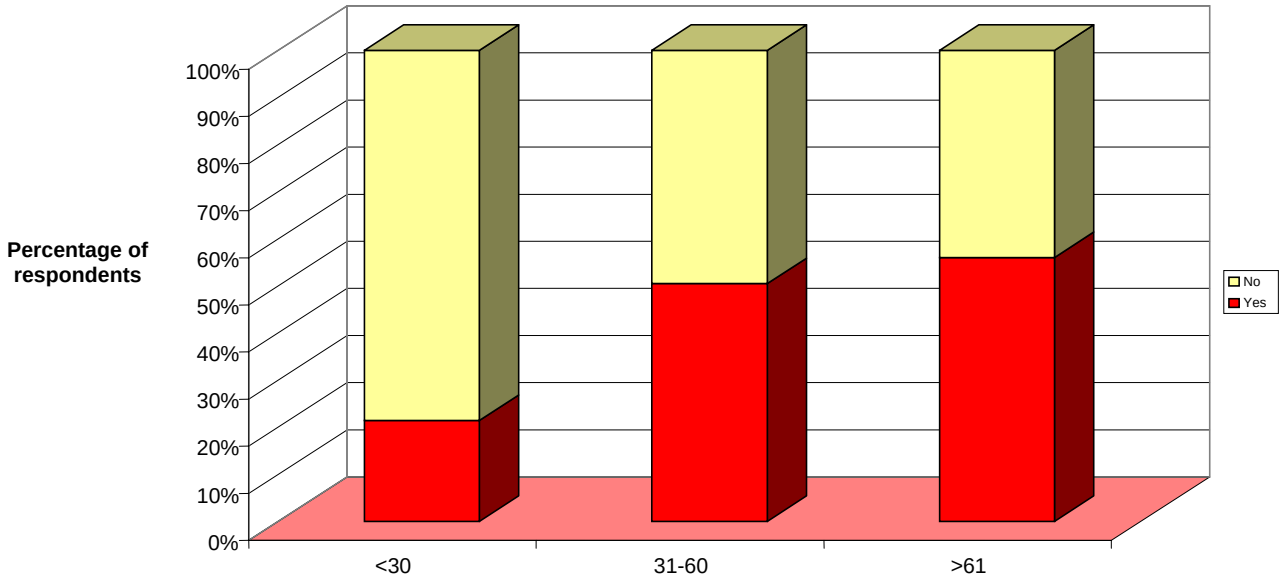
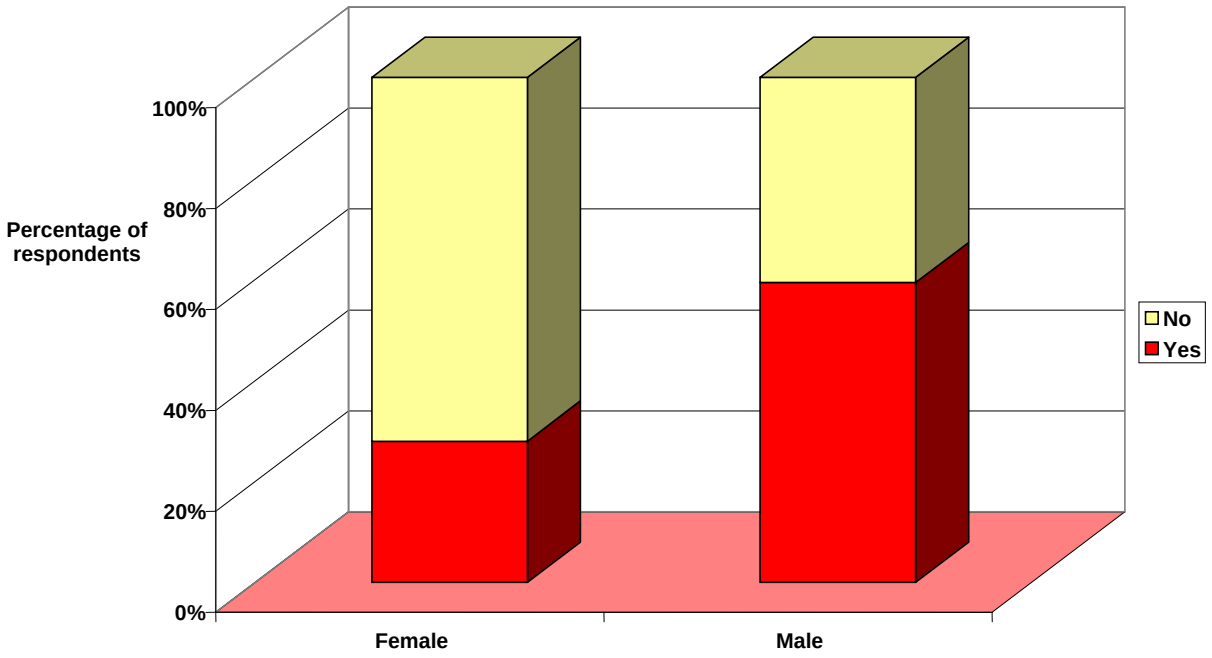


Figure (27) demonstrates the relationship of age and the choice of water provision as a key external assistance. This might be indicative of the elder generations choosing to continue livestock rearing in the face of drought and the younger generations focusing on waiting for divine intervention or putting their efforts into alternative livelihood strategies. More empirical work would be required to understand this particular choice.

Figure (28) The provision of water as a key livestock interventions in times of drought (by gender)



The provision of water as a key livestock assistance was again broken down by gender. Males (59%) significantly opted for this particular type of intervention, compared to just 28% of women. The most likely of many potential explanations for this phenomenon is that, apposed to men, women may have played down the importance of water because they stay at the home-base, where, for the households sampled, water, for both human and animal consumption, may not have been an issue. On the other hand, for those, predominantly men, used to herding livestock in distant pastures, the availability of water is likely to have been a greater concern. To some extent, this explanation is supported by responses to other questions. For example, in answer to the livelihoods assistance question, 12 respondents indicated the need for assistance in water and pasture tracking, and 10 respondents indicated the need for provision of water in dry season pasture. Ultimately, further research would be required to ascertain the reasons for this choice.

8.3 Animal fodder

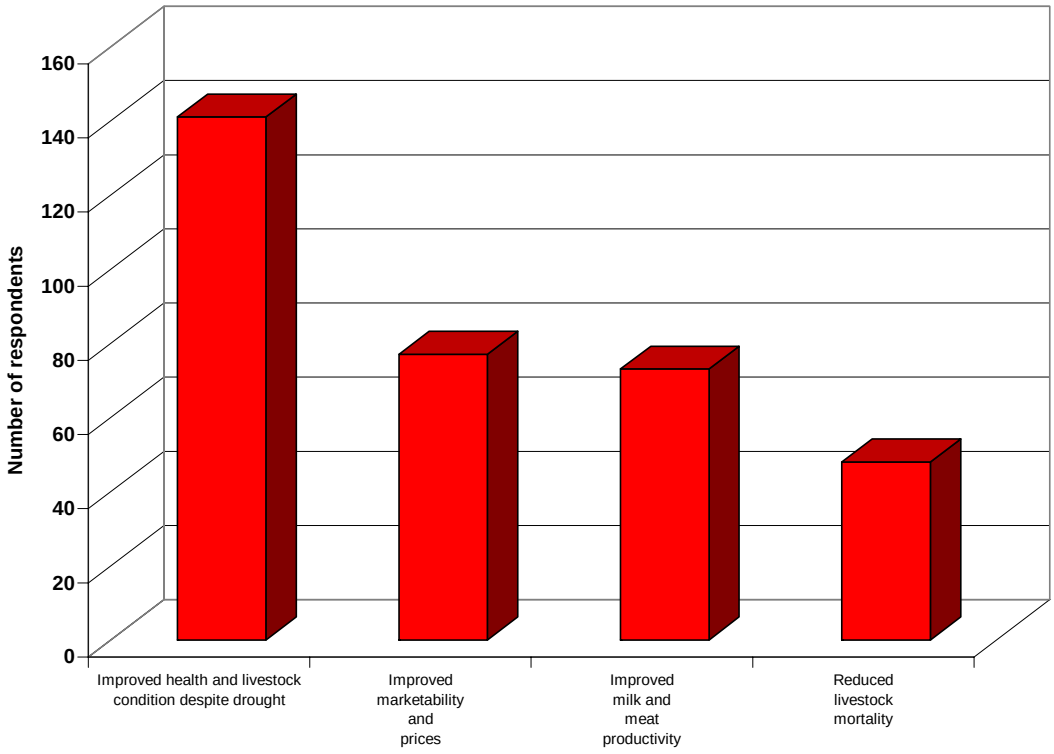
The provision of fodder was mentioned by 9% of the pastoralists surveyed. However, this percentage was much higher in Wajir (35%) and Mandera (25%).

8.4 Assurance of livestock markets

The assurance of livestock markets and good livestock prices was identified by only 4% of respondents across the districts.

9. Expected short-term impacts of veterinary interventions

Figure (29) Expected short-term impacts of the veterinary interventions



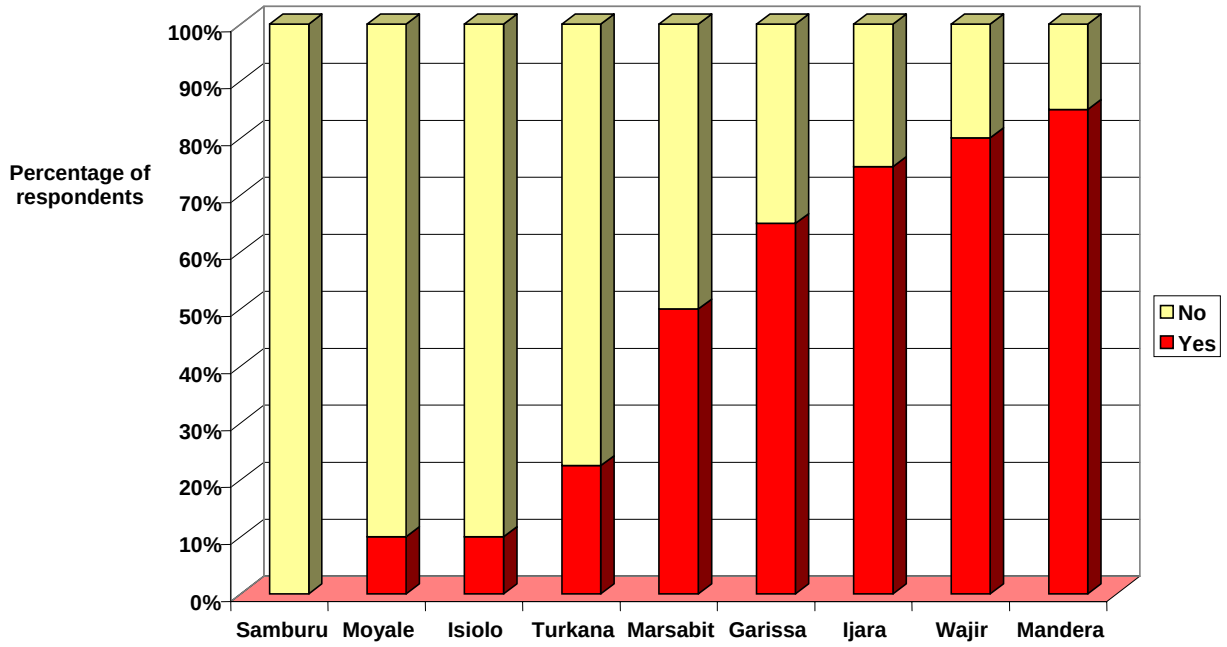
9.1 Improved health and livestock condition

In spite of continuing drought, 88% of respondents indicated that they expected improvements in livestock health and condition. This expectation was particularly prevalent in Mandera, Garissa, Ijara and Turkana (100%) but was also very high in Wajir (90%), Moyale (80%), Marsabit (75%), Samburu (66%) and Isiolo (60%).

9.2 Improved marketability and livestock prices

Improved marketability and livestock prices were expected by 48% of respondents (Figure 30). However, this varied significantly by district. It was a particularly popular response in Garissa (87%), Mandera (85%), Wajir (80%) and Ijara (75%). In Marsabit, 50% of respondents identified improved marketability and livestock prices as an expected impact of the veterinary interventions, compared to only 22.5% in Turkana, 10% in Moyale and Isiolo and 0% in Samburu.

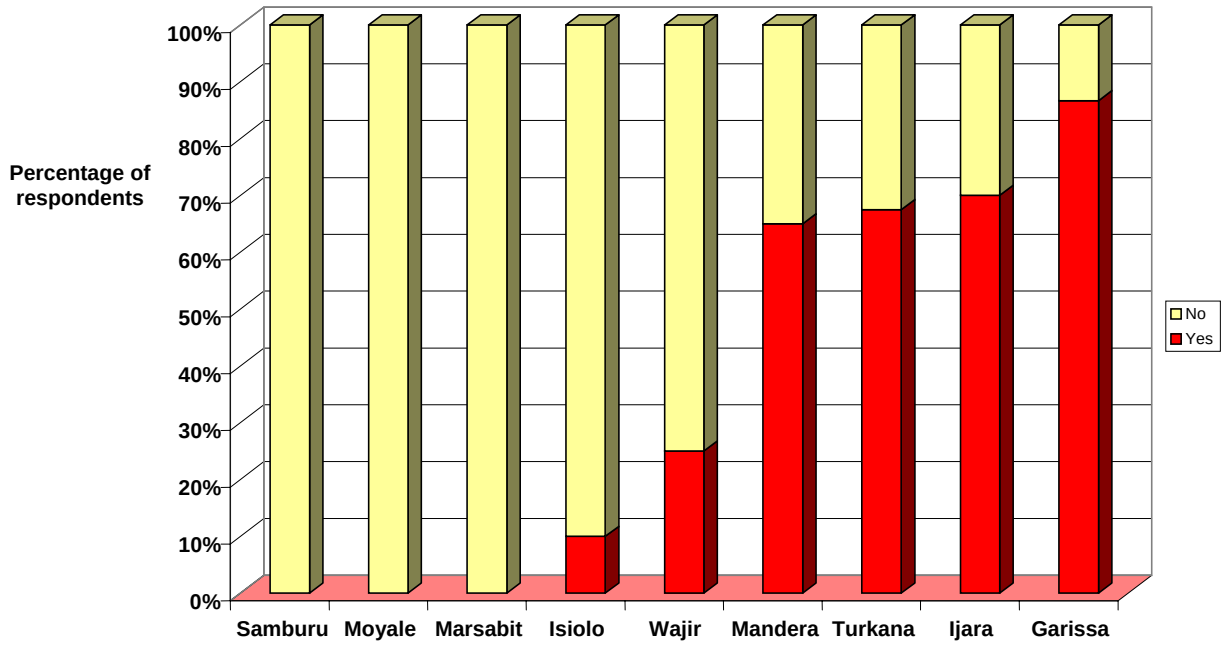
Figure (30) Improved livestock marketability and prices as an expected short-term impact of the veterinary interventions



9.3 Improved animal productivity

Forty-six percent of respondents expected improvements in milk and meat productivity as a result of the veterinary interventions. Again, this varied considerably by district. In Garissa, Ijara, Turkana and Mandera, 87%, 70%, 67.5%, and 65% respectively of respondents expected milk and meat productivity to increase. However, this was not the case in Wajir (25%), Isiolo (10%) and Marsabit (0%), Moyale (0%), and Samburu (0%). Expectations also varied by gender as 56% of females expected improvements in milk and meat productivity compared to just 37% of males.

Figure (31) Improved milk and meat productivity as an expected short-term impact of the veterinary interventions



9.4 Reduced livestock mortality

Thirty percent of respondents expected the veterinary interventions to reduce livestock mortality. This also varied considerably by district. In Mandera, 75% of respondents indicated that they expected the livestock interventions to lead to reduced livestock mortalities. This was followed by Moyale (50%0, Samburu (42%), Wajir and Isiolo (40%), Marsabit (25%0, Turkana (20%0, Garissa (8%), and Ijara (0%).

9.5 Enhanced rate of reproduction/herd growth

Twenty-three percent of respondents expected the veterinary interventions to result in an enhanced rate of reproduction rate/herd growth. Seventy-two point five percent, or 29 out of 37) of respondents in Turkana expected this impact, followed by 47% from Garissa 47% (7 of 37), and 5% from Ijara (1 of 37). None of the respondents from Marsabit, Moyale, Samburu, Isiolo, Mandera and Wajir expected this impact.

9.6 Increased drought resistance

Increased drought resistance was identified as an expected impact of the veterinary interventions by 22% of the respondents. However, the vast majority of respondents came from Garissa and Ijara (83%); whereas no one identified this impact in Mandera,

Wajir, Turkana and Marsabit. It is likely that the catch phrase "drought resistance" has either evolved in these two districts in the past or has been used as a prompt by interviewers in the two districts during the data collection process. Whilst the small percentage of respondents in Isiolo, Samburu and Moyale did not specify drought resistance specifically, their responses were so similar to warrant their inclusion. Lastly, 7.5% of respondents indicated that, as a result of the veterinary interventions, they expected that their animals would be healthy enough to be able to search for water and pasture or trek to market. This was a key expectation in Marsabit, where 62.5% of respondents (5 of the 12 choosing this impact) identified this impact. This was followed by Moyale (20%), Samburu 16% (2 of 14), Isiolo 10%, and Mandera 5%. No one in Garissa, Ijara and Turkana identified this impact.

Figure (32) Improved drought resistance as an expected short-term impact of the veterinary interventions

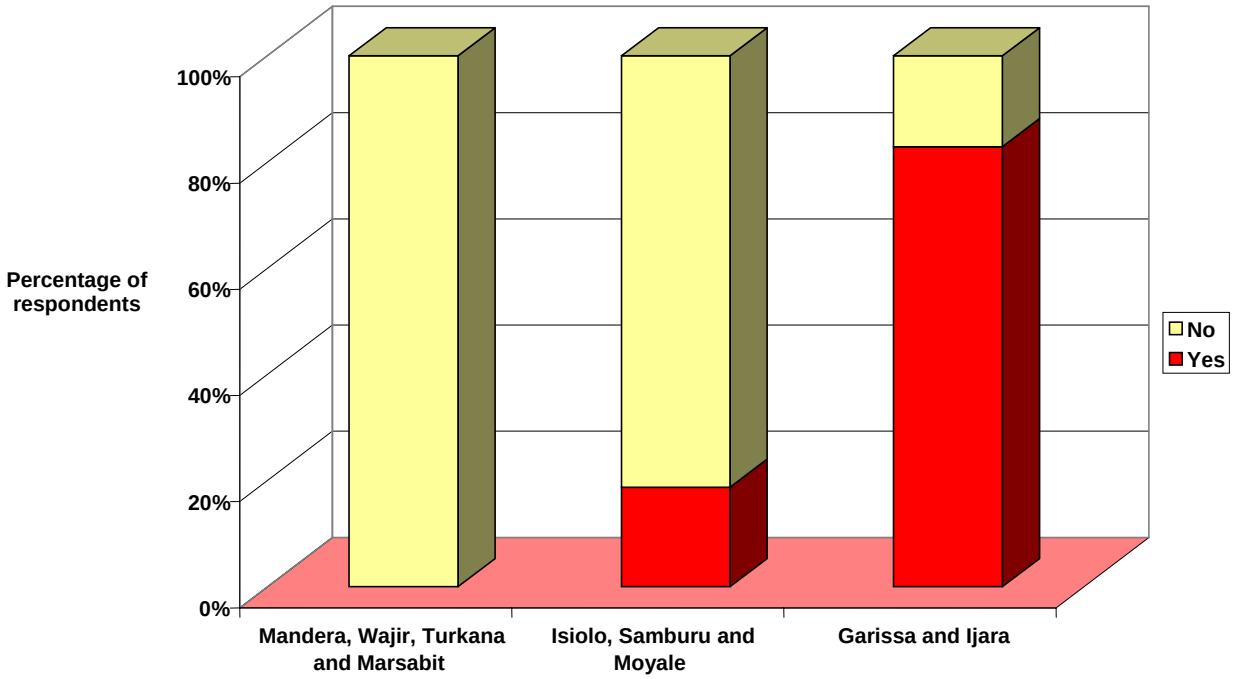
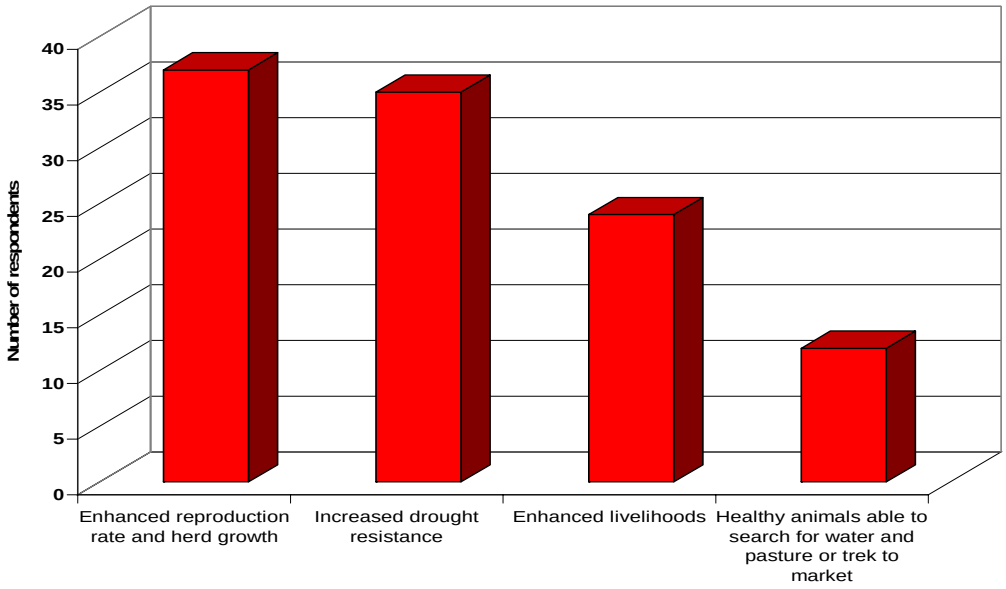
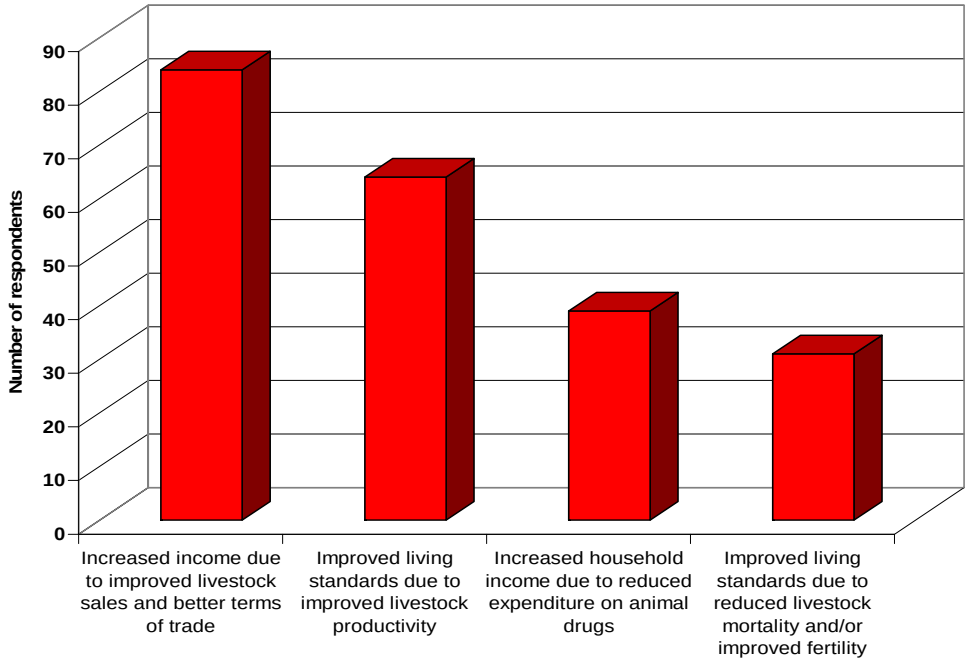


Figure (33) Expected short-term impacts of the veterinary interventions (minor responses)



10. Expected livelihoods impacts of intervention

Figure (34) Expected livelihoods impacts of the veterinary interventions



10.1 Increased income due to improved livestock sales and better terms of trade

Increased income, due to improved livestock sales and better terms of trade, was identified by 53% of respondents. This varied significantly between districts. In Ijara, fro example, this impact was identified by 100% of respondents; followed by, Garissa (80%), Wajir (75%), Mandera (70%), Samburu (42%), Marsabit (25%), Isiolo (20%), and Moyale (0%). Responses also varied by age and health status. For example, 85% of the age group ≤30 identified this impact compared to just 36% of the ≥61 yrs category. Likewise, 59% of able-bodied respondents identified this impact compared to just 25% of the infirm.

Figure (35) Increased income due to improved livestock sales and better terms of trade (by district)

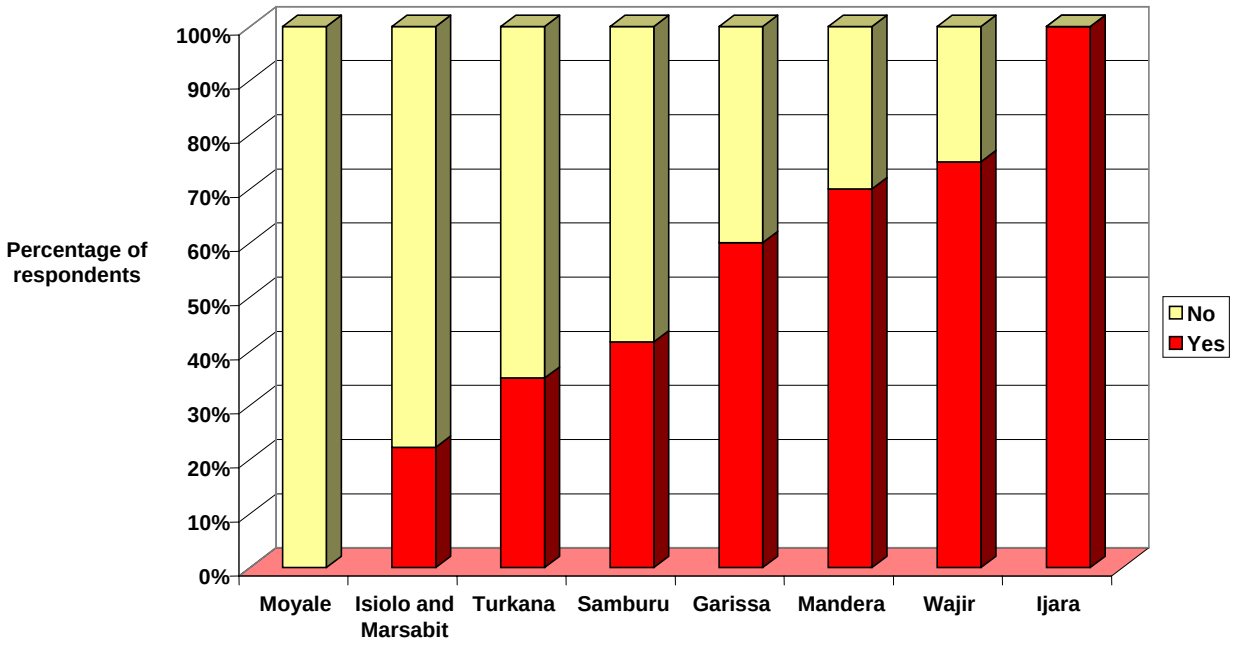


Figure (36) Increased income due to improved livestock sales and better terms of trade (by age)

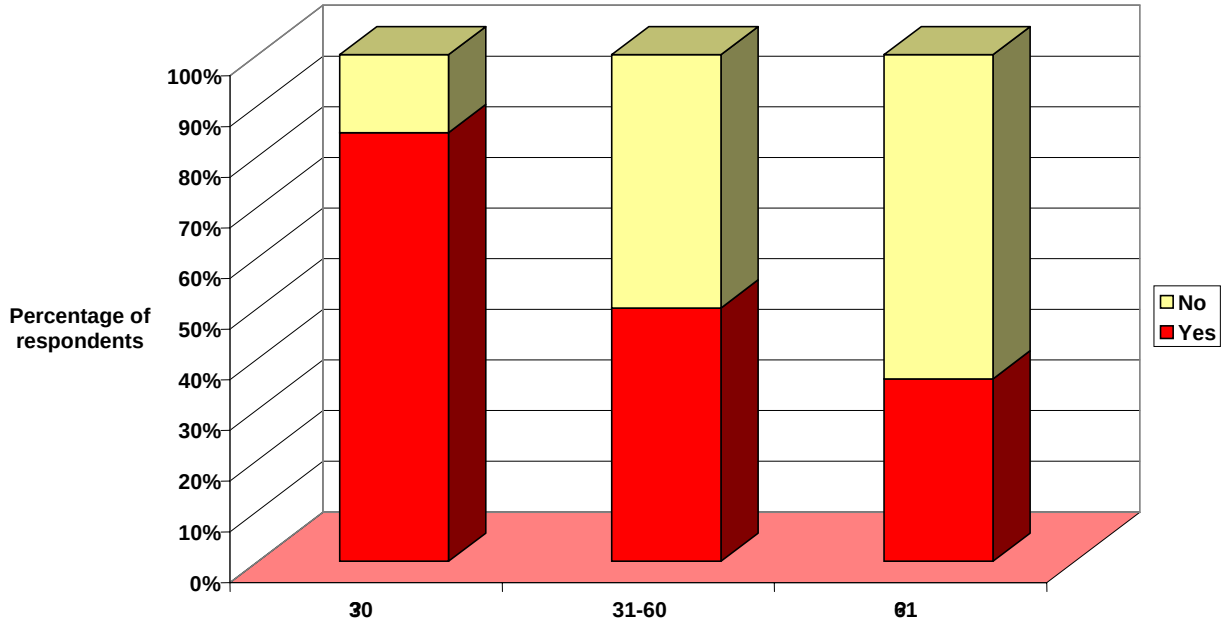
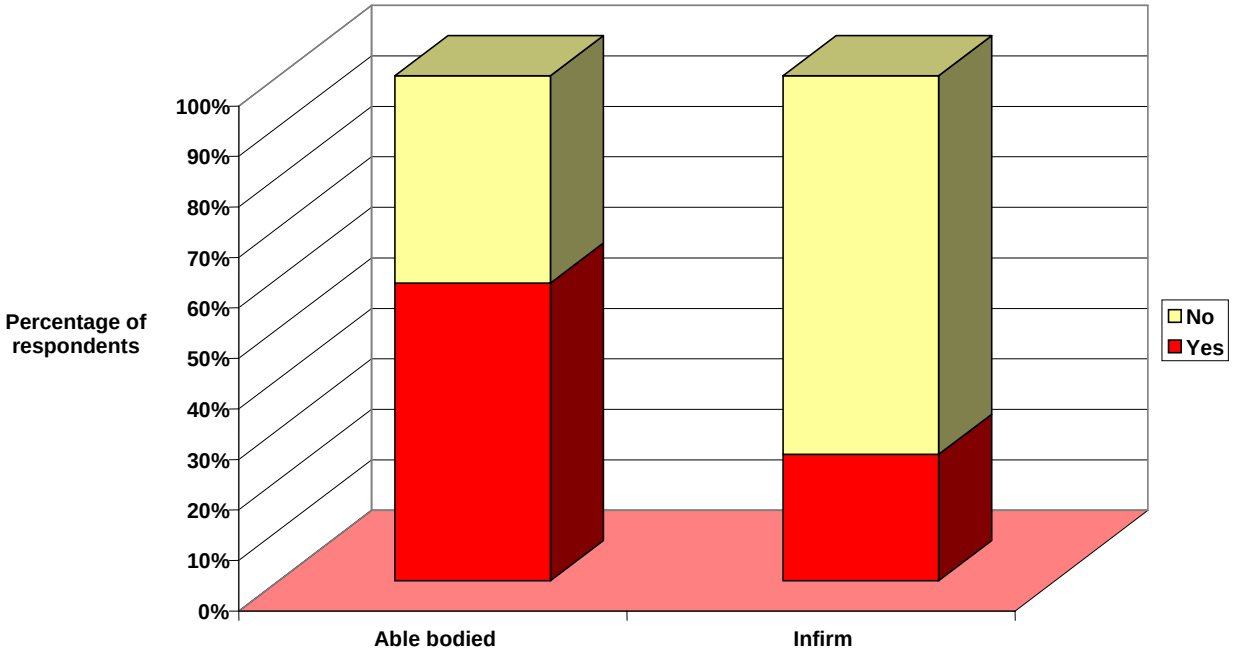


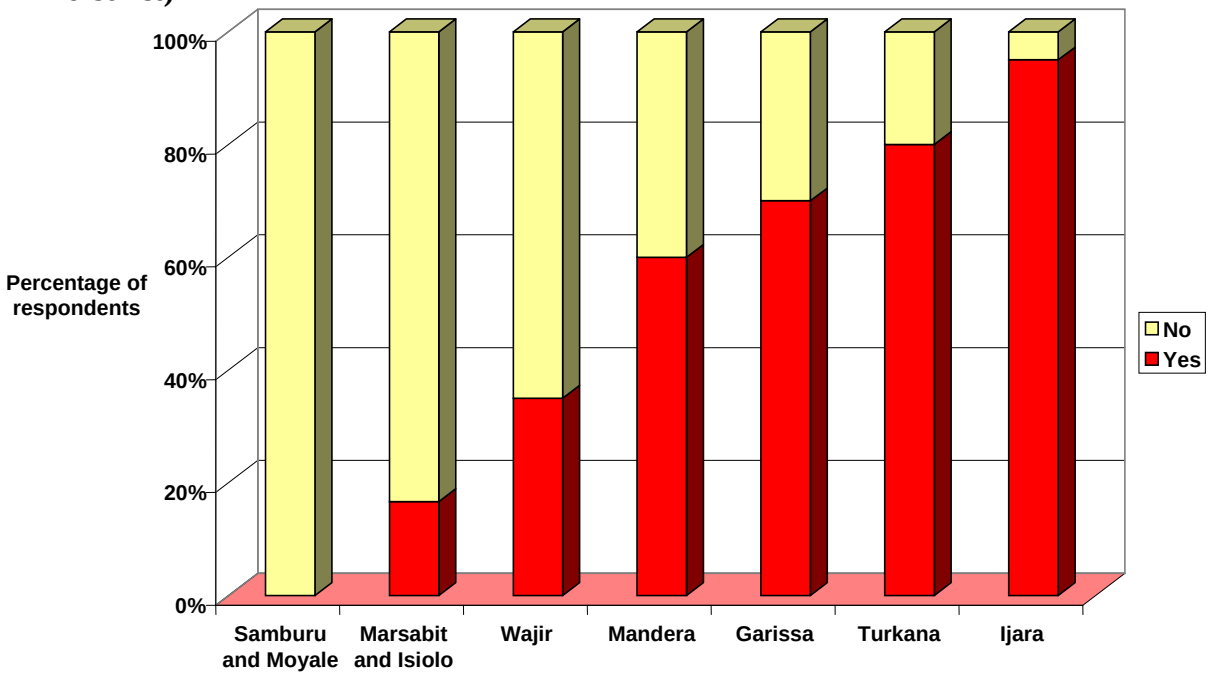
Figure (37) Increased income due to improved livestock sales and better terms of trade (by health status)



10.2 Improved living standards due to improved livestock productivity

Forty percent of respondents believed that the veterinary interventions would lead to improved living standards due to improved livestock productivity. Again, this varied significantly by district. For example, 95% of respondents in Ijara, 93% in Garissa, and 55% in Mandera identified this impact. However, only 25% in Turkana, 20% in Isiolo, 12% in Marsabit and 0% in Samburu and Moyale identified this impact. Responses also varied by gender and age; 54% of females and 32% of males, and 73% of the ≤30 age category compared to only 25% of the ≥61 age category expected this impact.

Figure (38) Improved living standards due to improved livestock productivity (by district)



10.3 Increased household income due to reduced expenditure on animal drugs

As a result of veterinary interventions, 24% of respondents expected increased household income due to reduced expenditure on animal drugs. Again, this varied considerably by district with 70% of respondents in Isiolo, 58% in Samburu, 62.5% in Marsabit, 50% in Mandera, and 45% in Wajir indicating this impact. Conversely, this was identified by only 10% of respondents in Moyale, 7% in Ijara and Garissa, and 0% in Turkana 0%.

Other, less popular responses include expectations that the veterinary interventions would lead to improved living standards due to reduced livestock mortality and/or improved fertility 19%, enhanced food security 18% (19 of 24 respondents came from Turkana and the remaining 5 came from Ijara), improved family health 15% (18 of 22 respondents came from Turkana), and less stress and happiness 14% (25 of 28 respondents came from Turkana). See Appendix (3) for a complete list of expected livelihoods impact of veterinary intervention.

Figure (39) Increased household income due to reduced expenditures on animal drugs (by district)

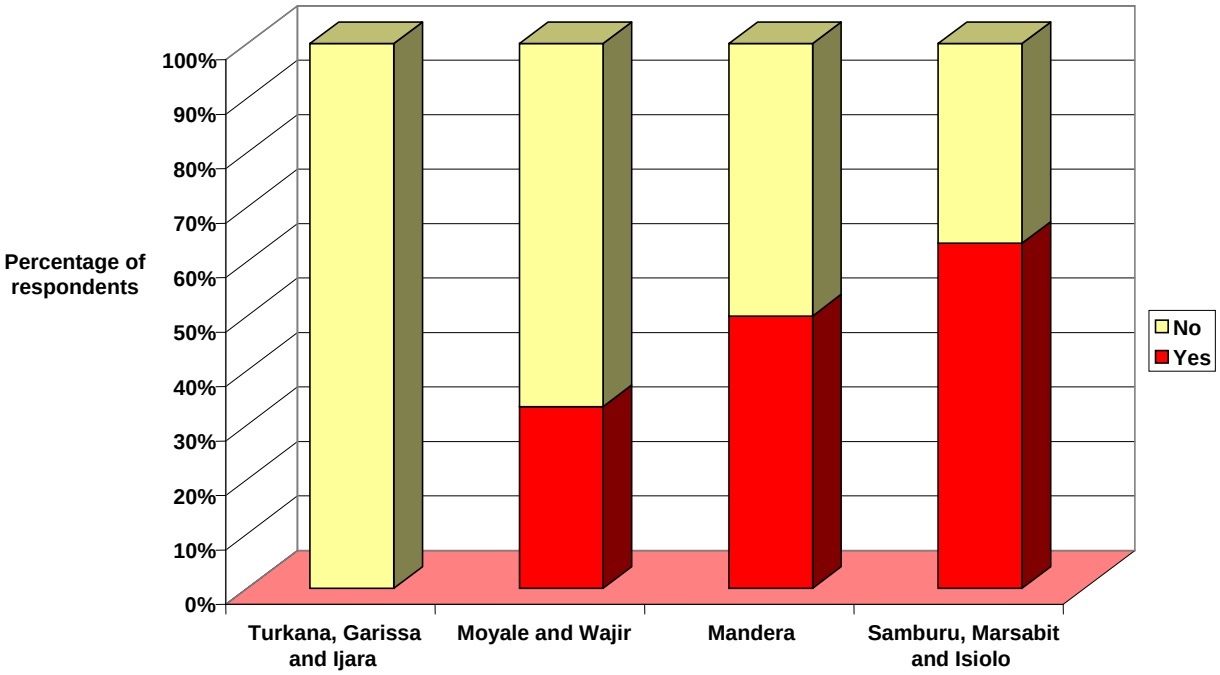
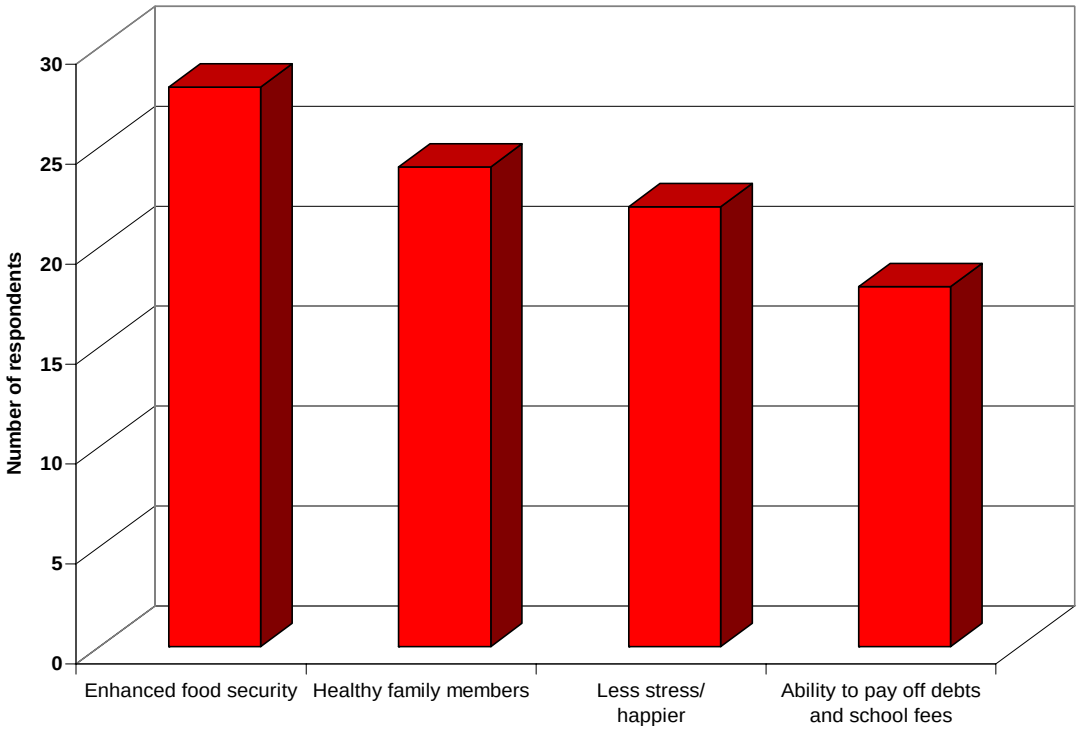


Figure (40) Expected livelihoods impacts of the veterinary interventions (minor responses)



11. Regional Overview

Figure (41) Regional Overview

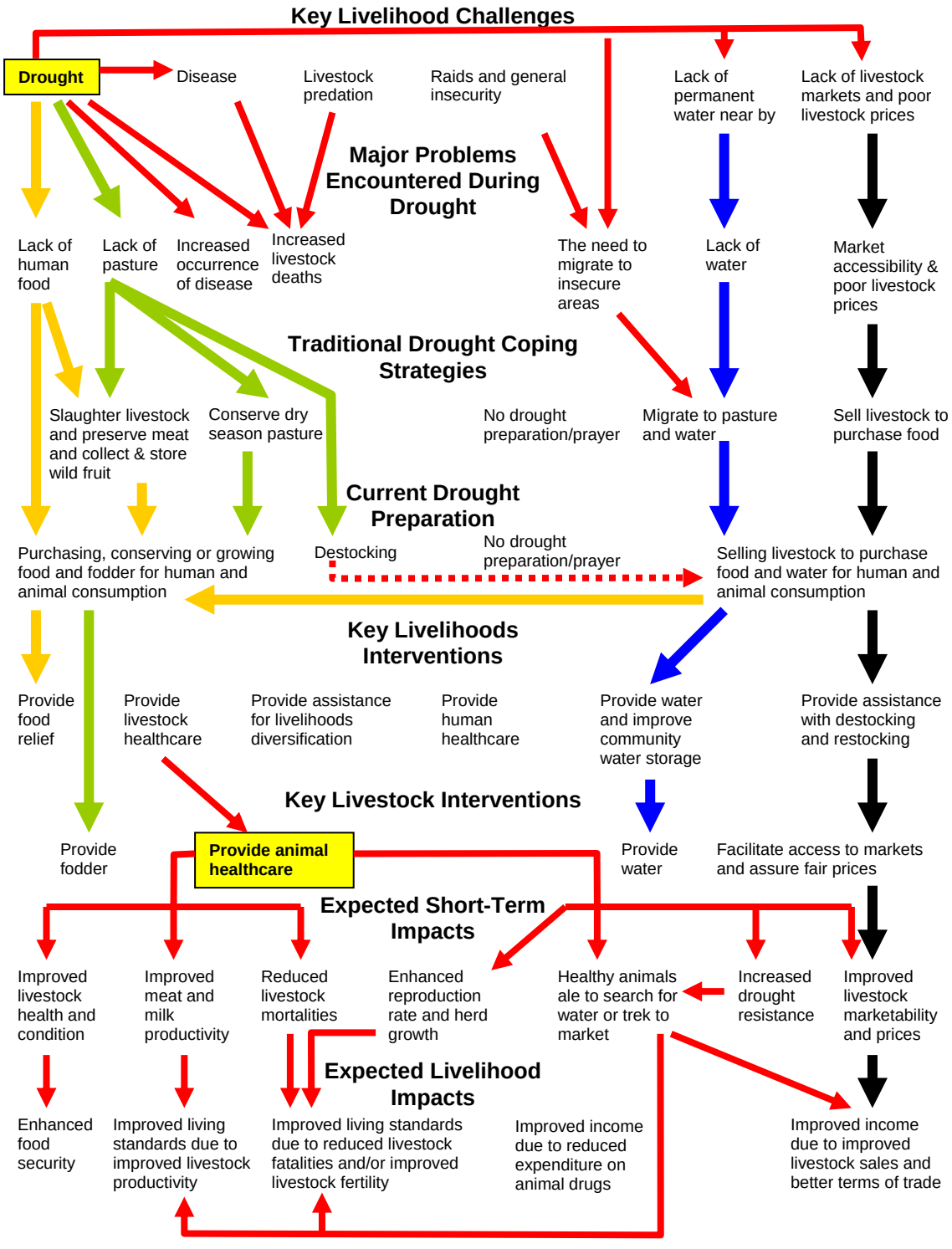


Figure 41 illustrates the conceptual and relational framework applied during this research in order to try and ascertain the relevance of the veterinary interventions with regard to: 1) Redressing major livelihood challenges faced by pastoralists; 2) redressing major problems encountered during drought; 3) bolstering traditional and current drought mitigation strategies, and; 4) meeting the expectations of pastoralists.

It can be seen from Figure 41 that there are several key thematic continuities that appear throughout. These include: Food security (humans and livestock); Livestock health; Water (humans and animals), and; Livestock markets. For example, in the case of livestock markets, Figure 41 illustrates that not only is the lack of livestock markets and poor livestock prices a key livelihood challenge, market accessibility and poor livestock prices are a major problem during drought. It can also be seen that selling livestock in the market to purchase food and selling livestock in the market to purchase food and water for humans and animals are key traditional and current drought mitigation strategies. Furthermore, market-based interventions, in the form of destocking and restocking and facilitating access to markets and ensuring fair prices, are key areas in which pastoralists would appreciate external assistance. Lastly, markets are crucial in ensuring the livelihood impacts that pastoralists perceive will be the outcome of the veterinary interventions. Each thematic area is colour coded to assist the reader in following the themes down through the schematic.

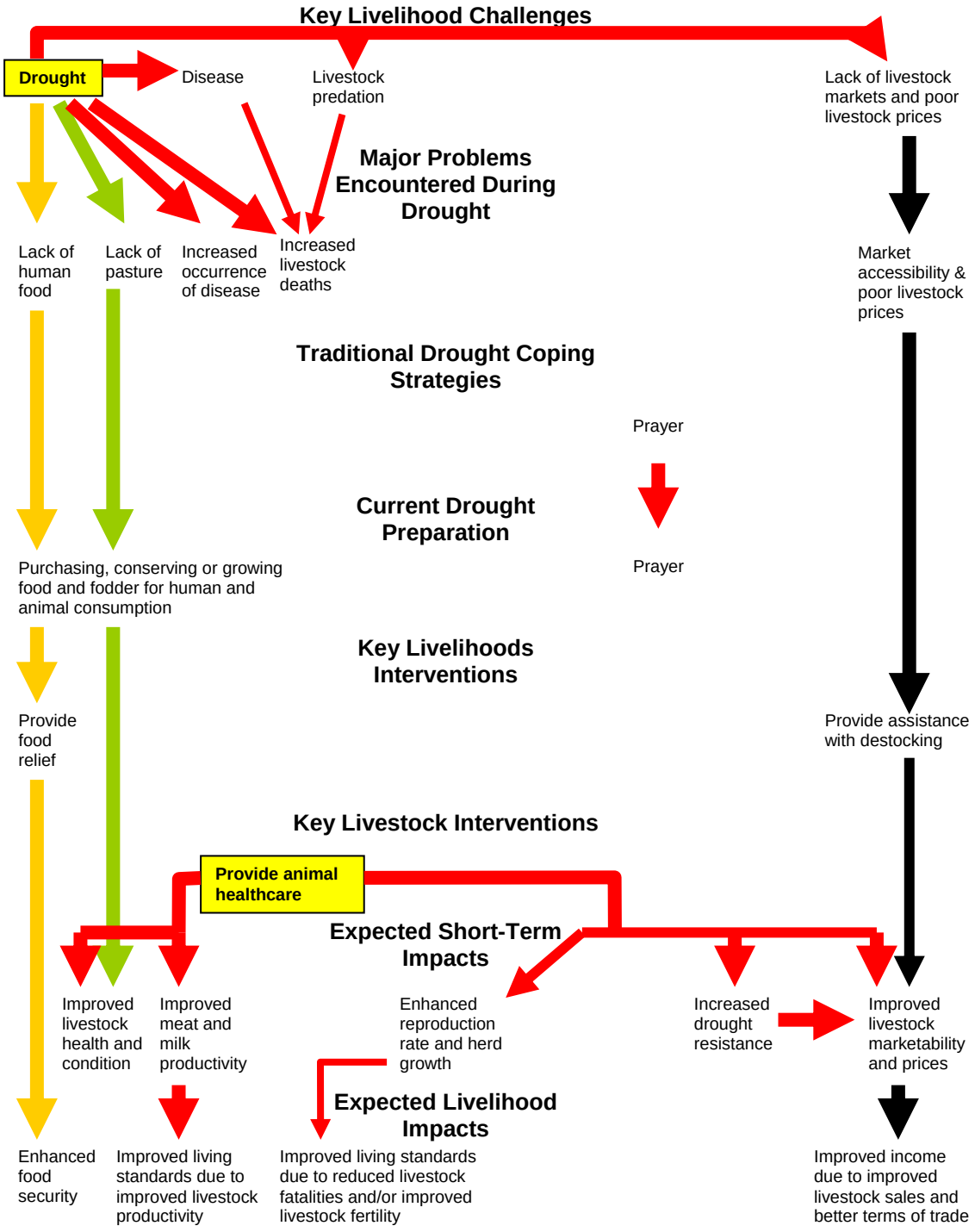
Figure 41 also illustrates key thematic discontinuities including: Livestock predation and raids and general insecurity. This form of presentation allows both reader and analyst to detect key discontinuities or anomalies. For example, in answer to the livelihood challenges question, 61 respondents indicated that livestock predation was a major livelihood challenge, yet no one mentioned it directly as a major problem during drought, and only one individual sought assistance for the control of livestock predators. The second discontinuity/anomaly refers to the significant expression of concern for raids and general insecurity in answer to the livelihood challenges question, with the almost complete absence of calls for conflict management assistance. Insecurity was mentioned as a key livelihoods challenge by over 50% of the respondents, yet only one respondent called for assistance with conflict management. Further work is required to explore these anomalies.

The next sections work through the summary schematics for the nine districts. Whilst it is possible to draw certain conclusions from the district summaries, and the data provided in this report, it must be remembered that, in most cases, the information used to generate both the schematics and the results in this report have been based on very small sample sizes, which can in no way be taken as fully representative of the districts in which the household surveys were conducted, and has been collected by individuals with little or no training in household survey techniques.

12. District-level summaries and recommendations

12.1 Garissa

Figure (42) Summary for Garissa District



The district-level summary for Garissa (Figure 42) clearly demonstrates a range of key continuities and discontinuities. First, it demonstrates the importance of the market to pastoralists in Garissa. It also illustrates concerns regarding animal food. It can be seen that the pastoralists surveyed in Garissa lack pasture during drought and endeavour to ensure adequate animal feed and as an insurance measure, and human food through purchasing, conserving, growing food and fodder for human and animal consumption.

On the negative side, prayer also seems to be a key drought mitigation strategy as well as the reliance on food relief. As with many of the districts, whilst livestock diseases are recognised as key livelihood challenges, as a major problem during drought, and as a key area for livestock intervention, respondents from Garissa failed to identify explicit disease-related drought mitigation strategies.

Recommendations for Garissa include: the need for future strategic market interventions; assistance with the development of more robust mechanisms for conserving or growing human food and animal fodder as an insurance against drought, and the assistance in the development of broad-based community-wide drought mitigation/coping strategies; the continued provision of food relief and livestock healthcare assistance where existing livelihood coping strategies fail in the face of drought. However, extensive additional research is required in order to develop more detailed recommendations based on larger, and more representative, sampling frames.

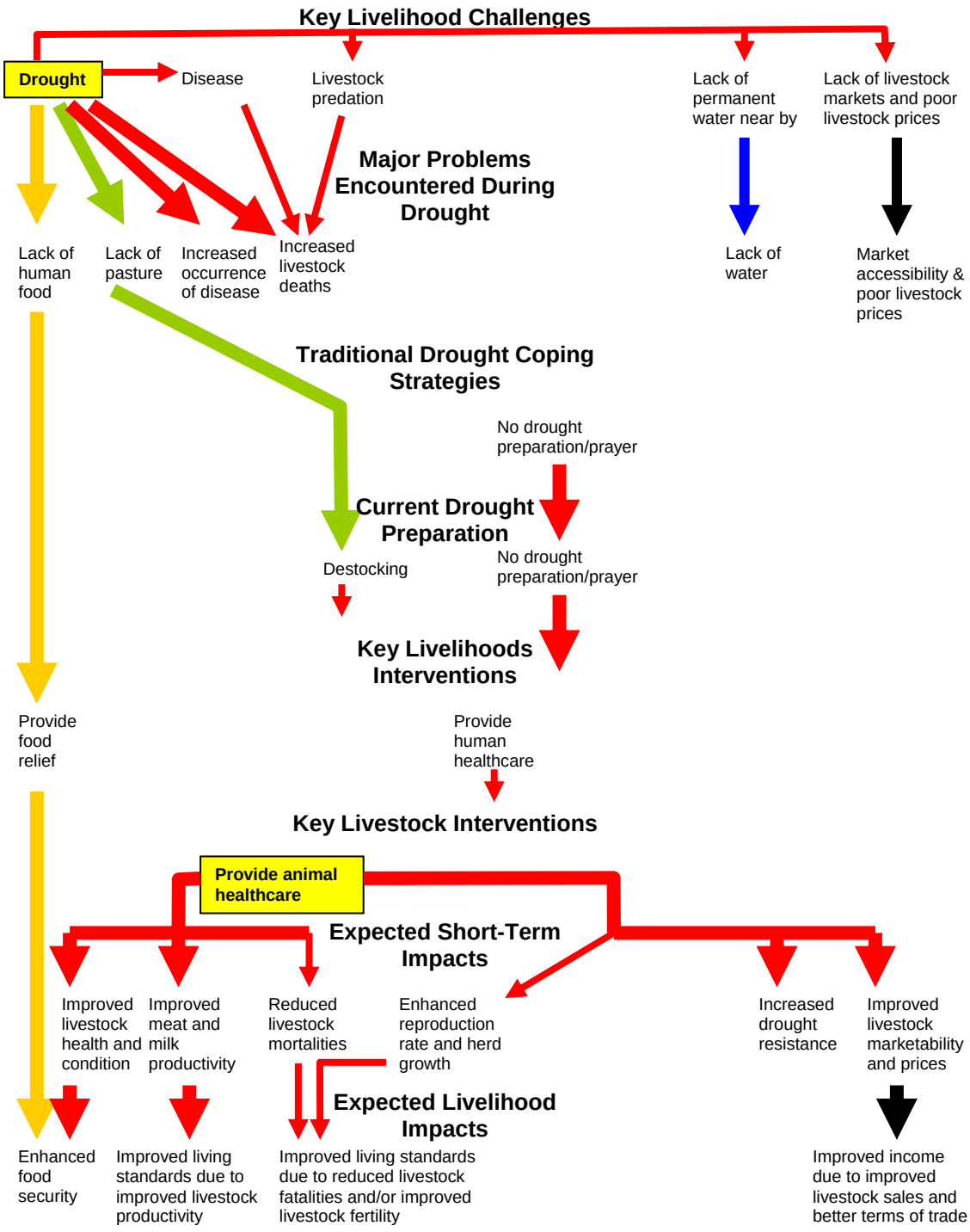
12.2 Ijara

Unlike Garissa, Figure 43 illustrates that the market does not feature as strongly in Ijara. While it is identified as a moderate livelihood challenge and a problem during drought, the market is not viewed as much of a constraint compared to Garissa. However, the market is seen as the place where the fruits of veterinary interventions can be realised.

In contrast to Garissa, whilst it suffers from a lack of livestock pasture, pastoralists in Ijara have tended to undertake limited de-stocking rather than to try and secure additional animal feed. In concert with Garissa, Ijara also tends to have a limited menu of drought mitigation strategies as seems to rely on food aid during times of drought. Again, while animal diseases are major concerns, respondents from Ijara did not give the impression that they attempted to control livestock diseases without support from external agencies. Also, even though both markets and lack of water are identified as key livelihood challenges and major problems during drought, respondents in Ijara did not attempt to address these concerns as part of their drought mitigation strategies, nor did they require external assistance.

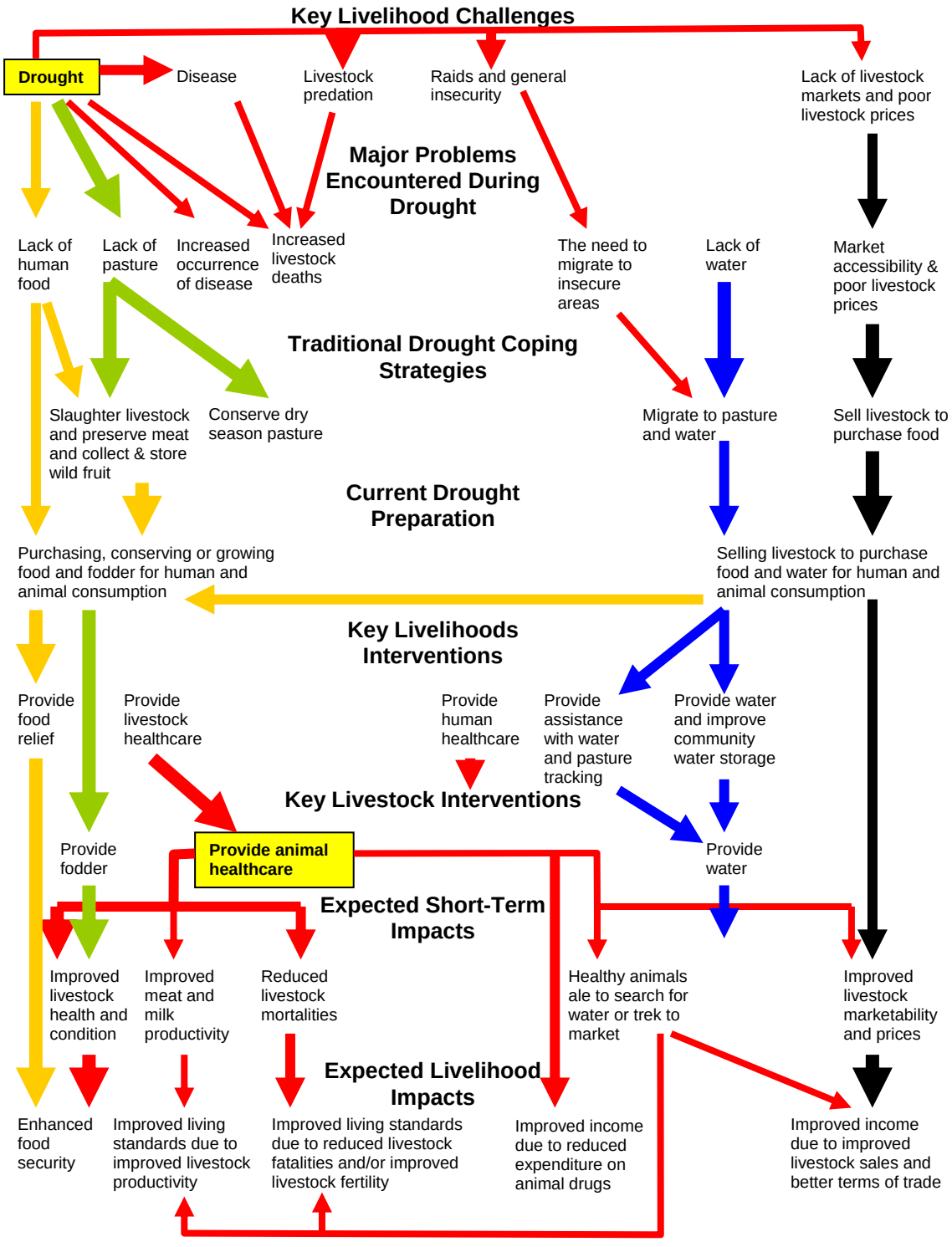
Recommendations for Ijara include: the need for future strategic market interventions; assistance in the development of broad-based community-wide drought mitigation/coping strategies, and; the continued provision of food relief and livestock healthcare assistance where existing livelihood coping strategies fail in the face of drought. There may also be a need for strategic water interventions but a more detailed investigation is required in order to determine whether or not this is the case. However, extensive additional research is required in order to develop more detailed recommendations based on larger, and more representative, sampling frames.

Figure (43) Summary for Ijara District



12.3 Wajir

Figure (44) Summary for Wajir District



Unlike Garissa and Ijara, Figure 44 illustrates that the respondents interviewed in Wajir have not only been able to identify key livelihood challenges and drought related problems in the past but have also been proactive in attempting to redress them. Respondents recognised the importance of properly functioning markets to their livelihoods. One could even conclude that, the inclusion of the provision of livestock healthcare in both the areas of livelihoods and livestock assistance, demonstrates their acknowledgement of the importance of livestock health with regard to trekking to find water and pasture as well as trekking to markets for sale. Unlike Garissa and Ijara, Wajir also explicitly emphasises the critical importance of water both as a key livelihoods challenge and problem during drought but also as a key area of external assistance. Drought coping strategies have evolved over time aimed at optimising available water and pasture resources during drought. But it is obvious; at least from the limited number of respondents in Wajir, that external assistance is still required in this area.

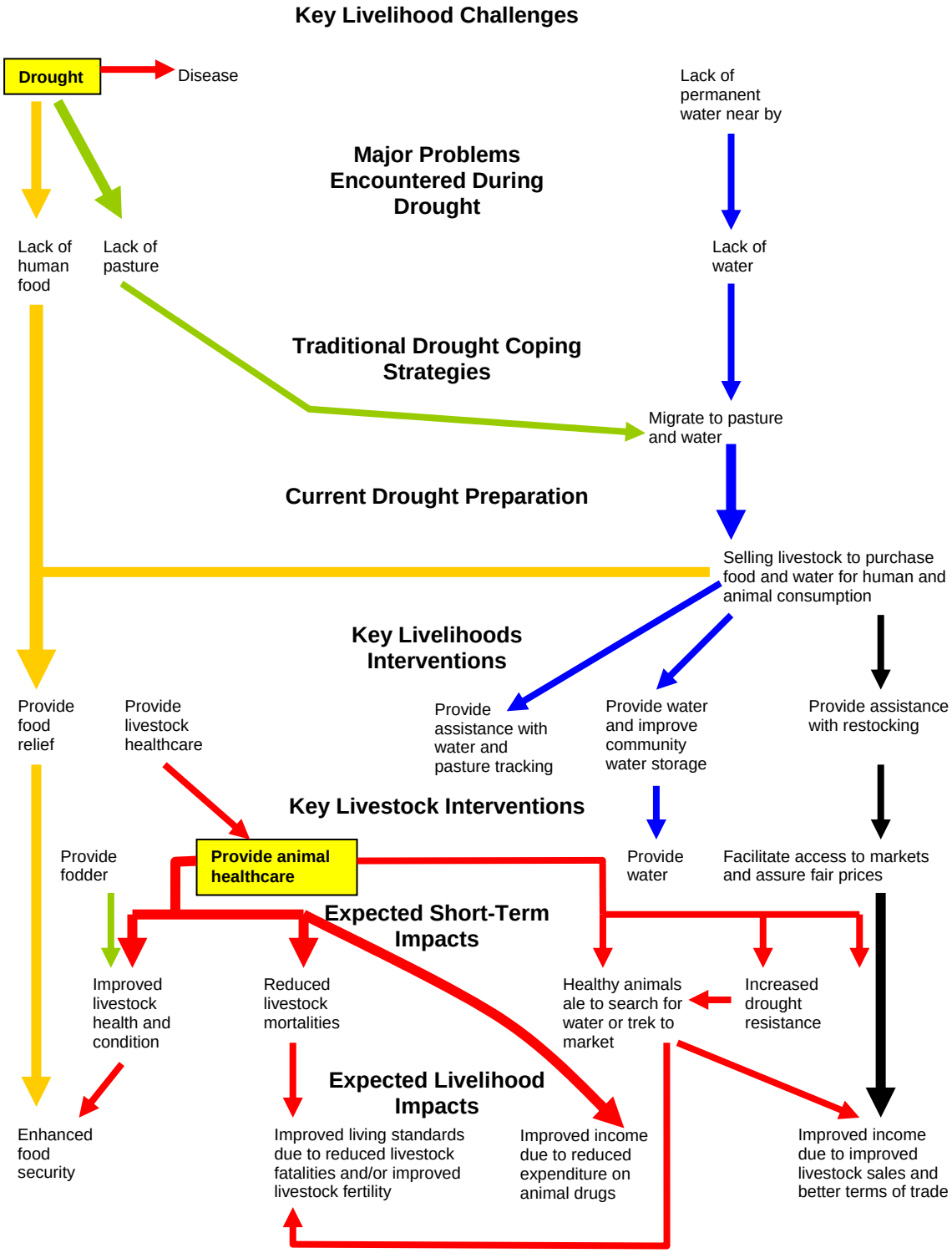
Recommendations for Wajir include: the need for future strategic market interventions; the need for strategic water-based interventions; assistance in the development of new broad-based community-wide drought mitigation/coping strategies and the bolstering of existing drought coping mechanisms, and; the continued provision of food relief and livestock healthcare assistance where existing livelihood coping strategies fail in the face of drought. However, extensive additional research is required in order to develop more detailed recommendations based on larger, and more representative, sampling frames.

12.4 Samburu

In many respects, respondents from Samburu district (Figure 45) often identified a range of sometimes seemingly unrelated and often surprising data. For example, while the market, and particularly market imperfections, were not raised as key livelihood challenges or major problems during droughts, but were key components of calls for livelihoods and livestock-related assistance and were seen to be instrumental in attaining enhanced livelihoods. Following both the green and blue arrows clearly illustrates the zonal nature of Samburu pastoralists, namely migrating from wet season lowland areas to dry season highland areas. However, this traditional drought coping strategy appears to have its limitations as respondents have also identified lack of pasture and lack of water as key livelihoods challenges and major problems during drought. In addition, assistance was also called for regarding the provision of water and water storage facilities and for water and pasture tracking.

Recommendations for Samburu include: the need for future strategic market interventions; the need for strategic water-based interventions; assistance in the development of new broad-based community-wide drought mitigation/coping strategies and the bolstering of existing drought coping mechanisms, and; the continued provision of food relief and livestock healthcare assistance where existing livelihood coping strategies fail in the face of drought. The provision of livestock healthcare was seen as a key livelihoods intervention as well as a key livestock intervention. However, extensive additional research is required in order to develop more detailed recommendations based on larger, and more representative, sampling frames.

Figure (45) Summary for Samburu District



12.5 Isiolo

Figure (46) Summary for Isiolo District

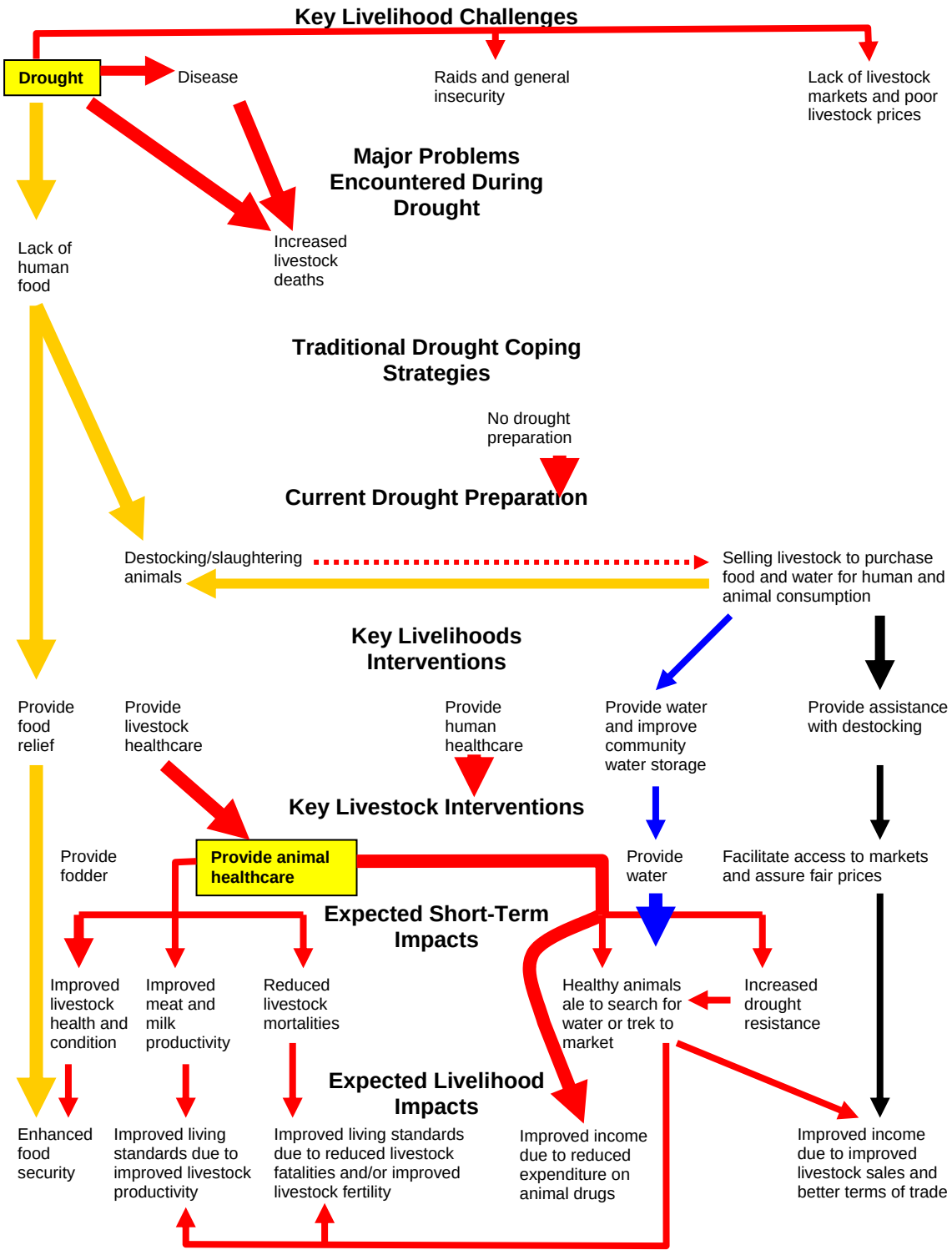


Figure 46 illustrates that, whilst respondents in Isiolo failed to identify lack of markets and lack of water as key livelihoods challenges and major problems during drought, the provision of water and the assurance of effective and equitable markets featured significantly in calls for livelihoods and livestock-related assistance and in the attainment of improved livelihoods. In addition, while diseases (both human and animal) were identified as key livelihood challenges and livestock fatalities identified as a major problem during drought, it is interesting to note that they did not list livestock health interventions as part of their traditional or current drought mitigation activities. This point is further confused by the fact that Isiolo was one of the few districts that made a strong positive link between the provision of livestock healthcare as part of both livelihoods and livestock-related interventions and improvements in their incomes due to reduced expenditures on animal health drugs.

Ironically, none of the respondents across all nine districts mentioned the vaccination or treatment of livestock as a traditional or current drought coping strategy. Isiolo stood out from the other districts, with the exception of Ijara, by identifying a very limited number of drought coping strategies. Indeed, aside from praying, destocking was about the only strategy mentioned and was a key component of the external assistance required.

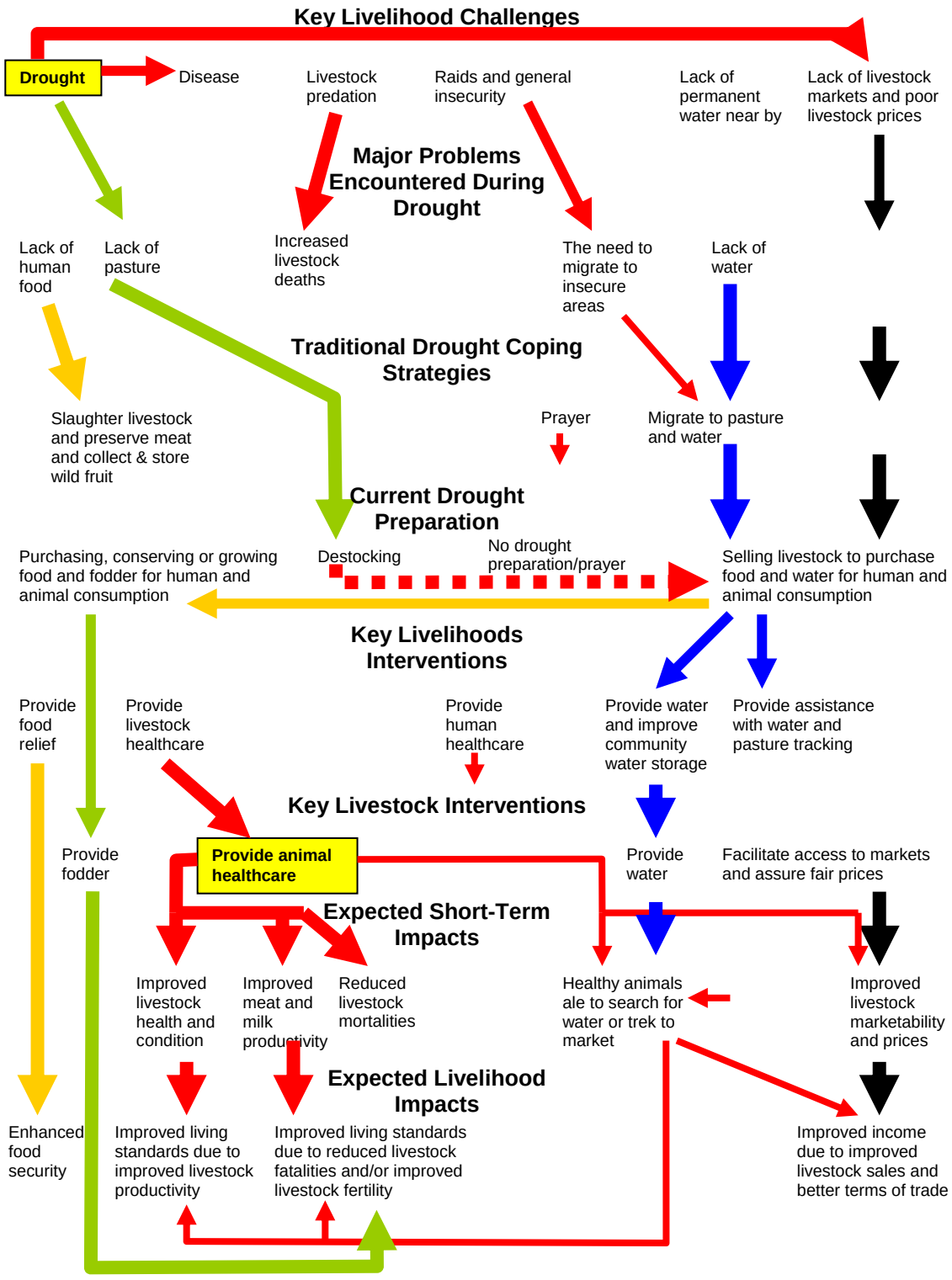
Recommendations for Isiolo include: the need for future strategic market interventions; the need for strategic water-based interventions; assistance in the development of new broad-based community-wide drought mitigation/coping strategies and the bolstering of existing drought coping mechanisms, and; the continued provision of food relief and livestock healthcare assistance where existing livelihood coping strategies fail in the face of drought. The provision of livestock healthcare was seen as a key livelihoods intervention as well as a key livestock intervention. However, extensive additional research is required in order to develop more detailed recommendations based on larger, and more representative, sampling frames.

12.6 Mandera

Again, Figure 47 illustrates the diverse characteristics of the DRP districts. In Mandera, as with many other districts, respondents identified a series of problems related to both the lack of markets or poor livestock prices and the lack of water, particularly rainfall for pasture growth. Respondents in Mandera also offered a range of drought mitigation strategies based on the substitution of animal fodder and food in the absence of pasture, the production and purchase of human food (through destocking livestock and using funds to purchase food for humans and livestock) and migration to areas of water and pasture during drought.

In addition, based on the key livelihood challenges and drought related problems, respondents in Mandera requested key external interventions assumedly aimed at bolstering existing drought mitigation activities. This includes the provision of fodder for livestock, livestock healthcare, assistance with the livestock marketing, community water storage and water and pasture tracking. Drawing conclusions from the data provided, respondents in Mandera seemed to have the most comprehensive grasp of what needs to be done, with external assistance, to ensure their livelihoods in the face of significant livelihood and drought-related challenges.

Figure (47) Summary for Mandera District



However, there are two significant inconsistencies, namely; the identification of livestock predation and raids and general insecurity as key livelihoods challenges and increased livestock deaths (not necessarily cause and effect) and the need to migrate to insecure areas during drought. Whilst these are major concerns to the respondents from Mandera, assistance is not sought either in predator control or conflict management.

Recommendations for Mandera include: the need for future strategic market interventions; the need for strategic water-based interventions; assistance in the development of new broad-based community-wide drought mitigation/coping strategies and the bolstering of existing drought coping mechanisms, and; the continued provision of food relief and livestock healthcare assistance where existing livelihood coping strategies fail in the face of drought. However, extensive additional research is required in order to develop more detailed recommendations based on larger, and more representative, sampling frames.

12.7 Moyale

Figure 48 illustrates the responses from Moyale district. One striking characteristic is the total omission of livestock market-related problems, calls for market-related external assistance and key market-based impacts. As with Mandera, respondents from Moyale also expressed concerns regarding raids and general insecurity as well as the need to migrate to insecure areas during drought. However, as with Mandera, none of the respondents called for external assistance for conflict management. One interesting point to note is that, whilst respondents identified few drought coping strategies, several mentioned the conservation of dry season grazing and requested the provision of fodder as a key livestock intervention. Whilst not identified as a key livelihood challenge or major problem during drought, assistance in the provision of water and water storage was called for as key livelihoods and livestock interventions.

Respondents from Moyale also expected increased incomes due to reduced expenditures on animal drugs; even though they had not included livestock vaccinations or treatments as a drought mitigation strategy. This could be an example of down-playing their own livestock healthcare initiatives in the light of the current veterinary intervention in case the veterinary teams responded by reducing the scale and scope of their activities. Or, conversely, details of livestock vaccinations and treatments may not have been explored during the interview process.

Recommendations for Moyale include: the need for future strategic market interventions; the need for strategic water-based interventions; assistance in the development of new broad-based community-wide drought mitigation/coping strategies and the bolstering of existing drought coping mechanisms, and; the continued provision of food relief and livestock healthcare assistance where existing livelihood coping strategies fail in the face of drought. However, extensive additional research is required in order to develop more detailed recommendations based on larger, and more representative, sampling frames.

Figure (48) Summary for Moyale District

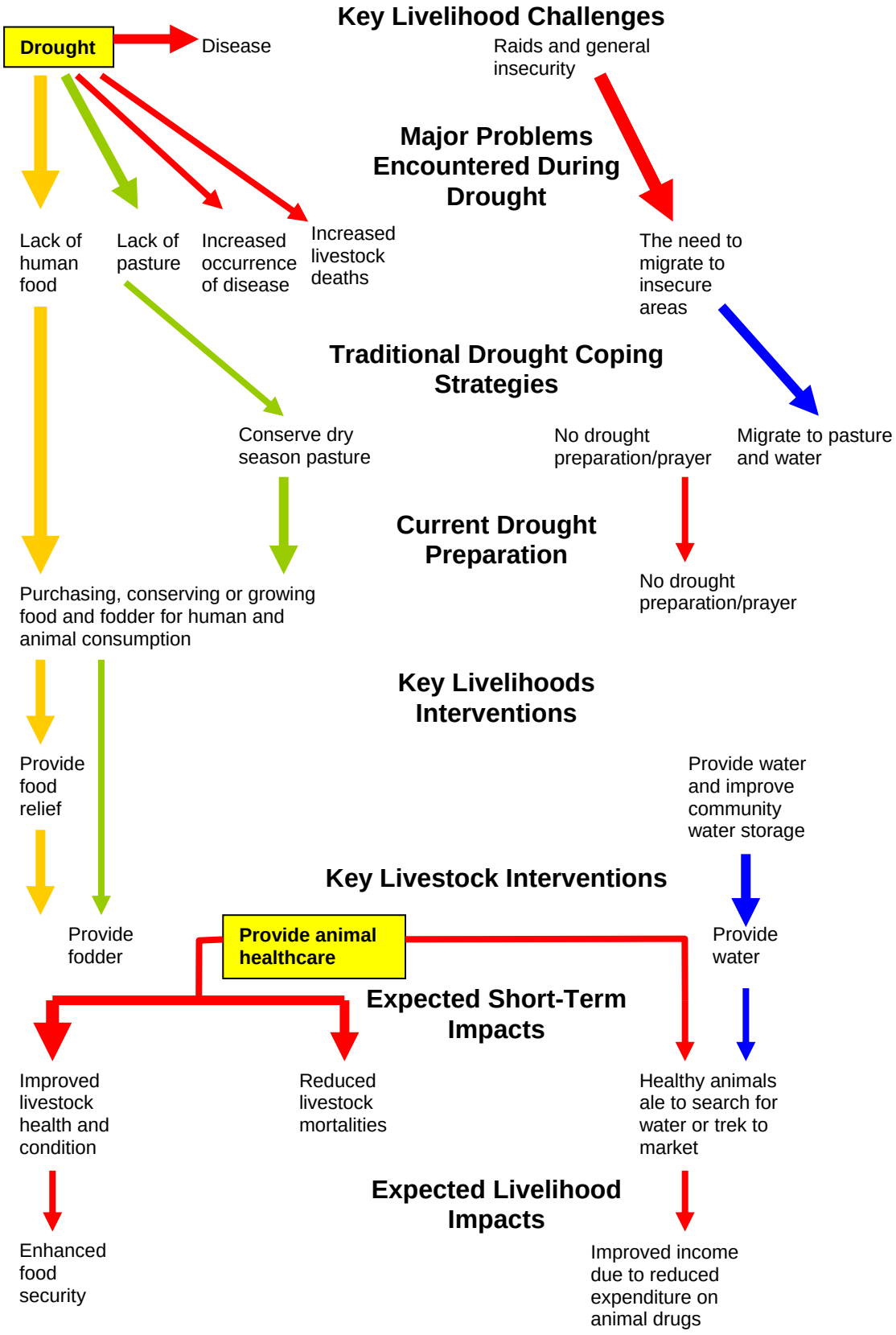
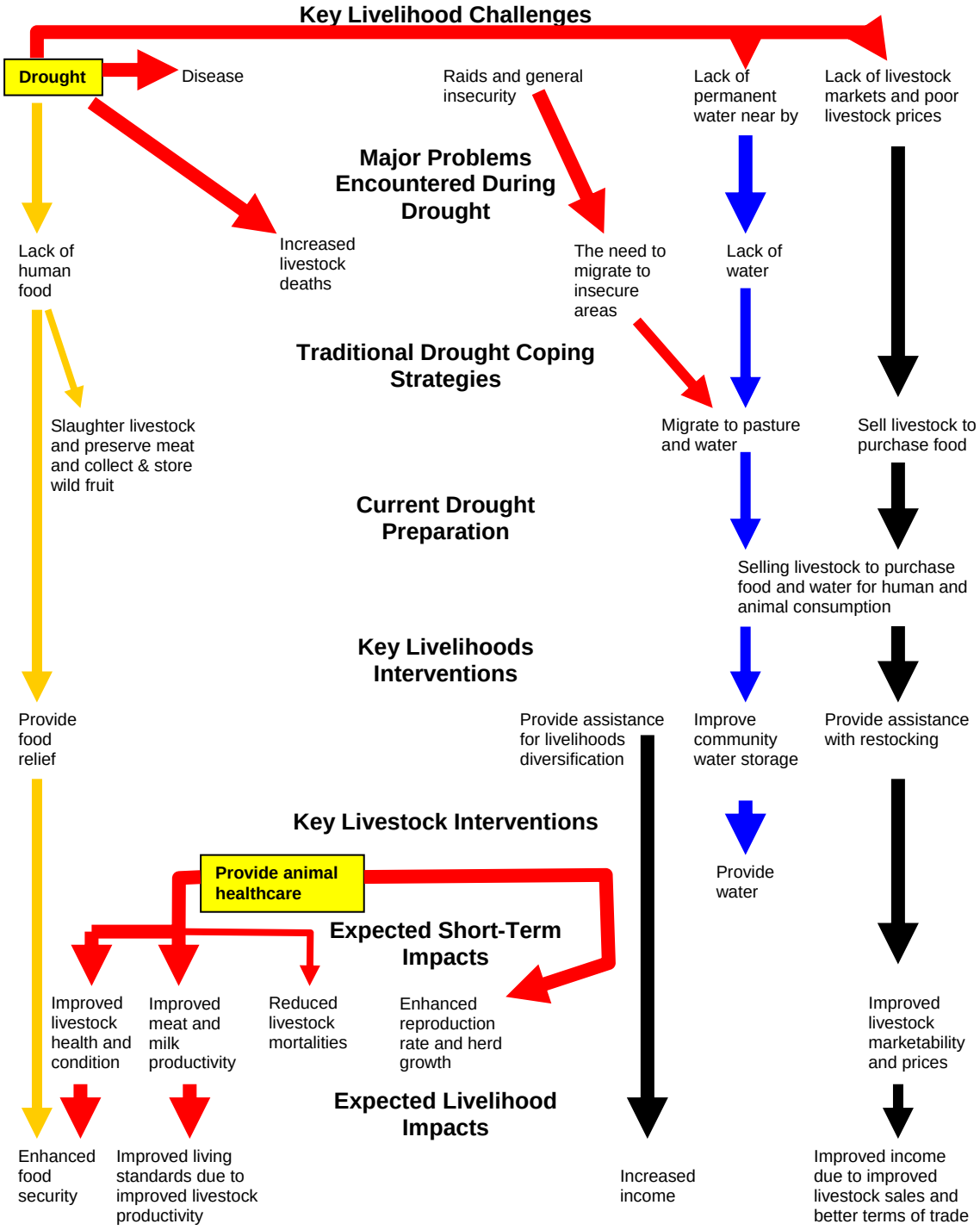


Figure (49) Summary for Turkana District



12.8 Turkana

In many respects, Turkana (Figure 49) is similar to many other districts of the DRP. However, respondents from Turkana placed a significant amount of emphasis on both the market and water interventions throughout the schematic. In concert with Mandera and Moyale, respondents from Turkana also identify raids and insecurity, and migration to insecure areas as key concerns but fail to request assistance in conflict management. As a district, it is also characterised as identifying only two drought mitigation strategies, namely; migration to pasture and water, and slaughtering livestock and preserving the meat. However, a review of literature indicates a broader menu of drought mitigation options, including: the preservation of grazing areas for times of extreme drought; division of large herds into smaller units and species; keeping multiple species; stock loaning between relatives and friends; collection of wild fruits and bartered cereals, and; begging for food. In addition, Turkana is unusual as respondents dominated calls for assistance in diversifying livelihoods.

Recommendations for Turkana include: the need for future strategic market interventions; the need for strategic water-based interventions; assistance in the development of new broad-based community-wide drought mitigation/coping strategies and the bolstering of existing drought coping mechanisms, and; the continued provision of food relief and livestock healthcare assistance where existing livelihood coping strategies fail in the face of drought and further investigation into the possibilities for livelihoods diversification in the district. It must be noted that if the suspected urban bias is in fact the case, overwhelming calls for assistance in livelihoods diversification would be easier to explain. However, extensive additional research is required in order to develop more detailed recommendations based on larger, and more representative, sampling frames.

12.9 Marsabit

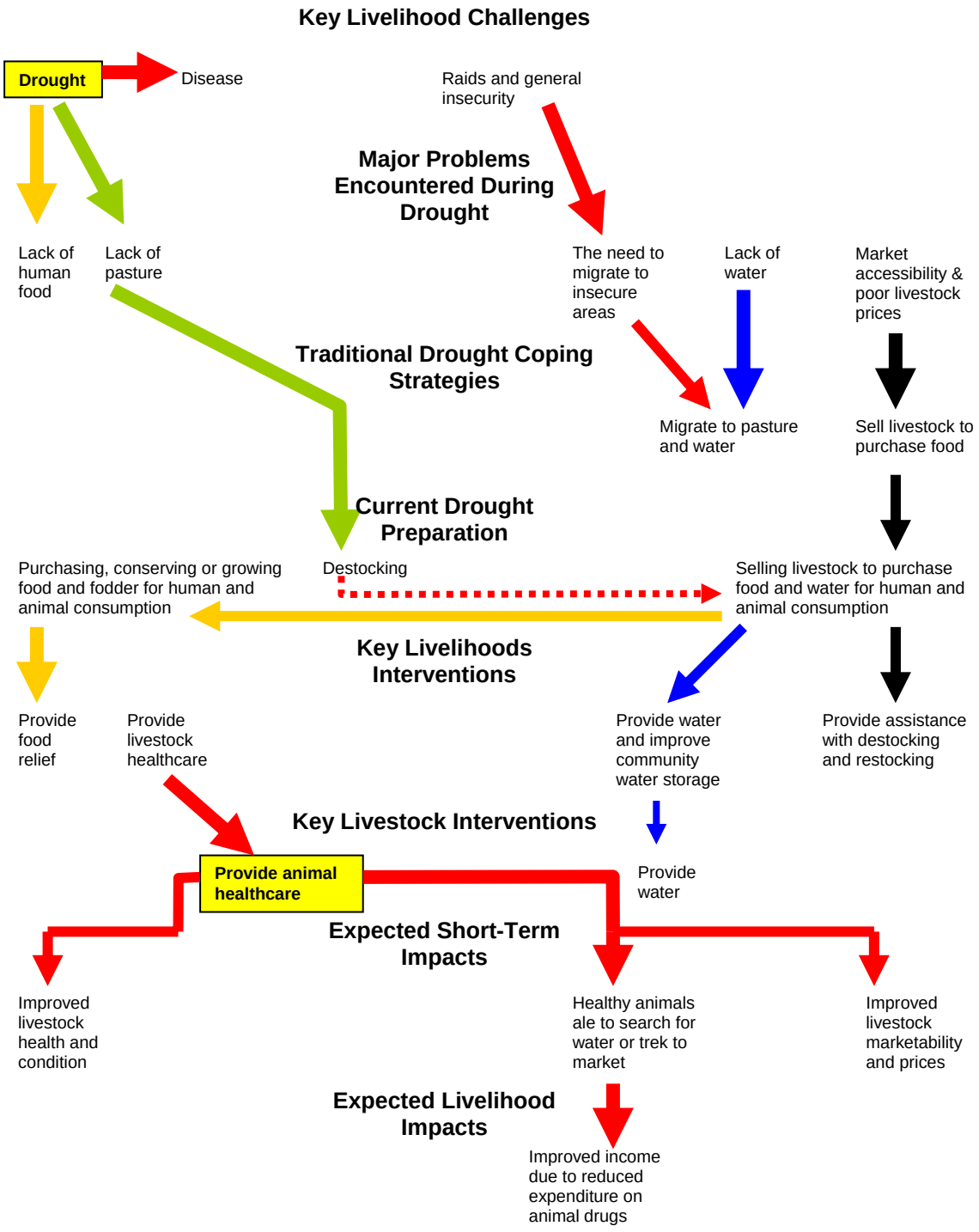
Interestingly, respondents from Marsabit (admittedly only 8 individuals) indicated a narrow range of key livelihood challenges. As with other districts, whilst raids and general insecurity, and the need to migrate to insecure areas, were accredited with key importance, conflict management assistance was not requested. Interestingly, concerns over lack of water and access to markets and poor prices were only identified as major problems during drought. Traditional drought mitigation strategies include destocking in response to lack of pasture and lack of human food and migration to areas of water and pasture.

The key areas of external assistance requested are: livestock market, water, livestock health and human food-related. Interestingly, the key livelihoods assistance indicated was that of increased income due to reduced expenditure on livestock healthcare. Again, respondents failed to mention livestock healthcare as a drought mitigation strategy.

Recommendations for Marsabit include: the need for future strategic market interventions; the need for strategic water-based interventions; assistance in the development of new broad-based community-wide drought mitigation/coping strategies and the bolstering of existing drought coping mechanisms, and; the continued provision

of food relief and livestock healthcare assistance where existing livelihood coping strategies fail in the face of drought. However, extensive additional research is required in order to develop more detailed recommendations based on larger, and more representative, sampling frames.

Figure (50) Summary for Marsabit District



Chapter 2

Effects of water interventions on livelihoods and the environment in Northern Kenya

Bancy M. Mati

1. Introduction

Water resource availability and development to reach human and livestock users are major constraints in Northern Kenya, which forms one of the driest regions in the country. Northern Kenya suffers from insufficient and widely dispersed water resources and low rainfall characterized by high uncertainty. Consequently, the risks to loss of livestock assets due to lack of water are very high, causing recurrent conflicts. The poor performance of the long rains of April and May 2004 caused shortage of pasture, browse and water availability and accessibility. Pastoralists were forced to adapt using coping mechanisms like migration in search of pasture inside and outside the country. The average distance travelled to water sources increased, reaching over 70 kilometres in some areas. Livestock condition in most districts dropped below normal and was expected to further deteriorate due to early migration to distant grazing areas and water points. This drought was further compounded by the fact that pastoralists had not yet fully recovered from the previous drought of 2000. Vulnerability to food insecurity was high, as about 40% of the pastoralists live below the poverty line. The frequency of drought-related crises has increased in the recent past preventing full recovery.

The poor distribution of water sources also affects availability of forage and is probably the main cause of the poor distribution of livestock in the rangelands, especially during the dry season. Without a water source, it is difficult to keep livestock in an area long enough to achieve proper utilization of forage. Consequently, large numbers of animals concentrate on the few water points leading to heavy grazing pressure and trampling of soil within several kilometres of a water point. The result is retrogression of plant communities to the dominance of less palatable species. And, with the reduction of palatable species, further overgrazing takes place setting off a vicious cycle of degradation.

It has been argued that bringing development to ASALs by increasing the number of water points for livestock may not necessarily achieve the desired results. This is because traditionally, water availability in the dry season was the critical factor that limited livestock populations and pasture access. Traditional systems often had well-defined rules governing access to resources and their utilization. Disease also limited human and animal populations. The natural checks prevented intensive land use and environmental degradation, which would have caused a reduction in the overall carrying capacity. Introduction of veterinary services and the provision of water through boreholes have removed some of these limitations leading to human and animal population growth, but these have happened in the absence of sound management. The new factor that becomes dominant in the control of livestock populations is lack of

forage. Since pastoralists like to keep large herds of livestock, overgrazing consequently causes land degradation. Therefore, in addition to water developments in the future, which are needed for areas with severe scarcity, there is a need to balance the new interventions with the number of livestock as well as the grazing resources. This is especially important in the face of prolonged droughts that hit the region.
During the drought of 2004-2005, large herds of livestock and human lives were at risk. The need for emergency relief support and rehabilitation was expressed by the local people and NGOs working in the region. A large number of local and international NGOs are active in the nine targeted districts mainly in the water sector, namely; CIFA, EPAG, Ramati Initiatives, Northern Aid, TISP, Tupado, Cods, Cidri, ITDG, Cordaid, CARE, World Vision, Oxfam GB, Merlin, SNV and AMREF. This section of the report presents the water and environment component of the response to the drought of 2004-2005, in four districts of Northern Kenya; Moyale, Samburu, Isiolo and Marsabit.

1.1 Objectives

The main objective of the Environment and Water component was to help in planning and developing monitoring tools to evaluate the overall project impact on pastoral livelihoods, and to assess the effect of the project on livestock and livestock livelihoods, including an assessment of the effects of the interventions on the natural resources base including estimation of livestock carrying capacity, genetic diversity, environmental degradation and water resources preservation. The benchmark was to determine whether the project activities had increased cumulative water availability by at least 400,000 litres per day, in the selected districts.

2. Methodology

2.1 Providing technical backstopping

Technical backstopping was provided through advisory consultations, with the NGO – COOPI (COOPerazione Internationale), which coordinated implementation of the water and environment component of the emergency drought response project, in four districts in Northern Kenya; Moyale, Samburu, Isiolo and Marsabit. Several meetings were held between the water and environment specialist and COOPI staff, particularly the hydrologists, geologists and engineers. Reviews were made of the proposed water sources identified for rehabilitation by the project, to ensure that the geographic location of the major water points were in line with major cattle routes.

2.2 Planning and developing monitoring tools

In collaboration with COOPI and other project partners, a questionnaire was developed as the principal monitoring tool. This tool was used to assess the impacts of the rehabilitation of water sources on the overall goals of the project. Recorded information on water in the target districts was difficult to source. Indeed, only one borehole in Marsabit had good records. Information on water, grazing and browse resources, and the project impacts on livelihoods were obtained from interviews with key stakeholders, focused group discussions, a review of

office records and field observations. The identification of target water facilities for improvement was carried out through community meetings with pastoralist beneficiaries and consultations with Arid Lands Resource Management Project, District Water Officers, District Steering Group (DSG) members and local NGOs active in the targeted districts. Coordination with CORDAID and UNICEF was promoted to provide a mutual exchange of information as well as to avoid overlapping and to fill the gaps. In some cases, such as in Khorr and Sagante in Marsabit District, similar interventions to rehabilitate a cluster of shallow wells were carried out by both COOPI and CORDAID in order to strengthen the impact of the interventions on the benefiting communities.

2.3 Field visits and formal surveys using questionnaires

In June 2005, the water and environment specialist visited Samburu, Marsabit and Isiolo Districts (Appendices 6 and 8). The visit was co-hosted by NGOs working with COOPI in the respective districts, these being Ramati in Samburu, CIFA in Marsabit and CARITAS in Isiolo. The original itinerary planned to visit two boreholes in Samburu, one borehole and ten shallow wells in Marsabit, and one sand dam and four shallow wells in Isiolo. Due to security concerns, the programme for Marsabit was changed and instead one borehole and ten shallow wells were visited, while logistical arrangements in Isiolo enabled two boreholes, two sand dams, and two shallow wells to be visited. The overall conclusion was that the water sources selected for rehabilitation were all strategic in terms of spatial stratification and availability of water in drought periods. In water sources, where rehabilitation work had started, the designs and quality of work were of high standards, and work was progressing at a good pace. However, socio-economic conflicts were mentioned at Harsilwa in Marsabit and Mlango in Isiolo and these concerns were reported for further investigation and resolution before continuation with the physical works. During the visit, interviews were conducted with local leaders, officials of the Ministry of Water and NGOs, while the questionnaires were administered to 15 respondents, who were water users of the facilities visited.

2.4 Data analysis

Data collected informally by PRAs (i.e. matrix scoring, ranking and proportional piling) were aggregated and analysed in EXCEL spreadsheets and subjected to descriptive analysis and tabular techniques. In addition, calculations were done to determine the increase in water yield from each individual water source, based on test pumping results and estimates from records (Appendix 7).

3. Major Findings and Impacts

The water and environment component of the project involved rehabilitation and improvements of existing water facilities. This was meant to achieve increased water yield (litres per day), reliability of the extraction equipment, and improved hygiene and safety. Each intervention was site-specific to suite the conditions, and wishes, of the

communities. In general, interventions ranged from rehabilitation of shallow wells, through re-capping and improving staircases to water sources/wells. For boreholes, it included, installation of pumps, construction of water tanks to enable some temporary storage of water pumped from boreholes, rehabilitation and installation of gensets, separation of access points for animals from humans, (in two cases) there was drilling of replacement boreholes, construction of livestock drinking bays, pump housing and safety. The project therefore had the following impacts; (i) increased water availability during the drought period, (ii) environmental conservation, and (iii) improved livelihoods.

3.1 Increasing water availability

The project achieved cumulative increased water availability by 617,400 litres per day, which exceeds the benchmark 400,000 litres set for the project. Therefore, the project met the target on increasing water availability. In terms of spatial distribution, the improved water facilities were spread across 14 strategic local sites on livestock routes in the four districts (Marsabit, Moyale, Isiolo and Samburu). In total, 36 water sources were improved; most of which were permanent water sources, including nine boreholes and 22 shallow wells rehabilitated and the construction of three shallow wells and two sand dams. More specifically, replacement boreholes were drilled at Mlango in Isiolo and Leisirikan in Samburu District, increasing water availability by 240,000 lt/day. The new hand dug wells in Daaba in Isiolo District increased water by 134,400 lt/day. By operationalizing Rawana borehole in Moyale District, through repairs to the generator and provision of pump, water was increased by 120,000 lt/day. The provision of an appropriate pump for the Amballo borehole in Moyale District added 96,000 lt of water/day, while the construction of Longopito and Namelok sand dams in Isiolo District added another 13,000 and 14,000 m^3 of water respectively.

3.2 Safety and hygiene

Another aspect is safety and hygiene, which were improved in shallow wells due to capping, stabilizing walls with masonry, raising the well head above ground, building stepping rings and landings and through the provision of livestock watering troughs. Local communities interviewed during the field visits indicated that they were opposed to installation of hand pumps, which they claimed made water extraction slow and reduced discharge. Thus, as per their wishes, no hand pumps were installed. The construction of the two sand dams was driven by community demands, and based on the fact that sand dams have been quite sustainable in the Oldonyiro Division in the past. Site selection was undertaking in a participatory manner, using local knowledge; both sites had good natural dykes. The construction of water storage tanks, increasing the number of troughs, specific distribution facilities for human and animal consumption and separating water distribution for animal and human consumption improved the hygienic and environmental conditions, particularly during drought periods when there is high concentration of livestock.

3.3 Impacts on the environment

Environmental impact assessments conducted during field visits and through interviews with local people, government officers and NGOs revealed that the rehabilitation of water facilities at the 14 sources would have minimum negative impacts on the environment. Ground truthing studies revealed there was no evidence of excessive denudation, nor evidence of severe soil erosion such as rills and gullies (Appendix 8). There are several reasons for this. First, nearly all the water sources are existing ones for which environmental resilience was already established. In addition, the pastoral communities in these areas have in-built mechanisms to reduce overgrazing and land degradation around water points, by regulating the distance around water points that may be grazed. Animals are expected to graze at least 5 km away from the water source. In addition, these were strategic water sources, predominantly for use during the dry season. During the wet season, when livestock are grazing in other areas, vegetation is able to recover. It should also be appreciated that, at the time of the evaluation, there had been a drought spanning approximately one year, therefore natural vegetation was at its lowest levels. Moreover, most of the water sources were either non-operational or only partially operational, explaining the presence of good vegetation around some of the water points. The improvement of shallow wells helped improve hygiene, safety and reduce siltation of the wells, reducing the need for regular de-silting.

3.4 Impacts on livelihoods

Pastoral livelihoods in the four districts of Isiolo, Marsabit, Moyale and Samburu are dependent on livestock, and during drought, water is the lifeline to their survival. By availing water during drought through this project, human livelihoods directly benefited; as nearly all the sources serve both livestock and human water demands. As planned, all rehabilitation and construction works were carried out along main livestock routes; resulting in increased availability of water with substantial advantages to the beneficiaries, which outweigh any risk of potential adverse environmental impacts. The project benefited approximately 15,000 pastoralist households, of which 450 households were directly benefiting from access to drinking water.

On average, the distances to water along migratory routes during drought periods were reduced by 20% to 70% depending on the site location. More specifically, the distance between strategic water sources along livestock routes was reduced by drilling and equipping replacement boreholes at Leisirikan, in Samburu District, and Mlango in Isiolo District. In case of breakdown at Kawap or Masikita in Samburu District, the animals would previously have to travel a distance of 47 km to reach alternative water sources. Now the distance that would be travelled is 19.5 km (Masikita – Leisirikan) and 30 km (Kawap - Leisirikan). As a result of Mlango replacement borehole, the distance has been reduced from 33 km (Kipsing – Ngare Ndare) to 26.5 km (Kipsing – Mlango) and 10 km (Ngare Ndare – Mlango). Generally, the project benefited both male and female pastoralist community members through the animal health service delivery and the increased availability of water. Particular attention was paid to women and children and that was why it was decided to construct two sand dams in Isiolo District.

Generally, shallow wells can be over 10 m deep, each serving about 10 households. Upon improvement, each shallow well requires 4-6 persons to hand each other water, which is an improvement over the previous 7-8 persons, and safety is enhanced. Each sand dam can hold about 7,000 m^3 of water and is expected to serve a human population of about 2,500, 10,000 cattle, 30,000 shoats and 2,000 camels. With improved water facilities, livestock and people will have access to water within a reasonable distance in drought periods, thereby improving livelihoods, and resilience against droughts.

3.5 Other foreseen benefits

The boreholes have committees and cost recovery mechanisms hence scope for self-sustenance. Through participatory site selection, and involvement of communities throughout the project implementation, conflicts over water were reduced as the facilities rehabilitated were those the communities felt would result in fewer conflicts. There is also reduced environmental impact by increasing availability of water from existing watering facilities, and improved health of the people as well as livestock due to reduced distances travelled to reach watering points.

4. Conclusions

Response to drought in emergency situations for pastoral communities can be complicated by the fragility and mortality of the major livelihood resource, livestock. This was especially so in the provision of emergency relief and response to communities and livestock faced by the drought of 2004-2005 in Northern Kenya. In this project to preserve pastoral livelihoods in Northern Kenya during emergency drought situations, the interventions involved included vaccination and livestock disease control, as well as rehabilitation of strategic water facilities in four districts, viz. Isiolo, Marsabit, Moyale and Samburu. The water facilities rehabilitated at the 14 sources were strategically selected to fall within livestock routes and to reduce the long distances traversed to water during drought. By having strong community participation, and combining government, local and international NGOs with the right expertise, in conjunction with scientific backstopping by ILRI, the project was implemented with a strong monitoring and evaluation component.

The total increment in water made available to livestock and communities was 617,400 litres per day, thereby meeting the target set before the project commenced. This helped improve the livelihoods of 15,000 pastoralist households of which 450 households directly benefited from access to drinking water. In general, each water facility, especially strategic boreholes, is normally utilized by about 1,000-5,000 households, 5,000-10,000 cattle, 20,000-30,000 shoats and 2,000-5,000 camels. The rehabilitation of shallow wells helped to improve hygiene, safety and reduce siltation. With improved water facilities, livestock and people will have access to water within reasonable distance in drought periods, thereby improving livelihoods.

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Chapter 3

Epidemiological impact of the Drought Response Project in selected arid districts in Northern Kenya

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Abbreviations:

BQ	Black quarter
CCPP	Contagious caprine pleuropneumonia
CBPP	Contagious bovine pleuropneumonia
DRP	Drought Relief Project
ECF	East Coast fever
ET	Enterotoxemia
FMD	Foot and mouth disease
HS	Hemorrhagic septicemia
ILRI	International Livestock Research Institute
LSD	Lumpy skin disease
NGO	Non-governmental organization
SGP	Sheep and goat pox
TBD	Tick-borne disease
Tryps	Trypanosomiasis

Definitions
Annual Morbidity Incidence: The estimated number of individuals that became sick in a one-year time period. Morbidity includes both cases that recovered and those that died.
Annual Mortality Incidence: The estimated number of deaths in a one-year time period.

1. Introduction

Impact assessment as a tool for learning how to do a better job of designing and implementing projects is increasingly receiving attention. The COOPI Drought Relief Project represents an innovative step forward in livestock emergency relief activities in that it incorporated impact assessment as an integral project activity at the outset and sub-contracted a collaborating organization to assist in designing the data collection and to analyze the findings. As an innovation, there are important lessons to be learned not only about the impact of the project, but about how impact assessment can and should be practically conducted within the boundaries of a reasonable level of resources. To this end, the consultant requests that his analysis is taken as a step in a learning process for the entire team.

Beyond epidemiology, the conceptual framework that was used to design the data collection and conduct the analysis was sustainable livelihoods. For a detailed description of this approach as it relates to emergencies, the reader is referred to Schafer (2002). For the purposes of the this report, the author wishes to remind the reader that livelihood analysis considers both livelihood assets and the transforming process and institutions that shape asset utilization through the opportunities and constraints that processes and institutions create for different livelihood strategies. The livelihood approach also places heavy emphasis on the vulnerability context of beneficiaries and coping strategies for dealing with external shocks such as war, droughts and floods.

Donors are currently placing heavy emphasis on logical frameworks as a tool to structure project interventions in relation to desired outcomes and impacts. The conventional approach to project impact assessment is to define quantitative indicators and then measure progress against the agreed indicators. A common approach is to make measurements of baseline indicators prior to project implementation and then measurement of changes in indicators during and after project implementation.

Two types of indicators are generally recognized: process and impact indicators. Process indicators measure the progress of implementation of the project against its work plan. For example, the number of vaccinations, workshops or other completed activities. Impact indicators are designed to measure the effect that project activities have towards achieving project goals. Examples of impact indicators are lives saved, changes in the availability of food, changes in the underlying vulnerability, or effects on the coping strategies.

Good indicators not only need to relate clearly to project activities and goals, they should consider the practicality of measurement. Some dimensions of project impact are inherently difficult to measure in a quantitative sense. This is particularly true regarding vulnerability and coping strategies.

In general terms, the goal of the COOPI DRP project was to save human lives and livelihoods of pastoralists threatened by drought. It is the job of food aid and human health interventions to directly save human lives. By their nature, livestock interventions saving human lives by preserving livestock livelihoods. The job of impact assessment was to provide insights into how well the goal of preserving livestock livelihoods was served by the project. To that end, both process and impact indicators were designed into the project.

In the case of the animal health component of the COOPI DRP, examples of key process indicators were numbers of vaccinations, numbers of treatments and community-animal health workers mobilized. Reliably tracking process indicators was mainly an exercise in good recording keeping and accounting. In other words, although tracking process indicators can be a tremendous amount of work, they are generally easier to measure than impact indicators.

The principal impact indicator selected for the Drought Relief Project from an epidemiological point of view was annual mortality incidence. This was a team decision that involved both the NGOs and ILRI. This indicator was extremely attractive as it related to the projects success in protecting a key livelihood asset: livestock. In this sense, the choice of livestock mortality as the principal indicator was logical. However, it did create some concerns on three fronts. First, how measurable was annual mortality within the resource constraints of the project. Secondly, to the extent that changes in mortality levels are detected, to what extent were these changes caused (were attributable) to project interventions. Finally, how closely did changes in annual mortality levels attributable to the project relate to the broader goal of saving human lives through preserving livestock livelihoods. These three concerns will be discussed below.

1.1 Measurement of Annual Mortality Incidence

This required the project to measure mortality levels by disease in all the major species. Although, it would seem logical that animal health interventions should reduce animal mortality, animal mortality is in practice difficult and costly to measure accurately using conventional quantitative epidemiological techniques. In the past, several large livestock sector development projects have implemented quantitative epidemiological components to measure disease specific animal mortality as a developmental objective of the projects in their own right. These projects often used standard quantitative questionnaires supported by laboratory diagnostics. The study designs ranged from sentinel herds to cross-sectional surveys. In hindsight, projects of this type were largely perceived to have failed. As a result, this approach to monitoring and targeting animal health in livestock development has generally fallen into disfavour. The point is that measuring the principal indicator of the DRP using conventional quantitative epidemiological would have consumed more resources than the entire project budget.

As a solution to this issue the project team elected to use participatory epidemiological techniques that were designed to rapidly collect epidemiological intelligence on annual disease mortality incidence on all diseases of importance to all species that were identified by the respondents as important to their livelihood. Using this approach, the project team carried out one comprehensive assessment to develop baseline estimates of annual mortality incidence by disease and species and assessments of the livelihoods importance of livestock, each species kept and each disease.

1.2 Attribution of Changes in Annual Mortality Incidence to Specific Causes

A wide variety of factors external to the project influence animal mortality and it is difficult to accurately attribute changes in mortality rates to specific causes. Examples of external factors are other animal health activities in the area, environmental changes such as exacerbation of the drought or the return of the rains, inter-current epidemics that temporarily exacerbate specific disease risks, political events causing forced migrations for security reasons, etc (Earl et al., 2001).

This means that if changes in mortality rates were detected before and after project interventions, it would be difficult to determine to what extent these changes were due to project interventions. The only way to do that would be to collect information on a series of intermediate indicators to establish a clear evidential link between changes in mortality levels and project interventions and to collect the same information on external forces. To a certain extent the project did this, however establishing a clear evidential link between all possible changes and all possible causes was beyond the scope of the undertaking. This was appropriate, as the vast majority of project resources should be dedicated to helping beneficiaries and not exhaustive studies for measuring impact.

To address the key issue of attribution of changes in impact indicators, the project team chose to predict the impact of project interventions from the baseline annual mortality incidence estimates and conservative estimates of the efficacy of the interventions

delivered. Although projecting impact is not the same as measuring impact, it avoids the problem of attribution of impacts to specific causes. For the resources available, this was an achievable and appropriate solution. It is a reliable and reproducible method, as the process indicators (numbers of vaccinations and treatments) are clearly attributable to the project and easily measured.

1.3 The relationship between reducing annual mortality incidence and saving livestock livelihoods

The essential conclusion of the epidemiological analysis is that the project did an excellent job of targeting interventions to key species and key diseases to maximize positive livelihoods impact. The process indicators clearly show that output targets were achieved and surpassed. The baseline assessment found a global mortality rate of 19.6% and the project interventions were predicted to reduce general livestock mortality by 1.8%. Based on this, the assessment predicted that the annual mortality incidence for all causes in all species rate after the project would 17.8%. Thus, the principal indicator was successfully met and over the short-term the project contributed to saving a key livestock livelihood asset. The mortality rate reduction of 1.8% may seem modest. However when one considers that the health interventions by disease category did not exceed 20% coverage of the population, this result reflects a very high level of project technical and operational efficiency in terms of targeting interventions and return in livestock lives saved per vaccination/treatment.

However, this analysis does not tell the full story on extent to which this project preserved livelihoods of the beneficiaries as a holistic set of assets, process and institutions. It also raises economic questions. From both livelihoods and economic perspectives, other questions need to be asked. For example:

- What was the impact of saving 1.8% of the livestock over the short-term on the long-term health of this asset category?
- What was the cost of saving livestock lives on a per head basis relative to the value of the livestock?
- What were the impacts of the intervention delivery methods on animal health institutions, markets and the accessibility of animal health services to the beneficiaries in the future?
- Will the beneficiaries be more or less vulnerable to future shocks as a result of this intervention?
- What affect did the project have on the coping strategies available to the communities?

As the project and the impact assessment of the project were structured team efforts. Data collection on these questions was largely addressed by components other than the epidemiological assessment. In part, the author will turn to the data and reports of his colleagues to address these questions. In addition, the author will draw on other project experiences and the literature to address these questions. This will be presented in the discussion.

2. Methodology

2.1 Overview of the design and implementation of data collection

The techniques of participatory epidemiology were applied to the collection of baseline data for the impact assessment. Only one, pre-intervention data collection exercise was completed.

The techniques employed were selected to collect information on:

- the livelihoods importance of livestock,
- the livelihoods importance of each livestock species kept,
- the relative impact and annual incidence of all livestock disease identified by the participants.

The following techniques were employed:

- semi-structured interviews (Appendix 4)
- scoring of livelihoods activities by proportional piling (Appendix 10)
- scoring of the benefits of keeping livestock followed by weighted matrix scoring of species importance (Appendix 10)
- disease morbidity and mortality scoring by the process of dividing piles (Appendix 10)

Each of the four NGOs was asked to nominate two participatory facilitators for the data collection phase and an abbreviated two-day participatory training workshop on participatory epidemiology was presented by the consultant. The check list for the semi-structured interviews and selection of scoring methods to be used were finalized by consensus during the training. A number of potential problems and solutions were discussed for each of the scoring methodologies and the participants selected the final methods to be implemented by the group. Each of the selected methods to be used in the field was practiced by participants using in-class role plays.

Each NGO was requested to perform at least 10 interviews at four different sites within their intervention area. In total, 16 sites were covered and over 160 interviews were completed.

The data was entered in an Access database by data entry personnel of each respective NGO. Once the completed databases and copies of the paper records were handed over to ILRI, the epidemiologist cleaned the data and accessed the results for consistency of scoring methods. Any electronic records that were unclear, incomplete or appeared to depart from the consensus methodology were compared with the paper records and reports of the data collection teams. Records that departed from the consensus methodology could not be incorporated in the aggregate (overall) analysis.

2.2 Overview of descriptive analysis: calculating average scores

The scoring exercises for livelihoods importance of livestock, the livelihoods benefits of keeping livestock and livelihoods importance of each livestock species, and annual disease morbidity and mortality scoring were all conducted using 100 counters. For the analysis of each scoring activating, average scores were calculated by summing all the responses for each category and dividing by the sample size (N).

In participatory epidemiology, the identification of categories for inclusion in scoring exercise is left to the choice of the beneficiaries. In this manner, the scoring exercise reflects the priorities of the respondents rather than the study designers. The participants are asked to identify all categories that they consider important. If a group of respondents did not identify a particular category (for example a disease or species) for inclusion in the scoring exercise, than a score of 0 is used in used in the calculation of averages. This is the standard procedure used in calculating average scores in participatory epidemiology (Mariner and Paskin, 2000; Catley et al. 2001).

The principal indicator for the project was global annual mortality incidence for all species. The technique for scoring annual morbidity and mortality is based on a process of dividing piles. Briefly, the respondents were presented with a pile of 100 counters and asked to think about one livestock species. They were then asked to divide the pile to represent the relative number (or percentage) of that species that became ill over the last year and the relative number of that species that remained health. The respondents were then asked to divide the pile of those that became ill into a pile for each disease that occurred over the last year. Thereafter, the respondents are asked to divide the piles for each disease into those that recovered and those that died or were sacrificed.

The first step of dividing piles into those that became sick and those that remained healthy gives an overall annual morbidity incidence score due to all causes in the species. The subsequent step of dividing the ‘sick pile’ by diseases they experienced gives annual morbidity incidence scores for each disease in the species. The third step of dividing piles into those that died and those that recovered provides disease specific annual morbidity and mortality incidence scores for the species. The overall annual mortality incidence score for the species is then calculated by summing the disease specific annual mortality scores.

2.3 Input for modelling project impact:

The baseline data on the annual mortality incidence for all diseases identified by the respondents was combined with data on the type and number of interventions by district in spread sheet model to predict the impact of the interventions on the overall annual mortality incidence rate for the project area. The analysis model required four elements as input:

1. estimates of disease-specific annual mortality incidence
2. numbers of treatments and vaccinations by type
3. population estimates for the project area

4. estimates of the effect of each treatment or vaccination by type on mortality risk

Input element one (mortality estimates) was estimated from the field data as described above. The second input element (numbers of interventions by type) was derived from the project process indicators as provided by the project to the consultant. The population estimates for the project area were based on the official 2003 Livestock Census of Kenya as provided by the project to the consultant. The intervention and population figures used in the analysis are presented in Table 1.

The estimation of the effect of treatments and vaccinations by type was completed by the consultant. When available, published data on efficacy and duration of effect were used. However, for several interventions very little information was available that was relevant to pastoral settings in East Africa and realistic estimates had to be made.

Estimate the effect of vaccinations on individual annual mortality risk:

For vaccination, three components were used to estimate effect of interventions as they were applied in the field (Rossiter and James, 1989; Mariner et al. 2005; Mariner et al, 2006):

- vaccine efficacy under controlled conditions.
- duration of immunity
- efficiency of vaccine application in the field

Vaccine efficacy is the percentage of inoculations that actually result in protective immunity. In regard to vaccine efficacy, reliable data is available for FMD and CBPP vaccine (Mariner et al, 2006), but not for the other vaccines used in the project. The efficacy of FMD vaccine was taken as 90% and the efficacy of CBPP vaccine was 65%. Both of these estimates were generous and in the case of FMD the assumption was made that the vaccine contained serotypes that were appropriate to the local disease challenge. For all other vaccines, efficacy was estimated at 90%.

The duration of immunity for all vaccines except FMD was estimated to be 1 year. The duration of immunity for FMD vaccine was estimated as 6 months.

The efficiency of vaccine application in the field is a measure of how well the vaccination was carried out. Considerable data was available on this point from the sero-monitoring of the Pan African Rinderpest Campaign. Under laboratory conditions, rinderpest vaccine is essentially 100% efficacious. However, sero-monitoring has shown that only about 70-80% of all vaccinations carried out in mass campaigns actually generate protective immune responses. The best result ever achieved was in an NGO managed campaign using heat-stable vaccine in Somalia. In this case, 95% of the vaccinations carried out were properly administered and resulted in a protective immune response. An efficiency figure of 95% was used for the heat-stable vaccines administered as part of the DRP. The vaccines judged to be heat-stable were BQ, LSD and SGP. All other vaccines were considered heat-labile and a vaccination efficiency of 90% was used.

The impact of each individual vaccination on the probability of individual annual morbidity and mortality risk was calculated using the following formula:

(vaccine efficacy) x (duration of immunity) x (efficiency of application)

Taking FMD as an example, the vaccine efficacy was estimated as 80%, the duration of immunity as 0.5 years and the efficiency of application as 90%. The calculation is:

0.9 x 0.5 x 0.9 = 0.405

This means that an animal that received FMD vaccination was 40.5% less likely to become ill with FMD over the course of one year.

The estimates of the effect of vaccinations on the individual annual mortality risk are presented in Table 2.

Table 2: Estimates of the Effect of Vaccination on Individual Animal Mortality Risk

	Efficacy	Efficiency	Duration	Effect
BQ	0.90	0.95	1.00	0.855
CBPP	0.65	0.90	1.00	0.585
CCPP	0.90	0.90	1.00	0.810
ET	0.90	0.90	1.00	0.810
FMD	0.90	0.90	0.50	0.405
LSD	0.90	0.95	1.00	0.855
SGP	0.90	0.95	1.00	0.855

Table 2: The Efficacy column gives the estimate of the proportion of inoculated animals expected to develop immunity in controlled vaccine trials. The Efficiency column provides the proportion of animals vaccinated under field conditions that were estimated to be correctly vaccinated with properly handled vaccine. The Duration column provides the estimates of the duration of immunity for each vaccine expressed in years. The Effect column gives the proportion of animal mortality risk eliminated by each vaccination type. The values in this column are the product of efficacy, efficiency and duration.

Estimating the effect of treatments on individual mortality risk:

The direct effect of each individual ectoparasitic, anthelmintic and trypanocidal treatments on the probability of annual mortality risk was estimated as a 50% reduction in the risk of the recipient of dying from the disease in question over the course a period of one year. Severe mange is a very difficult disease to treat successfully. The direct effect of mange treatments was estimated as a 20% reduction in the risk of the recipient of dying from mange.

For example, this means that each individual animal that received an anthelmintic treatment was considered half as likely to die from helminthes for an year. Similarly, a

single treatment for ectoparasites was considered to reduce to the risk of dying from the direct effects of ectoparasites by half over the course of one year.

In addition to direct effects of treatments, an indirect effect ('health benefit' or 'drought resistance benefit') for anthelmintics and ectoparasite control were factored into the model. In the case of anthelmintics, all animals treated were considered to be 10% less likely to die from any disease cause. The indirect effect of ectoparasite control was incorporated as a 20% reduction of all tick borne disease (TBD) annual mortality risk for individuals treated for ectoparasites.

Table 3: Estimates of the Effect of Treatment on Individual Animal Mortality Risk

	Effect
Ectoparasite Direct	0.5
Ectoparasite Indirect	0.2
Anthelmintics Direct	0.5
Anthelmintics Indirect	0.1
Mange Treatments	0.2
Trypanocidals	0.5
Antibiotic Treatments	0.5

Table 3: The Effect column gives the proportion of animal mortality risk eliminated by each vaccination type.

Calculation of impact of each intervention on mortality risk of recipient animals and summation of individual impact:

In order to calculate the impact of the project interventions on the global population mortality, it was necessary to calculate the impact of each intervention (e.g. CCPP vaccination) on the mortality risk of the recipient species. These disease specific intervention impacts were then summed by species. Finally, to arrive at the impact of all project health interventions on all diseases in all species, the project impacts on individual species annual mortality had to be averaged using an appropriate weighting factor.

The estimate of disease specific annual mortality incidence (mortality) was multiplied by the percent intervention coverage for the project area and the effect of the intervention on individual mortality risk (effect) to give the reduction in mortality that the intervention could be expected to achieve in the target species. Intervention coverage was the number of interventions (int) divided by the total population size (pop). The formula was:

$$(\text{mortality}) \times (\text{int}/\text{pop}) \times (\text{effect})$$

Taking the example of CCPP in goats, the annual mortality incidence for CCPP in goats was estimated from the livestock owner's scores as 5.8%, the number of interventions was 1,064,454 CCPP vaccinations, the overall goat population size was 4,357,200 and

the effect of each CCPP vaccination was estimated as 0.81 reduction in the risk of death over one year. The calculations are:

$$0.058 \times (1{,}064{,}454 / 4{,}357{,}200) \times 0.81 = 0.011$$

Thus, the CCPP vaccination carried would be expected to reduce the mortality in goats due to CCPP by 1.1%. Before the project intervention, the annual mortality rate due to CCPP was 5.8%. After the project intervention, the annual mortality rate due to CCPP was predicted to be 1.1% less than 5.8%.

These calculations were repeated for all interventions types in each species where they were applied. These results were then summed for each species to give the reduction in annual mortality expected due to all interventions in that species.

As the principal project indicator was the annual mortality incidence in all species as a group, the reductions in mortality per species had to be aggregated for all species. This was done by calculating a weighted average of mortality reductions in all species. The numerical percentage that each of the four principal species or represented in the total population of all four species was used as the weighting factor.

3. Results

3.1 Observations on data quality

Overall the quality of data was good to excellent and the data collection was smoothly implemented. Where departures from the consensus methodology were apparent, the records in question were eliminated so as not to compromise the integrity of the overall dataset. Records that were eliminated are described here in order to clarify the limitations of the data set.

A number of relative disease incidence scoring results had to be eliminated from Samburu, Marsibit and Moyale Districts as the data collection team departed substantially from the consensus methodology developed in the participatory epidemiology workshop. The methodology called for the use of 100 counters to represent relative numbers of animals of a single species. The first step was to ask the farmer to divide the 100 counters into two piles. One pile represented the number of the species that remained healthy during the year and the other those that became sick.

The team for the region that included Samburu, Marsibit and Moyale Districts employed three different methodologies. Methodology 1: In some exercises no score for healthy animals was given and the counters were all divided into disease categories. Methodology 2: Individual counters were used to represent individual animals and the total number of counters used represented the herd size. Methodology 3: More than 100 counters were used in a subset of exercises allowing farmers to indicate if an individual animal became ill with more than one disease during the year. Although, methodologies 2 and 3 are valid approaches, using a variety of non-consensus methods meant that the

scores could not be aggregated with the data from other teams (or even for between methods for the team in question).

Some of the results from the relative disease incidence exercise for Turkana District also had to be dropped from the analysis because the exercises were conducted for all species as a group rather than for an individual species.

3.2 Results of the Scoring Exercises

The results are presented in tabular rather form rather than graphs to give the reader maximum access to the data and analysis. The results of the scoring on the importance of livelihood activities are presented by District in Table 4 and ethnic group in Table 5. Overall, pastoralism ranked the highest with a global score of 59. It was noted from the livelihood scoring in Turkana that several respondents were primarily shop keepers or livestock traders who did not engage in livestock keeping.

Table 4: Average Livelihoods Activity Scores by District:

	Garisa	Ijara	Isiolo	Mandera	Turkana	Wajir	Global
Pastoralism	64	69	69	81	33	68	59
Shop keeping	8	4	12	0	39	2	15
Employment	11	0	0	0	9	13	6
Livestock Trading	0	0	0	0	17	6	5
Agriculture	15	0	5	4	0	1	4
Sale hides and skins	0	13	0	0	0	0	2
Selling of mirra	0	0	8	0	0	0	2
Selling gum Arabica	0	0	0	7	0	5	2
Hotel	0	8	0	0	0	0	1
Butchery	3	2	0	0	0	1	1
Selling of firewood	0	0	6	0	0	0	1
Selling building sticks	0	0	0	5	0	3	1
Charcoal making	0	0	0	0	2	0	1
Selling water	0	4	0	0	0	0	1
Selling Reeds	0	0	0	2	0	0	0
Weaving ropes	0	0	0	1	0	0	0
Selling hay	0	0	0	0	0	1	0
Photography	0	1	0	0	0	0	0
Bee keeping	0	1	0	0	0	0	0
Total	100	100	100	100	100	100	100
N	9	7	9	6	14	6	51

Table 4: Overall the respondents gave pastoralism a livelihoods importance score of 59%. It was noted that 6 respondents from the Turkana sample were shopkeepers or livestock traders that did not own livestock indicating that improper respondents were selected in this district. In other districts, those that scored shopkeeping or trading indicated that these were side activities. Those that scored employment were government chiefs.

Table 5: Average Livelihoods Activity Scores by Ethnic Group

	Borana	Garre	Sakuye	Somali	Turkana	Global
Pastoralism	90	81	42	68	33	59
Shop keeping	0	0	28	4	39	15
Employment	0	0	0	7	9	6
Livestock Trading	0	0	0	1	17	5
Agriculture	0	0	12	7	0	4
Sale of Hides and Skins	0	0	0	4	0	2
Selling of mirra	0	0	19	0	0	2
Selling gum Arabica	0	14	0	1	0	2
Hotel	0	0	0	2	0	1
Butchery	0	0	0	2	0	1
Selling of firewood	10	0	0	0	0	1
Selling building sticks	0	5	0	1	0	1
Charcoal making	0	0	0	0	2	1
Selling Water	0	0	0	1	0	1
Selling Reeds	0	0	0	0	0	0
Weaving ropes	0	0	0	0	0	0
Selling hay	0	0	0	0	0	0
Photography	0	0	0	0	0	0
Bee keeping	0	0	0	0	0	0
Total	100	100	100	100	100	100
N	5	3	4	25	14	51

Table 5: Note that the sample size for Borana, Garre and Sakuye is small. The same comments for Turkana as a district made in Table 1 apply to the results for the Turkana as an ethnic group as reported here.

The results of the importance of each species to the livelihood of the respondents are presented by District in Table 6 and by ethnic group in Table 7. The total livelihoods importance scores assigned to small ruminants by the beneficiaries was 63 out of 100. This indicated that the project correctly identified small ruminants as the species for concentration of interventions.

Table 6: Average Species Ranking Scores by District

	Garisa	Ijara	Isiolo	Mandera	Moyale	Samburu	Turkana	Wajir	Global
Goats	50	38	35	51	18	14	68	44	48
Cattle	24	34	24	6	50	53	12	32	23
Sheep	12	28	24	22	13	0	3	14	15
Camels	7	0	8	21	19	33	13	10	10
Donkeys	1	0	0	0	0	0	8	0	2
N	7	8	10	6	2	1	14	7	55

Table 6: Overall, goats were scored the highest in terms of livestock livelihoods benefit, followed by cattle. The combined score for small ruminants is 63 out of 100. The sample size for the Samburu (1) is too small to be meaningful.

Table 7: Average Species Rank Scores by Ethnic Group

	Borana	Garre	Sakuye	Samburu	Somali	Turkana	Global
Goats	44	35	21	14	49	63	48
Cattle	31	27	14	33	25	14	23
Sheep	26	18	21	0	17	4	15
Camels	0	20	19	33	7	15	10
Donkeys	0	0	0	0	1	9	2
N	6	5	4	1	27	12	55

Tables 7: Overall, goats were scored the highest in terms of livestock livelihoods benefit, followed by cattle. The combined overall score for small ruminants is 63 out of 100. The Turkana placed the greatest emphasis on goats and did not emphasize sheep. Given that Somalis were the dominant ethnic group in several of the districts, there views had the greatest influence on the global score. Taken together, the Turkana and Somali provided 39 or the 55 useable records. This would account for the relatively low emphasis placed on sheep in the project-wide scores.

The average annual morbidity and mortality incidence scores are presented for goats (Table 8), cattle (Table 9), sheep (Table 10) and camels (Table 11). As was described in the methodology, these tables present the average of all scores for each disease by species. If a particular disease was not introduced into the scoring exercise by the participants, it was not considered to have been an important cause of morbidity or mortality over the last year and a value of zero was used for that interview in calculating the average. The row marked total in the tables present the sum of all average morbidity and mortality scores for all diseases for that species. These total annual morbidity and mortality scores by species are summarized in Table 12 to facilitate comparison between species. Finally, weighted averages for all four principal species are presented in Table 13. The weighted average figures of the annual morbidity scores are presented in Table 14. Three different weighting factors were examined: Sample size (N), livelihoods importance species scores, and the numerical contribution each species made to the total livestock population in the project area based on the 2003 Livestock Census of Kenya.

In terms of quantitative emphasis of targeting of interventions the project did an excellent job.

- The project attained 24.4% coverage of goats against CCPP. This vaccine was estimated to reduce individual annual mortality risk by 81% for a disease that caused 5.8% annual mortality among goats. Overall, this intervention was projected to reduce mortality among goats by 1.1% throughout the project area.
- The project attained 31.5% coverage of sheep against enterotoxemia. This vaccine was estimated to reduce individual annual mortality risk by 81% for a disease that caused 5.2% annual mortality among sheep. Overall, this intervention was projected to reduce mortality among sheep by 1.3% throughout the project area. Although sheep scored after cattle in terms of livelihoods benefits, scores were not disaggregated by wealth indicators. It is probable that ovine scores would have been higher in poorer households
- The project attained 21.0% coverage of cattle against CBPP. This vaccine was estimated to reduce individual annual mortality risk by 58.5% for a disease that caused 1.1% annual mortality among cattle. Overall, this intervention was projected to reduce mortality among cattle by 0.1% throughout the project area. Thus, as an emergency livelihoods intervention the return on this activity was negligible.

- In terms of quantitative emphasis of targeting of mass treatments:
  - Overall, 16.7% of the population was treated with anthelmintics. This was the highest coverage for any of the four treatment interventions. Considering both direct and indirect effects, this was projected to avoid 0.64 of the annual mortality experience. When other mass treatments intervention were compared with anthelmintics, *and coverages were*

adjusted to 16.7%, none were projected to achieve the same level of impact. Thus, anthelmintics were appropriately emphasized in the treatment activities.

- As a disease shared across species, the overall annual mortality score for trypanosomiasis was 5.1%. Considering all four principal species, only 1.1% of the population was treated. This suggests that impact could be increased by placing more emphasis on trypanocidal treatments in future interventions.
- The predicted impact of mange treatments was zero. This came about as the mortality scores provided by the project beneficiaries for mange were essentially zero. However it is widely accepted that mange is an important source of mortality in goats. Thus, this result was surprising and probably not indicative of the true impact of mange treatment.

- In terms total mortality avoided:
  - Vaccination was projected to reduce mortality by 1.07%.
  - Treatment was projected to reduce mortality by 0.73%.
  - Total mortality avoided was 1.80%

- The impact of community animal health worker (CAHW) delivered individual treatments given to clinically ill animals had greater impact per treatment than mass treatments. The effect increasing the assumed mortality to 50% for clinically affected animal benefiting from treatment was examined for antibiotic and trypanocidal treatments.
  - Overall impact of 23,928 antibiotic treatments to clinically ill animals reduced the population annual mortality rate by 0.020%.
  - Overall impact of 7,441 trypanocidal treatments to clinically ill animals reduced the population annual mortality rate by 0.066%
  - This change in the analysis would increase the overall impact of all treatments to 0.81% reduction in mortality, an increase of 0.08%.
  - The 0.08% increase in the impact of treatments resulting from this limited number of CAHW interventions delivered reflected in an 11% increase in the overall impact of project treatments on annual animal mortality.

Table 8: Average Morbidity and Mortality Scores in Goats

Goats N=45	Morbidity	Mortality
CCPP	10.8	5.8
Worms	10.2	4.6
Tryps	4.1	2.2
SGP	3.3	1.8
Cowdriosis	3.4	1.1
Orf	1.6	1.1
Other	1.9	0.9
Anaplasmosis	1.3	0.8
Tick Infestation	1.3	0.8
Foot Rot	3.2	0.7
Tunya	1.5	0.4
Pneumonia	1.2	0.2
FMD	0.8	0.2
Anthrax	0.4	0.2
Besnoitia	0.4	0.2
Humat	0.3	0.2
Retained Placenta	0.4	0.1
Lice	0.1	0.1
Tick Paralysis	0.1	0.1
Mange	0.1	0
Total	46.4	21.5

Table 8: Diseases are ordered by mortality rate. Note that Tunya and Humat are local goat disease names which the facilitators were unable to assign to Western terminologies. N is the sample size.

Table 9: Average Morbidity and Mortality in Sheep

Sheep N=11	Morbidity	Mortality
ET	10.5	5.2
Tryps	3.3	2
Worms	9.1	1.9
Cowdriosis	2.8	1.7
Bottle jaw	4.3	0.7
SGP	0.8	0.5
Foot rot	0.8	0.3
Pneumonia	0.9	0.3
Tick paralysis	1.5	0.3
Ephermal Fever	1.5	0.2
Tumbur	0.4	0.1
Other	0.8	0.7
Total	36.7	13.9

Table 9: Diseases are ordered by mortality rate. Note that Tumbur is local sheep disease name which the facilitators were unable to assign a Western terminology. N is the sample size.

Table 10: Average Morbidity and Mortality in Cattle

Cattle N=22	Morbidity	Mortality
Tryps	15.3	8.4
Tick Paralysis	5.5	3.5
Worms	9.7	3.1
FMD	14	2
BQ	4.1	1.7
CBPP	3.9	1.1
Cowdriosis	1.6	0.9
LSD	2.5	0.8
other	1.2	0.6
Emphemral fever	3	0.4
Babesiosis	0.2	0.2
Tick Infestation	1.9	0.2
Foot rot	0.7	0.2
rabies	0.7	0.2
Anthrax	0.8	0.1
HS	0	0
Anaplasmosis	0	0
ECF	0	0
Total	65.1	23.4

Table 10: Diseases are ordered by mortality rate. N is the sample size.

Table 11: Average Morbidity and Mortality in Camels

Camels N=11	Morbidity	Mortality
Tryps	5.3	1.5
Pneumonia	2.6	0.2
Camel Pox	8.2	3.1
Lymphadenitis	4.9	0.8
Arthritis	0.5	0.3
Nervous condition	1.2	0.6
HS	3.1	0.7
Contagious Skin Necrc	0.2	0
Camel Fever	1.6	0.2
Cowdriosis	0.6	0.5
Orf	0.7	0.2
BQ	1.3	0.7
Tick Infestation	1.9	1.4
Wry Neck	0.4	0.1
Worms	0.8	0.3
Other	1.5	0.6
Total	34.8	11.2

Table 11: Diseases are ordered by mortality rate. N is the sample size.

Table 12: Total Annual Morbidity and Mortality by Species

	Count	Morbidity	Mortality	Healthy
Goats	45	46.4	21.5	53.6
Sheep	11	35.7	12.9	64.3
Cattle	22	65.2	23.5	34.8
Camels	11	34.8	11.2	65.2

Table 12: The morbidity and mortality scores by species are the summation of the average morbidity and mortality scores for each disease in each species. The average morbidity and mortality scores for each disease are reported in Tables 7-10. The column marked count is the number of records used in the analysis. The column labeled Morbidity is the percentage of the total population that became ill in the year prior to the data collection. The column marked Morality is the percentage of the population that died during the previous year. The column labeled Healthy represents the percentage of the population that remained healthy during the previous year.

Table 13: Global Annual Morbidity and Mortality as Weighted Averages of Species Morbidity and Mortality Scores Totaled for All Diseases

Weighting Factor	N	Livelihood Score	Numerical Pop
Global Morbidity in All Species	51.9	46.1	51.9
Global Mortality in All Species	23.3	18.8	19.6

Table 13: The overall morbidity and mortality scores are presented as weighted averages for all four species: goats, sheep, cattle and camels. Three different weighting methods were used. The column labeled ‘N’ presents the averages when the number of records for each species was used as the weighting factor. The column labeled ‘Livelihood Score’ presents the averages when the global livelihood scores (Tables 5 and 6) were used as the weighting factor. The column labeled ‘Numerical Pop’ presents the average morbidity and mortality scores when the population figures from the official 2003 Livestock Census of Kenya figures were used as the weighting factor. For calculating the impact of the program on global mortality (the principal indicator of project success), the average weighted by the percentage each species contributes numerically to the total population was considered most appropriate. However, it is of interest to note that the principal contributions to the global mortality weighted by livelihoods importance score came from goats (10.3) and cattle (5.4). This suggests that reducing mortality in these two species resulted in the greatest benefit to the respondents.

Table 14: Weighted Average Mortality Scores for Disease Affecting More Than One Species

SGP Mortality in Small Ruminants

	Mort	Pop Wt	Wt Mort
Goats	0.018	0.68	0.01224
Sheep	0.005	0.32	0.0016
All			0.01384

Ticks Direct (Ticks and tick paralysis)

	Mort	Pop Wt	Wt Mort
Goats	0.009	0.204023	0.001836
Sheep	0.021	0.226862	0.004764
Cattle	0.037	0.478892	0.017719
Camels	0.014	0.090224	0.001263
All		1	0.025582

Ticks Indirect (All TBD)

	Mort	Pop Wt	Wt Mort
Goats	0.026	0.204023	0.005305
Sheep	0.017	0.226862	0.003857
Cattle	0.011	0.478892	0.005268
Camels	0.005	0.090224	0.000451
All		1	0.01488

Helminths Indirect (Worms and Bottle Jaw)

	Mort	Pop Wt	Wt Mort
Goats	0.046	0.204023	0.009385
Sheep	0.026	0.226862	0.005898
Cattle	0.031	0.478892	0.014846
Camels	0.003	0.090224	0.000271
All		1	0.0304

Tryps

	Mort	Pop Wt	Wt Mort
Goats	0.022	0.204023	0.004488
Sheep	0.02	0.226862	0.004537
Cattle	0.084	0.478892	0.040227
Camels	0.015	0.090224	0.001353
All		1	0.050606

Table 14: The table presents weighted average mortality scores for diseases that affect more than one species. This was done by averaging the disease specific mortality scores for each individual species using the numerical fraction of the total population that each species represented.

Table 15: Global Mortality Reductions Expected by Vaccination Type Based on Annual Mortality Incidence, Percent of the Population Covered and the Impact of Vaccination on Individual Mortality Risk.

Disease	Species	Pop Wt	Reduction	Wt Pop Mortality Reduction
BQ	Cattle	0.20402	0.00183	0.04%
CBPP	Cattle	0.20402	0.00135	0.03%
CCPP	Goats	0.47889	0.01148	0.55%
ET	Sheep	0.22686	0.01328	0.30%
FMD	Cattle	0.20402	0.00306	0.06%
LSD	Cattle	0.20402	0.00030	0.01%
SGP	Sheep and Goats	0.70575	0.00122	0.09%
Wt Avg				1.07%

Table 15: Note that overall all reduction in the global mortality in all species as a result of project interventions was projected to be 0.72%. The vaccinations with the highest impact were CCPP in and enterotoxemia (ET).

Table 16: Global Mortality Reductions Expected by Treatment Type Based on Annual Mortality Incidence, Percent of the Population Covered and the Impact of Mortality on Individual Mortality Risk.

Treatment	Species	Pop Wt	Reduction	Wt Pop Mortality Reduction
Ecto Direct	All	1.0000	0.00048	0.05%
Ecto Indiirect	All	1.0000	0.00011	0.01%
Hel Direct	All	1.0000	0.00251	0.25%
Hel Indirect	All	1.0000	0.00390	0.39%
MGE	Goats and Camels	0.5691	0.00000	0.00%
Tryps	All	1.0000	0.00027	0.03%
Antibiotic	All	1.0000	0.00007	0.01%
Wt Avg				0.73%

Table 16: The direct effect of ectoparasite control was calculated based on their expected impact (50% mortality reduction) on mortality due to tick infestation and tick paralysis. The indirect effect of ectoparasite control was calculated based on their expected impact (20% mortality reduction) on mortality due to tick borne disease. The direct effect of anthelmintics was calculated based on their expected impact (50%) on mortality due to helminthes and bottle jaw. The indirect effect of anthelmintics was calculated as a 10% reduction in mortalities due to all diseases in treated animals. Note that the analysis suggests that the indirect effect of anthelmintics was greater than the direct effect, provided the assumptions are true.

4. Discussion, Lesson Learnt and Conclusions

4.1 Methodology, Data Collection and Limitations of the Data

The impact assessment provided appropriate mortality estimates for all major diseases of all principal target species. This was done with a minimal investment of project time and financial resources. The methodology harvested a broad data set and allowed the target diseases to be accurately assessed within the general context of all disease problems.

The approach adopted of assessing baseline mortality and then projecting the impact of interventions on the underlying mortality estimates was achievable given the resources available for the assessment. This approach avoided a number of issues that are usually overlooked in the 'measurement' of project impact. Foremost among these is the problem of attribution of changes in impact indicators to the forces active in the project area.

Overall, the quality of data was good and in some cases excellent. In regard to training of the participatory facilitators, data quality could be improved by investing more time in training and conducting field-based training of facilitators. In all previous projects where participatory epidemiological methods have been employed, field practical exercises have been the major emphasis of the training workshop. In this project, training was not field-based due to budgetary constraints. In some cases, the facilitators who actually carried out the data collection were not those trained in the workshop. The minimal increase in cost would be warranted in any future assessment.

The data collection was implemented vertically with each NGO responsible for data collection and data entry within its area of operation. Overall aggregate estimates derived from the epidemiological data were apparently appropriate at the project-wide level. However, variation was observed in the data between different regions. As facilitation teams were associated with specific districts, the spatial and ethnic variation in scoring data could not be distinguished from enumerator bias using objective techniques. As a result, it was not appropriate to examine district and cultural variations in many of the basic estimates. In future exercises, the ability to make useful spatial and cultural inferences would be greatly enhanced by implementing data collection though a more unified data collection and data entry structure. In a unified system, the implementing partners could pool human resources and enumerator bias could be addressed through randomization of field assignments between teams.

Requiring each NGO to enter their own data resulted in a considerable work load for the consultant in terms of data cleaning. One NGO utilized a different version of the data base with a different data structure from the other three. This meant that several days of the consultancy were essentially spent on clerical tasks. One lesson is that a unified data collection and data entry structure would lead to better standardization of the data.

4.2 Implementation and Targeting of Interventions

The results of the impact assessment indicate that the project did an excellent job of targeting interventions to priority species and priority diseases. The project also reached or surpassed planned targets.

The overall livelihoods importance scores assigned to small ruminants (63 out of 100) by the beneficiaries indicated that these species were the most important to their livelihood. The project correctly identified small ruminants as the species for concentration of interventions.

The mortality scoring suggest that the project did an excellent job of selecting target diseases within species.

In regard to goats, the project chose to address CCPP, helminthiasis, trypanosomiasis, SGP and ectoparasites. In terms of annual mortality experience for specific disease in goats, these were ranked by the beneficiaries as first, second, third, fourth and ninth. Cowdriosis and anaplasmosis were ranked as the fifth and eighth most important cause of mortality and these along with other tick borne disease was indirectly addressed by ectoparasite control. Thus, the caprine target diseases were appropriately selected.

Project interventions in sheep directly addressed enterotoxemia, tryposomiasis, helminthiasis, bottle jaw, and SGP. These were scored first, second, third, fifth and sixth in terms of annual mortality. Cowdriosis was received the fourth highest score and was indirectly addressed by ectoparasite treatment. The ovine targets were appropriately selected.

The cattle interventions addressed the top six diseases in terms of annual mortality scores assigned by the beneficiaries. The low impact of the CBPP vaccination resulted from both the limited efficacy and sporadic nature of this disease in northern Kenya. As an emergency intervention, CBPP vaccination was probably over-emphasized.

Trypanosomiasis received the highest annual mortality for camels and was addressed by the project.

4.3 Project Strategy

The projected reduction in the annual mortality incidence rate after the project intervention was 17.8% (19.6 – 1.8) when all interventions were analyzed as mass actions that were delivered at the herd level. This estimate is based upon the perceptions of the beneficiaries on the mortality induced by each disease. This suggests that the campaign actions of the project had a relative modest impact on mortality.

If the drought had been more severe, it would be reasonable to assume that the mortality experienced by an untreated population would increase. If one assumes that a drought had doubled the mortality risk across the population, then the impact of the projects mass actions would have probably been doubled. In this case, 39.2% of the population would have been expected to die from disease, if there had been no project. The impact of the project if it had been implemented in this scenario would have been doubled leading to a

3.6% expected reduction in annual mortality incidence rate. Similarly, if the mortality risk had been tripled to 58.8%, the project would have been expected to reduced the mortality rate by 5.4% to 54.4%. Thus, even in these more severe scenarios, the direct impact of the project on the annual mortality incidence rate would have been moderate.

However, when only two types of interventions carried out by animal health workers were assessed as individual treatments of clinically ill animals, the impact of treatments on the annual mortality incidence rate increased by 11%. These CAHW interventions accounted for only 1.5% of the total treatment interventions carried out by the project. This suggests that more targeting sick animals through a delivery system appropriate to pastoral conditions had the potential to generate much higher impact. This is a key lesson of the project.

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Chapter 4

THE SPATIAL ANALYSIS OF THE DROUGHT RESPONSE PROJECT IN NORTHERN KENYA

An M.O. Notenbaert

1. Introduction

Geographical Information Systems technology (GIS) was used in two stages of the project: planning and evaluation. During the planning stage of the project, the implementing NGOs were provided with detailed maps. These were taken into account for the selection of the areas where to carry out veterinary and water activities in order to benefit the vulnerable pastoralist communities. All intervention sites were geographically referenced so that the spatial spread of the interventions and beneficiaries and the poverty focus of the operation could be assessed.

2. Methodology

Powerful Geographical Information Systems software, i.e. ArcGIS9, was used for the storage, display, combination and analysis of several geographic layers of information. The intervention data was entered in Excel worksheets. Each NGO entered their respective data and the four data sets were cleaned by the consultant and concatenated in one Access database.

Different data sources have different spatial resolutions (level of detail). Since the location of the veterinary interventions and the origins of the beneficiaries was recorded at sub location level (administrative level 5), this is the highest level of detail used for the analysis of geographical spread of the interventions and beneficiaries. From the sub location level data was then aggregated up to location level for the analysis of poverty focus and to district level for reporting purposes. The link between the spatial and tabular data is a unique identifier for the sub location.

3. Results

3.1 Spatial database and maps

A geographically referenced database was compiled for the nine districts of the project area. A wide scope of thematic layers from a variety of sources was collected, cleaned and combined into one consistent database.

The thematic layers included in the database are:

- Administrative boundaries
- Population
- Poverty
- Roads
- Rivers
- Towns and villages
- Land cover
- Water sources
- Soil types
- Geology
- Elevation
- Annual Rainfall
- Grazing/browse Potential
- Protected Areas
- NDVI (1982 – 2004)

From this spatial database, a set of maps was produced. For each of the nine project districts, a base map and a map with administrative units were created. In addition, for the districts where poverty data is available (Isiolo, Marsabit, Moyale, Samburu and Turkana), poverty incidence and poverty density maps were produced. These district maps, together with an overview map of ethnic composition, were used by the NGOs for planning purposes. A more detailed description of the database and an overview of the maps produced can be found in appendices 11 and 12.

3.2 The geographical spread of the intervention and beneficiaries

The veterinary intervention dealt with more than 3 million animals of which about 1.8 million were treated and almost 2.7 million vaccinated. There were approximately 54,000 livestock owners who presented animals during the operation. Working on the assumption that a livestock owner represented only one household, about 17% of all households in the whole project area were reached (see table 2).

Between 70% and 85% of the total population pursue pastoralist livelihoods (see table 1). The number of pastoralist households was estimated based on the percentages of the districts' pastoralist population. It was observed that 22% of all pastoralist households sent a representative to one of the interventions sites during the duration of the project (see table 2).

Table 1: Pastoralist population in the nine target districts

District	Total population	% pastoralists
Turkana	497,779	75
Samburu	160,000	80
Marsabit	138,646	70
Moyale	55,458	75*
Isiolo	118,222	85
Mandera	305,000	70
Wajir	385,000	80
Garissa	400,000	75
Ijara	75,000	70
TOTAL	**2,135,105**	

** estimation*
Source: official data provided by local authorities at district level, August 2004

Table 2: Percentage of the total number of households in the project districts reached by the intervention – estimations based on assumption 1 LS owner recorded = 1 HH

District of origin	# LS Owners originating from this district	# Households in the district	%HH reached	# Pastoralist Households in the district	%Past. HH reached
Unknown	12,486				
ISIOLO	6,469	22,696	29	19,292	34
MARSABIT	8,733	30,064	29	21,045	42
MOYALE	3,752	10,411	36	7,808	48
IJARA/GARISSA	6,384	48,201	13	34,946	18
MANDERA	*3,436**	*44,663*	*8**	*31,264*	*11**
WAJIR	*3,143**	*54,520*	*6**	*38,164*	*8**
SAMBURU	8,322	32,678	25	26,142	32
*TURKANA***	*1,023**	*73,762*	*1**	*55,322*	*2**
Outside Project Area	194				
Total	53,932	316,995	17	233,983	23

** in these districts, the number of livestock owners was never noted down*
*** for Turkana, only 30% of the data contained information about the origin of the livestock owner, therefore most of the livestock owners from this district are categorised as "unknown"*

It is important to take into account that many pastoralists merged their herds together; a practice that wasn't always documented by the implementing NGOs. In reality, it may be assumed that the actual percentage of the pastoralist population reached by the veterinary intervention was considerably higher.

Using the same number of pastoralist households, we approximated the average number of animals per household by dividing the total livestock figures from the Government of Kenya by the number of pastoralist households. This figure was used to estimate the number of households theoretically reached through the intervention. In the assumption that the households reached are all average households, we find that 78,750 households

could have benefited from the veterinary interventions (see table 3). This means that over 1/3 of all households in the project area were directly benefiting from the veterinary intervention. Knowing that vulnerable pastoralists (with fewer animals) were targeted, this number is probably still an underestimation.

Figure1: Comparison of estimated percentage of Pastoralist Households reached

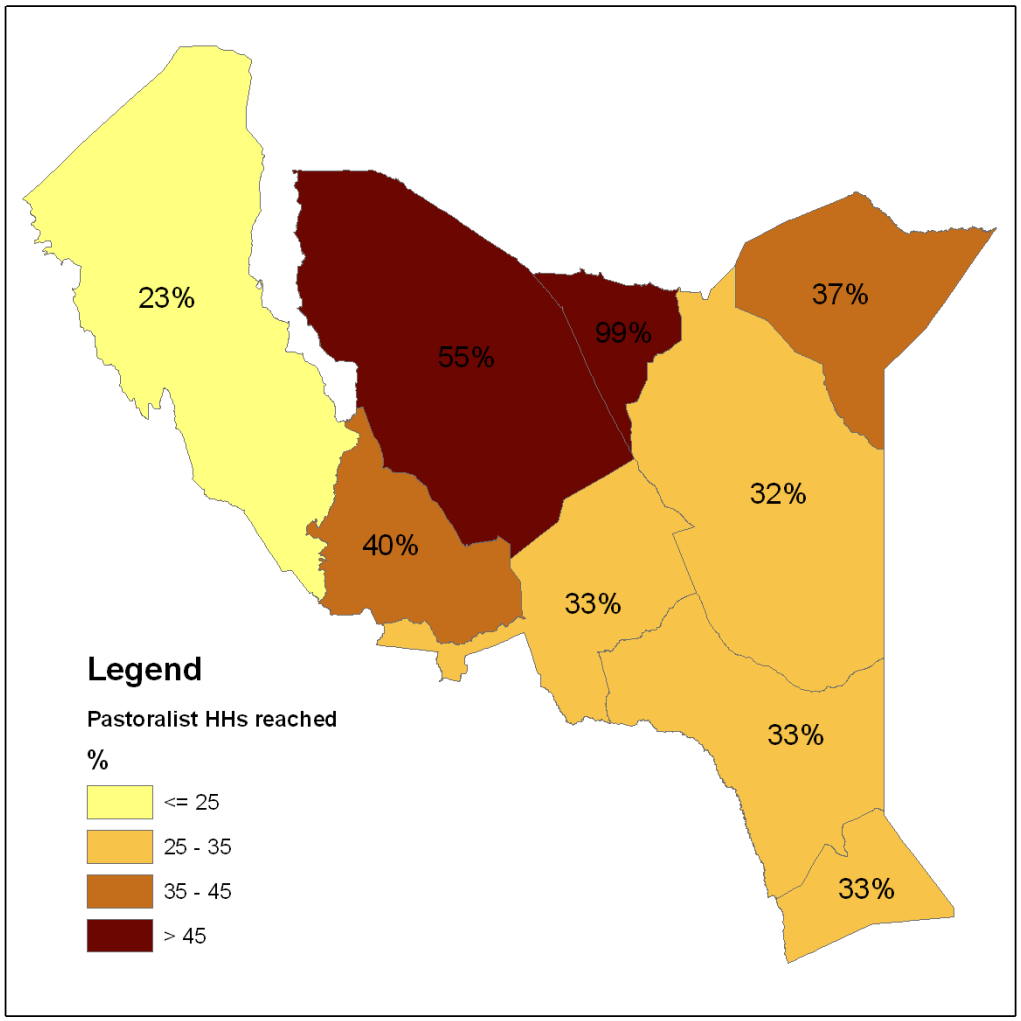


Table 3: Percentage of the total number of pastoral households in the project districts reached by the intervention –estimation based on average #cattle, shoat, camel and donkey per HH (figures from GoK and CBS)

District	#HHs	# Pastoralist households	# Animals	Average #animals per past. HH	# Animals treated and/or vaccinated	Estimated #HH reached through interventions	%Past. HH reached through veterinary interventions
Garissa/Ijara	48,201	34,946	999,300	29	338,748	11,846	33.9
ISIOLO	22,696	19,292	725,000	38	243,159	6,470	33.5
Mandera	44,663	31,264	1,010,500	32	374,272	11,580	37.0
MARSABIT	30,064	21,045	681,000	32	378,080	11,684	55.5
Moyale	10,411	7,808	105,300	13	105,180	7,799	99.9
Samburu	32,678	26,142	1,296,700	50	523,194	10,548	40.3
Turkana	73,762	55,322	3,298,800	60	784,831	13,162	23.8
Wajir	54,520	38,164	1,110,000	29	357,883	12,305	32.2
TOTAL	316,995	233,983	9,226,600	39	3,105,347	78,750	33.7

Care needs to be taken when interpreting the above figures. By noting down the origin of the livestock owners, we could assess the reach of the intervention and observed that not only local pastoralists were reached. We therefore have to take into account that not only local households were reached and that we oversimplified the matter by using the average district herd size.

Out of the total of about 54,000 livestock owners reached by the intervention, only 31% came from the same sub location in which the vaccinations and treatments were actually carried out (see table 3). While 69% of the pastoralists presenting animals at the intervention sites came from a different sub location, 21% of them even came from a different district.

There seems to be a significant difference between the districts. In Wajir, 99% of the LS keepers were reached in their home district, whereas in Moyale almost all had travelled from another sub location and 20% came from another district.

Table 4: Percentage of LS owners travelling per district

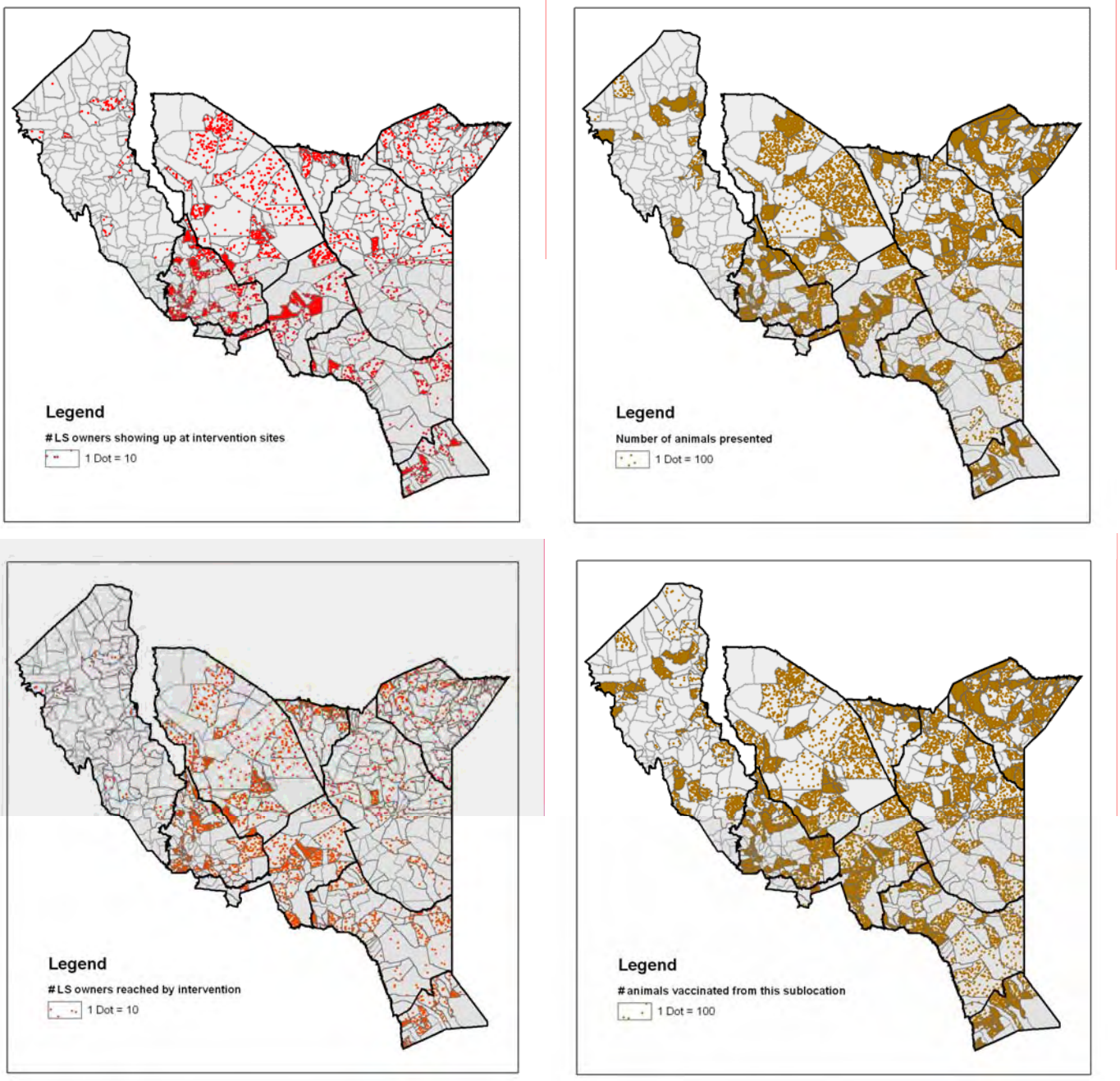
DISTRICT	# Livestock Owners	# Livestock Owners from same sub location	%travelling from other sub location	# Livestock Owners from same district	%travelling from other districts
GARISSA	2,892	1,835	37	2,648	8
IJARA	4,064	2,687	34	3,649	10
ISIOLO*	10,509	*3,570*	*66*	*6,130*	*42*
MANDERA	3,552	2,225	37	3,097	13
MARSABIT	9,651	334	97	9,220	4
MOYALE	4,459	70	98	3,558	20
SAMBURU*	12,496	*1,812*	*85*	*8,060*	*35*
WAJIR	3,551	3,053	14	3,525	1
Total**	51,174	15,586	70	39,887	22

** Care needs to be taken when looking at these figures, since more than 30% of the origins of livestock owners are unknown in these districts*

*** Due to availability of only partial data for Turkana, this district was left out*

Livestock owners from 423 different sub locations were reached; this is 59% of the 714 sub locations in the project area. Sub locations are the smallest administrative units in Kenya. Their areas range from less than 1 km^2 to more than 2000 km^2. Three quarters of the sub location are smaller than 400 km^2. If we look at administrative units of 1 level higher, we can see that livestock owners of 75% of all locations presented animals during the drought response program. The furthest pastoralists had travelled is about 460km. Only Sheep and Goat were taken this far; with Cattle and Camels they still travelled up to 435 and 424km respectively. The furthest travelling donkey covered a distance of about 247km. 194 Livestock owners came from outside the project area.

Figure 2: The number of pastoralist and animals showing up at the intervention sites and where they're coming from



** These maps were compiled on the basis of partial results for Turkana District.*

3.3 Poverty focus of the operation

Most of the almost 54,000 livestock owners presented a mixed herd. About 44% of the animals presented were goats, followed by sheep (33%); about 21% of the animals were cattle and 3% camels (see table 3).The focus of the livestock intervention was on small stock, which is clearly reflected in the number of treatments and vaccinations: 92% of the treatments and 79% of the vaccinations were on goat and sheep. We can also see that percentage of sheep and goats vaccinated and treated were much higher that the percentage of the cattle, camel and donkey populations.

Table 5: number of animals treated per district

District	#Goats treated	% on goats	%goats treated	#Sheep treated	% on sheep	%sheep treated	#Cattle treated	% on cattle	%cattle treated	#Camel treated	% on camel	%camel treated	#Donkey treated	% on donkey	%donkey treated
Turkana	313,729	73	16	108,403	25	11	2,984	1	2	4,379	1	3	229	0	1
Samburu	184,575	49	21	189,640	50	125	355	0	0	3,858	1	21	686	0	4
Marsabit	75,618	41	18	93,727	51	29	2,640	1	2	10,260	6	14	10	0	0
Moyale	13,552	58	53	5,979	26	95	1,476	6	2	2,097	9	18	115	0	6
Isiolo	59,609	31	26	130,378	68	50	109	0	0	1,230	1	4	4	0	0
Mandera	162,958	69	45	49,013	21	20	19,527	8	9	3,078	1	2	1,396	1	16
Wajir	126,772	50	74	117,845	46	35	7,530	3	2	2,357	1	1	1,249	0	10
Garissa	19,348	25	8	11,789	15	26	32,576	42	12	14,592	19	19		0	0
Ijara	4,610	9	6	6,870	14	38	37,960	77	15		0		2	0	0
TOTAL	960,771	53	22	713,644	39	30	105,157	6	6	41,851	2	5	3,691	0	3

Table 6: number of animals vaccinated per district

District	#Goats vaccinated	%vaccinations on goats	%goats vaccinated	#Sheep vaccinated	%vaccinations on sheep	%sheep vaccinated	#Cattle vaccinated	%vaccinations on cattle	%cattle vaccinated	Total	%livestock vaccinated
Turkana	497,599	87	25	53,950	9	6	17,397	3	9	568,946	17
Samburu	211,143	41	24	218,476	43	144	83,061	16	38	512,680	40
Marsabit	123,694	37	30	165,695	49	51	47,694	14	34	337,083	35
Moyale	31,818	33	125	12,773	13	203	52,034	54	87	96,625	92
Isiolo	70,108	31	30	133,489	60	51	19,416	9	10	223,013	31
Mandera	186,000	57	52	61,500	19	26	77,648	24	36	325,148	32
Wajir	139,000	43	81	118,500	36	35	68,500	21	22	326,000	29
Garissa	23,000	27	10	27,000	32	60	34,442	41	12	84,442	13
Ijara	18,359	9	26	28,760	14	160	165,615	78	66	212,734	61
TOTAL	1,300,721	48	30	820,143	31	35	565,807	21	30	2,686,671	28

The herd sizes presented varied considerably. About 11% of the herds presented had less than 10 animals, 68% less than 100. There seems to be little or no difference in the average size of their herds with the livestock owners coming from more distant sub locations.

Table 7: Average herd size per district

district	avg_herdsize	avg_herdsize same subloc	% of the herds below 100 animals
Unknown	57	82	99
ISIOLO	102	109	61
MARSABIT	55	44	84
MOYALE	56	57	91
IJARA/GARISSA	81	76	80
MANDERA*	127	127	59
WAJIR*	104	107	62
SAMBURU	89	29	65
TURKANA**	289	270	28
Outside project area	77	/	25
OVERALL	96	112	68

** In these districts the herds of several livestock owners were combined and recorded as 1 intervention with 1 livestock owner; therefore herd size are overestimated.*
*** figures for this district are based on partial data only*

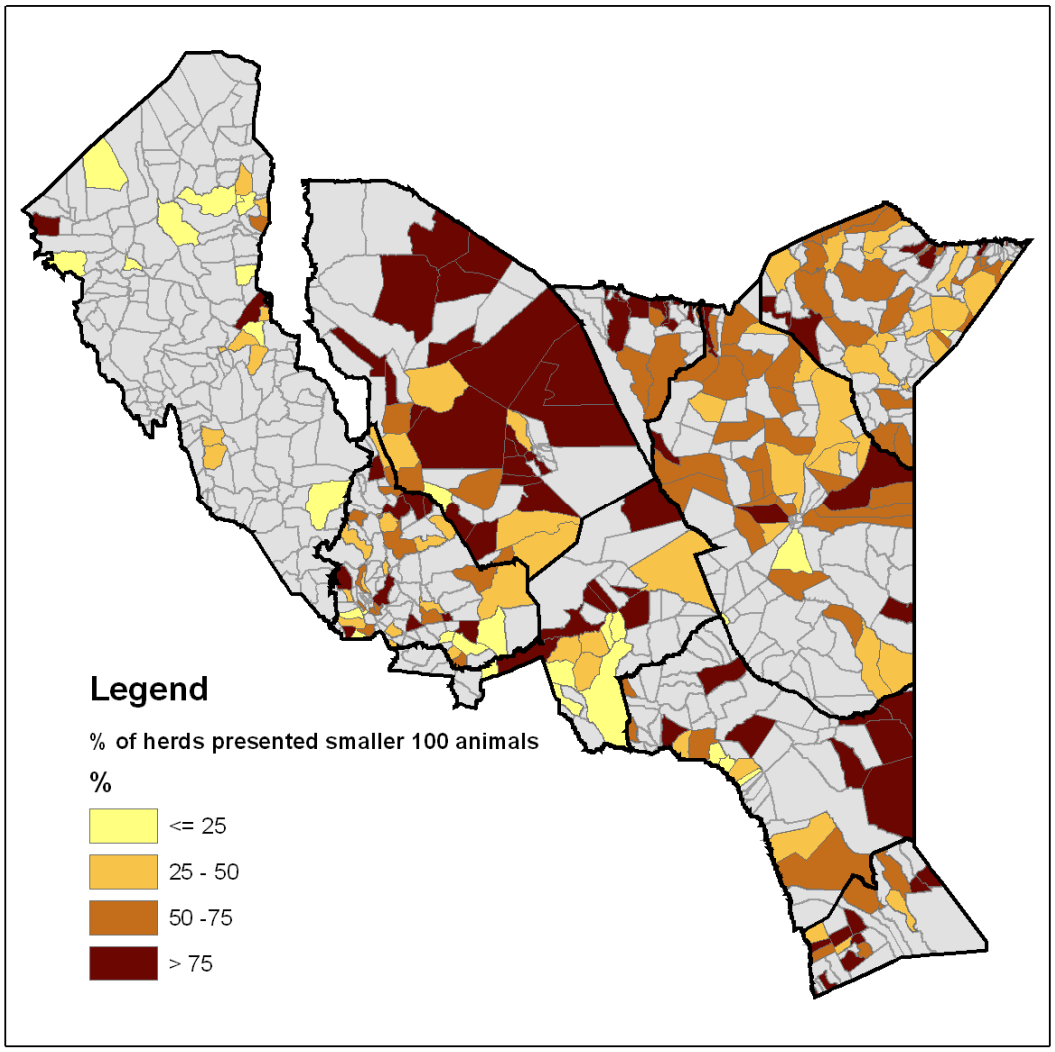
The DRP covered nine selected districts out of a possible 36 districts in Kenya. The nine were considered the most vulnerable amongst the 36 districts. The selected districts are all classified as arid land. It is important to observe that some of the highest poverty incidences in Kenya are found in constituencies belonging to the selected districts. Most of the constituency poverty incidences range from 39.8% for Samburu East to 70.54% for Wajir North constituency (Field, 2005; FAO, 2005). As mentioned earlier, livestock owners from 266 different locations within these nine districts were reached, which is 71% of the locations in the project area.

Out of the 152 locations for which poverty figures exist, 90 have more than half of their population living below the poverty line. These locations are referred to as "poor" locations. Interventions were carried out in 59 "poor" locations and in 49 "less poor" locations; thereby reaching 12,464 livestock owners from 75 different "poor" locations and 14,478 livestock owners from 49 different "less poor" locations (see table 8).

Table 8:

	# Locations	**# Locations with intervention sites**	**# Locations from which LS owners presented animals**	**# LS owners reached from the location**
"Poor"	90	59	75	12,464
"Less Poor"	62	49	49	14,478
"No info"	221	117	142	14,229
ALL	373	225	266	41,171*

** for more than 10,000 livestock owners their origin was not established*



** This map was compiled on the basis of partial results for Turkana district.*

An economic assessment of the impact of the drought response project during emergency drought situations in selected arid districts in Northern Kenya

Sospeter Nyamwaro, Luis C. Rodriguez, An Notenbaert, Ade Freeman

1. Introduction

The implementing NGO consortium jointly spent roughly 2 million Euros on the mass treatment and vaccination of almost 3 million animals. It was envisioned that this investment would have great impact on the livelihoods of many pastoralist households in the project area. The investment had two major direct impacts. First, mortality was avoided in more than 186,000 animals, the main livelihood asset of about 1.6 million pastoralists in the project districts. Second, the meat and milk productivity of many animals increased considerably. This chapter attempts to quantify the direct impacts of these interventions. Using data from different sources project costs and benefits were identified, priced, and valued in order to assess the returns to the investments made by the NGO consortium. An additional investment option was considered for comparison purposes. The full costs and benefits of these investments are presented and compared under different investment scenarios.

2. Methodology

The method used for assessing the economics of animal health interventions undertaken by the NGO consortium is based on a benefit-cost methodology that compares discounted costs and benefits using a discount factor for an 18 year period. The present value of the income streams generated from alternative animal health investment strategies are assessed under a "with" and "without" project scenario. The major elements of costs and benefits considered in the analysis are presented in Table 1. Project benefits are calculated using a herd model that is described below. Data was collected using a combination of questionnaires, participatory approaches, secondary data sources, and expert opinion.

The economic assessment estimates the potential returns to the NGO investments under three scenarios; a situation where there are no animal health interventions; a one off animal health intervention during an emergency; and targeted animal health interventions after every drought. The first scenario provides a baseline in which there is no change and represents a "without project" scenario. The two other scenarios explore alternative intervention options and they represent "with project" scenarios. A key objective of the analysis is to try to illustrate general trends that may determine the relative returns to investments from alternative animal health intervention strategies in an emergency situation or in situations that are prone to emergencies. The insights generated could provide broad guidelines for prioritizing animal health interventions in emergency situations on the basis of economic performance resulting from alternative investment strategies.

Table 1: Major elements of costs and benefits

Costs[a]	**Benefits (per species)**
Vaccination	Milk production
Treatment	Meat consumption
Delivery of vaccines and treatments to field	Animal sales
Training CAHWs	
Salaries	
Overhead	

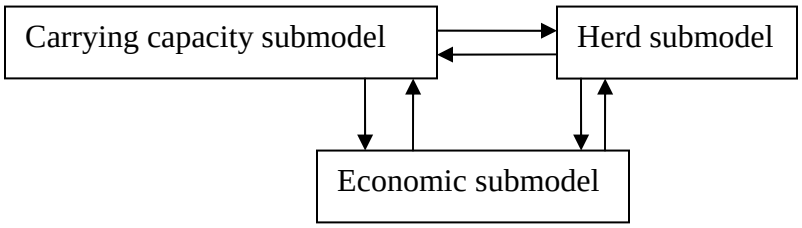
[a] A detailed overview of the cost structure is presented in the COOPI financial report

2.1 Basic model structure and data

We used a deterministic bio-economic model to represent the dynamics of animal populations and changes in primary productivity in the economic analysis of animal health interventions for the conditions of Northern Kenya. The model comprises three sub-models: the primary productivity sub model provides an estimate of the carrying capacity of the system and changes in grass availability based on rainfall values obtained from satellite images. The herd sub model, relates the dynamics of four different species cattle, goats, sheep, and camel to i) the primary productivity of the system, ii) a set of population and market parameters collected from PRA in northern Kenya, complemented with experts' consultations and published information, and iii) the effect of animal health interventions, i.e. mortality reductions due to vaccinations and treatments provided by community animal health workers (CAHWS).

Finally the economic sub model using field data and secondary sources i) quantifies in monetary terms the benefits of livestock production for each species considering the market sales, the production of milk and the consumption of animals within the household, ii) quantifies the costs of different interventions per drought event and iii) develops a cost benefit analysis of the animal health interventions. (Figure 1)

Figure 1. Conceptual bio-economic model showing the three sub-models and their linkages



2.2 Description of model sectors

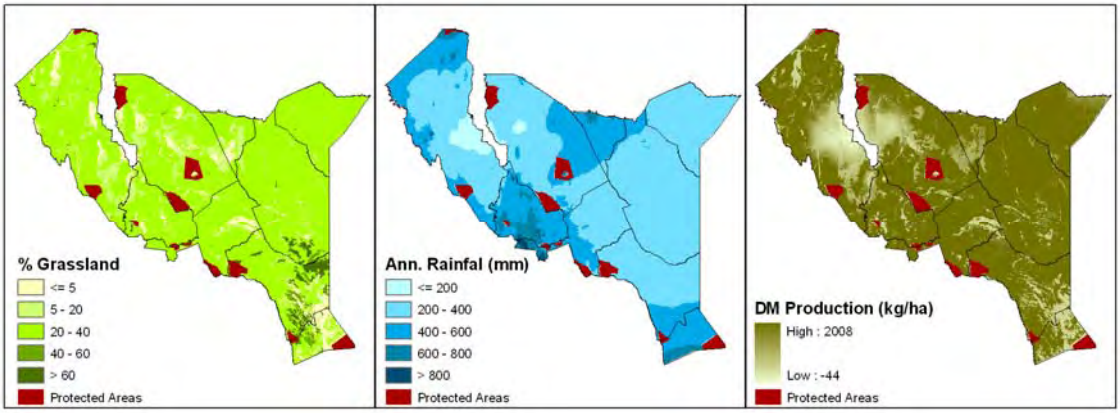
2.2.1 The carrying capacity sub model

This sub model determines the carrying capacity of the system by comparing the grass production of the study area with the feed requirements of animals expressed in Tropical Livestock Units.

First of all, the percentage grassland in the 9 districts was estimated on the basis of the land cover classification by Africover. Different classes were assigned different percentages of grassland cover. In combination with annual precipitation figures (Worldclim1.3 – Hijmans et al.), the primary dry matter production was then estimated following Illius et al.:

((Annual Rainfall * 4) - 800)) / 1000 * percentage grass (MT DM / ha)

Fig.2 Primary production in the study area



The total dry matter production for the complete study area (exclusive of national parks) in an average year was estimated to be 7.2 million ton dry matter.

From the Ruminants model the minimum maintenance requirements per TLU were taken to be 4.5 kg/TLU/day.This means that in a year with average rainfall 4.4 million TLU can potentially be maintained in the whole study area. This is in the assumption of free movement within the nine districts.

According to the Government of Kenya (Office of the president, 2001) on average a drought situation occurs once every 4 or 5 years. Assuming that in a drought year the annual rainfall in 20% below average, the carrying capacity is estimated to be only 2.6 million TLU.

The total carrying capacity was then further broken up over the different species, according to their proportions in the current herd.

2.2.2 The herd sub model

The herd sub model represents a stylized dynamics of animal populations in Northern Kenya. Four animal species were considered: cattle, goats, sheep and camel. The initial population size for each species was defined following the animal census values (GoK 2003) and because of data limitations no age structure was considered in the model. The changes in population size were modelled considering i) the number of animals coming

into the herd at a defined birth rate, ii) the number of animals going out of the herd at a defined consumption rate, iii) the number of animals going to markets, at a defined market rate which depends of the herd size in every period compared with the carrying capacity of the system obtained from the carrying capacity sub model, and iv) the number of animals going out of the heard at a defined mortality rate. This was considered dependent of the availability of rainfalls and the implementation of animal health interventions. Hence in a simplified approach the variable can take three different values depending on whether it is a normal year, drought event or a year in which an animal health intervention is being implemented. Table 2 presents the values of the parameters considered in the model for each animal species.

2.2.3 The economic sub model

The economic sector sub model considers the benefits obtained from livestock from each species. The contribution of livestock to the pastoralists' livelihood and rural income is well-know, but taking into consideration the availability of data, a limited set of benefits were estimated: animal market sales, milk production and animal consumption. These benefits were quantified in monetary terms considering the outputs of the herd sub model and the market values collected from the field surveys and secondary date from published records. Table 2 presents the values of the parameters that were used in the model to estimate the benefits from each animal species. In addition, the economic sub model quantifies the costs of different interventions i.e. vaccinations and treatment performed by CAHWs, per drought event based on information provided by the management of the project. The total cost for the veterinary intervention was estimated at 1,938,407 Euros. Finally, the economic sub model aggregates the benefits provided by each species, the costs of the implemented interventions and performs a cost benefit analysis estimating the net present value of the interventions at a defined period using the discount rate presented in Table 2.

Table 2: parameters used in the different sub models

	Sheep	Goat	Cattle	Camel	*Source*
Herd model					
Mortality rate normal (%)	15	12	10	5	*Literature and expert opinion*
mortality rate drought (%)	22	22	24	11	*PRA*
Mortality reduction (%)	2.2	1.9	2.5	0.7	*PRA & Calculations*
Increase rate (%)	45	33	30	18	*Literature and expert opinion*
Market rate (%)	20	17	2	2	*Expert opinion*
Consumption rate (%)	1	1.5	0.5	0.5	*Expert opinion*
Carrying Capacity fraction (%)	50	50	50	50	*Expert opinion*
Primary production					
Average annual rainfall (mm)	377	377	377	377	*Hijmans et al.*
Rainfall reduction (%)	20	20	20	20	*Expert opinion*
Average grass cover (%)	34	34	34	34	*Africover*
Surface area (ha)	30,212, 332	30,212,3 32	30,212,3 32	30,212,3 32	*GIS*
Proportion of total herd (%)	6	11	47.5	35.5	*GoK*
Economics					
Milk production (ltr/year/herd_animal)	127.75	142.35	503.7	584	*ALRMP*
Milk price (Euro)	0.315	0.315	0.315	0.315	*Key informants & Expert opinion*
Animal price – normal (Euro)	13.65	15.7	136.55	115.5	*Key informants & Expert opinion*
Animal price – droughtl (Euro)	4.2	5.2	31.5	105	*Key informants & Expert opinion*
Discount rate (%)	12	12	12	12	*Field estimate*

2.3 Scenario analysis

Three different scenarios were simulated in the bio-economic model in order to evaluate the impact of potential interventions.

2.3.1 Baseline scenario: This scenario presents a simplified behaviour of the system in a condition without interventions. Following the information from the GoK (Office of the President, 2001) the model assumes that drought events occur cyclically every five years in the total area of the project and the reduction in rainfall is the same every drought event. The simulation uses the initial set of parameters presented in Table 2 to provide counterfactual output values that will be used to evaluate the impact of different interventions.

2.3.2 Repeated vaccination and treatment scenario: This situation simulates the behaviour of the system when vaccinations and treatments are implemented after every drought event and the mortality rates are reduced as a result of the interventions for the values presented in Table 2. The scenario assumes that the costs of the interventions for each drought event are constant, and for that cost the overall mortality reduction is the same for each intervention event.

2.3.3 One vaccination and treatment scenario: This situation simulates the behaviour of the system when vaccinations and treatments are implemented only after the first drought event and no interventions are executed in the next droughts. The scenario assumes that the drought events occur at the same time and intensity that the baseline scenario, and the reduction in mortality is valid for one year after the intervention.

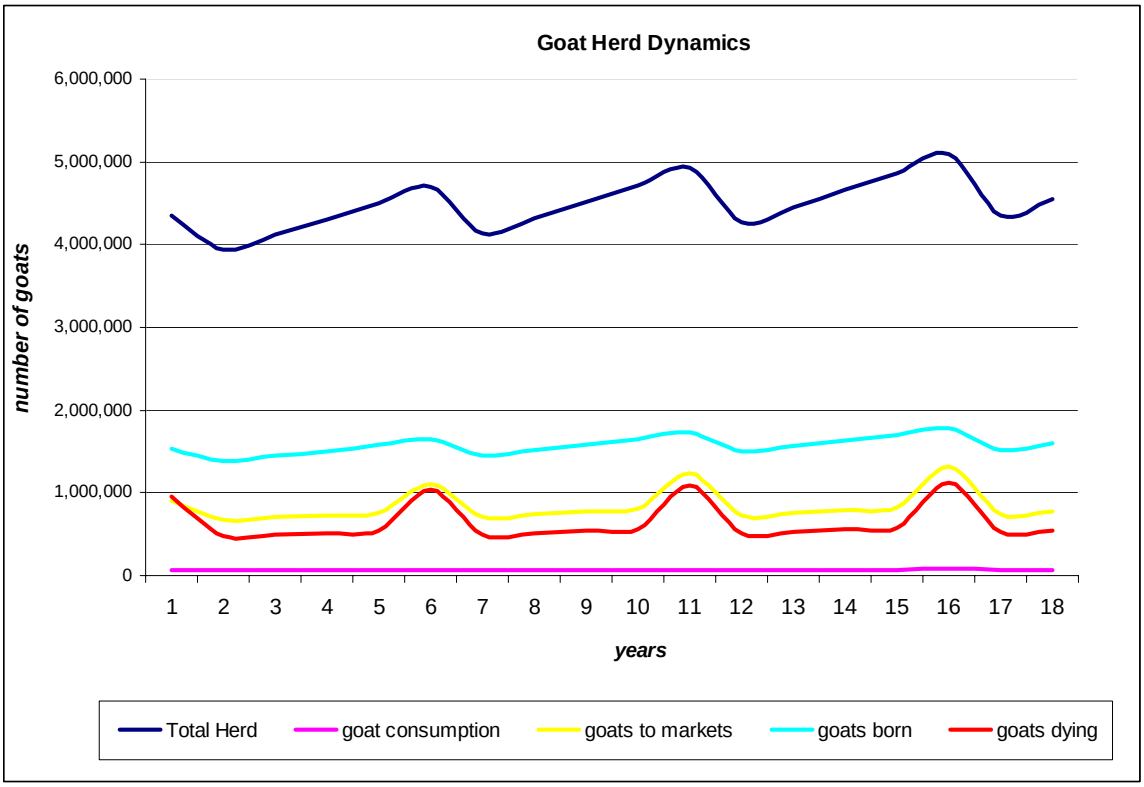
3. Results

We explored the behavior of the system under three different scenarios in 18-year simulation run, a time frame where at least three drought events might be expected and the changes in the dynamics of the animal herds after the droughts and intervention will be evidenced.

3.1 Baseline scenario

In a situation without intervention, and for a drought event every five years, the model shows as expected, that the initial population size decreases after the start of a drought event at time zero. The herd size recovers in few years at a rate dependent of the defined population parameters for each species, and without reaching the carrying capacity the population drops again after every drought event in a cycle that is repeated along the simulation time. For every cycle, the number of animals going to markets increases in the years of droughts as a strategy to reduce losses; however the number of animals dying in these events is also higher. Considering the assumption that the losses in animals do not affect the herd structure the number of animals coming into the herd every year follows the path of the herd size. Figure 3 shows the dynamics of the herd for the goats.

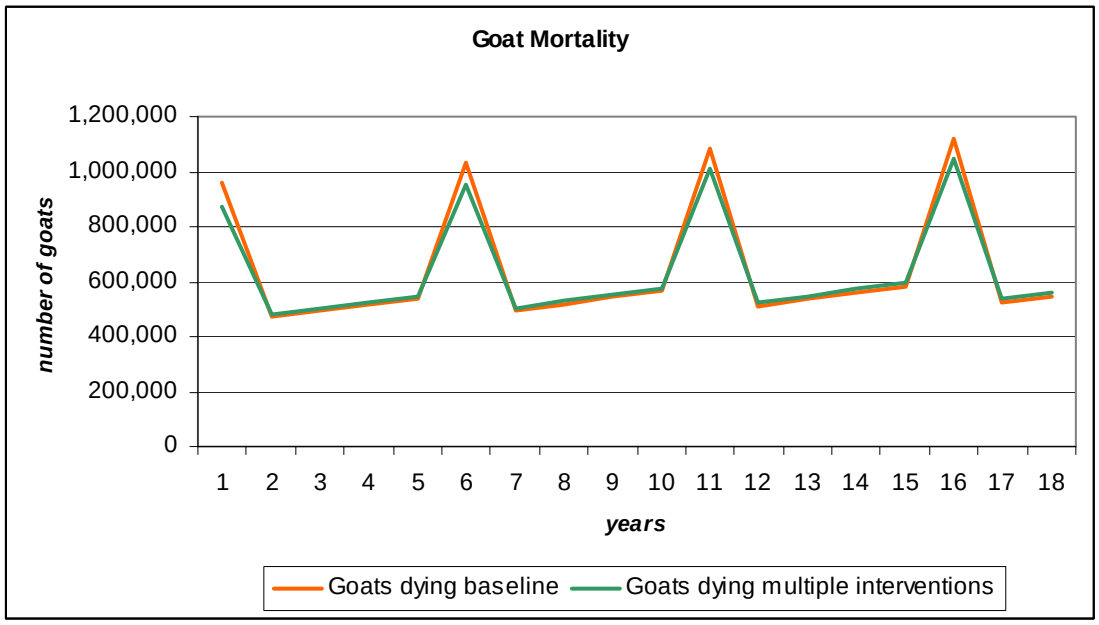
Figure 3: Herd dynamics for goats in the baseline scenario



3.2 Repeated vaccination and treatment scenario

For the conditions of this scenario, with vaccinations and treatments implemented every drought event, the herd size also decreases after the start of a drought and recovers faster because of the reduction in mortality promoted by the interventions. Figure 4 shows the number of animals dying in conditions without intervention and with interventions making evident the reduction of mortality every drought event.

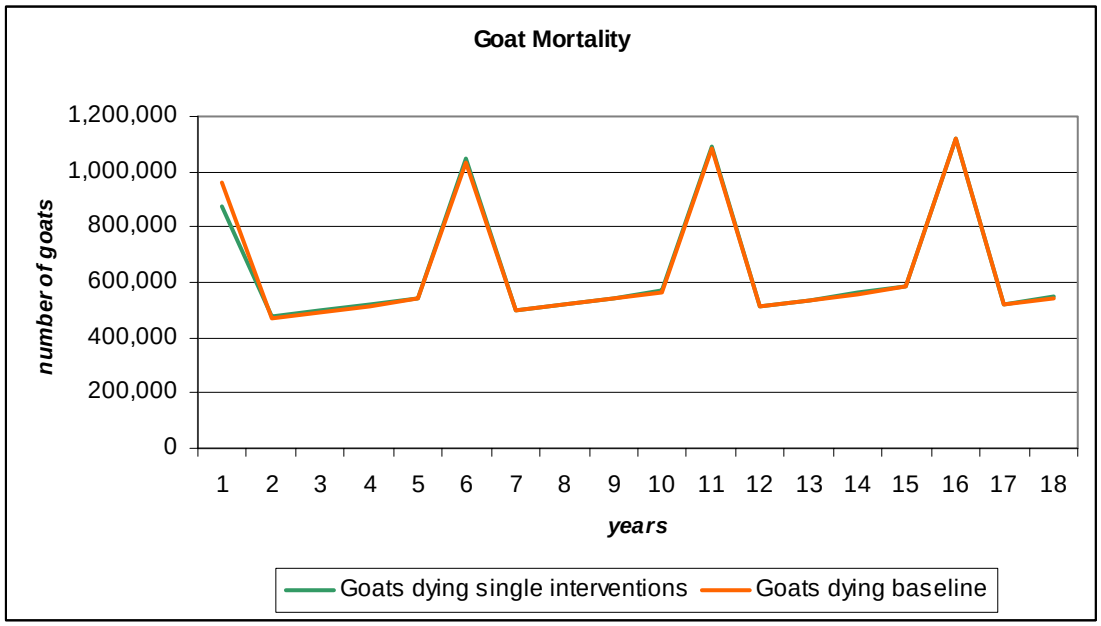
Figure 4: Number of goats dying in the baseline and repeated event scenarios



3.3 One vaccination and treatment scenario

For the conditions of this scenario, with vaccinations and treatments implemented only after the first drought event, the effect of the intervention reduces the mortality only at the implementation time since the vaccines provide protection for only one year and after that the behavior of the population in scenarios with and without intervention is similar since the population parameters are the same. Figure 5 shows the number of animals dying in conditions without intervention and with only one vaccination and treatment performed at time zero.

Figure 5: Number of goats dying in the baseline and single event scenarios



3.4. Scenario comparison

Using the outputs of the herd model, and the prices collected in the field complemented with published records, we estimated the total benefits derived from livestock production for the baseline scenario aggregating the benefits obtained from each of the species for the nine districts where interventions were implemented. Because of data limitations, these benefits consider only milk production, meat consumption and animal sales. For all the species, milk production has the lowest contribution to the total benefits, while market sales contribute most. Data about production costs were not available, so the net benefit of the livestock production are overestimated, representing an upper limit of estimated benefits. In the same way, the total benefits derived from the livestock production were estimated for i) repeated vaccination and treatment scenario, and ii) one vaccination and treatment scenario as the COOPI intervention. The total cost of the scenarios only includes those derived from the interventions. These costs were assumed constant for the simulation period. Data about production costs were not available and the net benefits might be also overestimated. The net present value of each intervention was estimated considering a period of 18 years and a discount rate of 12%. Table 3 summarizes the results for the repeated vaccination and treatment scenario for the nine districts showing that for this intervention, the net present value is initially negative and the break even point occurs between year three and four. The net present value for this intervention is 12.1 million euros. For the one vaccination and treatment scenario (Table 4), the results of the analysis shows that for this only intervention, the net present value is also initially negative with a break even point occurring between year three and four. The net present value of the intervention is 4.8 million euros. Based on the estimated present value of income streams generated by these investments, the results suggest that vaccination and treatment are valid strategies to reduce negative impacts of droughts in the study area. The returns to investments in targeted animal health interventions

following every drought are higher than the one time intervention in an 18 years period. However, in the context of an emergency intervention like the one implemented in Northern Kenya, investment in vaccination and treatment represents good money value since the return of the investment is positive for the overall level of mortality reduction achieved. A summary of this scenario comparison is presented in table 5.

Table 3

Without intervention scenario				Repeated vaccination and treatment scenario			
Years	Livestock benefits without intervention	Without intervention costs[a]	Net benefits without intervention [b]	Livestock benefits repeated vaccination and treatment scenario	Intervention costs repeated vaccination and treatment scenario[c]	Net benefits repeated vaccination and treatment scenario [d]	Net present value of the intervention
0	36,510,563.13	0	36,510,563.13	37,870,114.60	1,938,407.00	35,931,707.60	0
1	27,472,973.34	0	27,472,973.34	27,775,051.12	0	27,775,051.12	-578,856
2	29,977,574.96	0	29,977,574.96	30,308,930.18	0	30,308,930.18	-309,143
3	63,198,469.88	0	63,198,469.88	66,089,257.94	0	66,089,257.94	-44,989
4	84,702,451.02	0	84,702,451.02	86,989,266.96	0	86,989,266.96	2,012,617
5	63,225,044.86	0	63,225,044.86	65,526,472.66	1,938,407.00	63,588,065.66	3,465,930
6	29,892,477.22	0	29,892,477.22	30,721,057.09	0	30,721,057.09	3,671,918
7	72,244,729.14	0	72,244,729.14	76,454,364.44	0	76,454,364.44	4,091,702
8	95,733,708.29	0	95,733,708.29	98,738,854.04	0	98,738,854.04	5,995,927
9	106,550,286.55	0	106,550,286.55	108,448,858.05	0	108,448,858.05	7,209,655
10	68,618,963.51	0	68,618,963.51	71,024,095.16	1,938,407.00	69,085,688.16	7,894,299
11	32,761,222.97	0	32,761,222.97	33,626,873.46	0	33,626,873.46	8,044,572
12	78,217,006.20	0	78,217,006.20	82,471,506.29	0	82,471,506.29	8,293,426
13	101,175,537.17	0	101,175,537.17	104,235,738.72	0	104,235,738.72	9,385,450
14	109,978,124.65	0	109,978,124.65	111,944,051.73	0	111,944,051.73	10,086,769
15	69,848,795.33	0	69,848,795.33	72,355,978.98	1,938,407.00	70,417,571.98	10,489,037
16	33,293,395.04	0	33,293,395.04	34,212,411.35	0	34,212,411.35	10,592,950
17	79,190,389.81	0	79,190,389.81	88,440,131.42	0	88,440,131.42	10,742,862
18	102,219,546.42	0	102,219,546.42	102,527,376.64	0	102,527,376.64	12,090,034
						Discount rate	12%

[a] Production costs were not available

[b] The net benefits are overestimated since production costs were not available

[c] The cost considers only those derived from the interventions and no production costs were available for this scenario

[d] The net benefits are overestimated since production costs for the scenario with intervention were not available

Table 4

Without intervention scenario				One vaccination and treatment scenario			
Years	Livestock benefits without intervention	Without intervention costs[a]	Net benefits without intervention [b]	Livestock benefits one vaccination and treatment scenario	Intervention costs one vaccination and treatment scenario[c]	Net benefits one vaccination and treatment scenario [d]	Net present value of the intervention
0	36,510,563.13	0	36,510,563.13	37,870,114.60	1,938,407.00	35,931,707.60	0
1	27,472,973.34	0	27,472,973.34	27,775,051.12	0	27,775,051.12	-578,856
2	29,977,574.96	0	29,977,574.96	30,308,930.18	0	30,308,930.18	-309,143
3	63,198,469.88	0	63,198,469.88	66,089,257.94	0	66,089,257.94	-44,989
4	84,702,451.02	0	84,702,451.02	86,989,266.96	0	86,989,266.96	2,012,617
5	63,225,044.86	0	63,225,044.86	63,759,496.82	0	63,759,496.82	3,465,930
6	29,892,477.22	0	29,892,477.22	30,122,998.32	0	30,122,998.32	3,769,192
7	72,244,729.14	0	72,244,729.14	72,999,972.36	0	72,999,972.36	3,885,981
8	95,733,708.29	0	95,733,708.29	96,318,654.96	0	96,318,654.96	4,227,615
9	106,550,286.55	0	106,550,286.55	106,939,654.90	0	106,939,654.90	4,463,865
10	68,618,963.51	0	68,618,963.51	68,779,452.81	0	68,779,452.81	4,604,275
11	32,761,222.97	0	32,761,222.97	32,833,333.32	0	32,833,333.32	4,655,949
12	78,217,006.20	0	78,217,006.20	78,361,599.62	0	78,361,599.62	4,676,679
13	101,175,537.17	0	101,175,537.17	101,307,345.07	0	101,307,345.07	4,713,792
14	109,978,124.65	0	109,978,124.65	110,083,495.52	0	110,083,495.52	4,743,999
15	69,848,795.33	0	69,848,795.33	69,926,637.81	0	69,926,637.81	4,765,560
16	33,293,395.04	0	33,293,395.04	33,332,278.24	0	33,332,278.24	4,779,782
17	79,190,389.81	0	79,190,389.81	79,240,304.48	0	79,240,304.48	4,786,124
18	102,219,546.42	0	102,219,546.42	102,270,460.08	0	102,270,460.08	4,793,394
						Discount rate	12%

[a] Production costs were not available

[b] The net benefits are overestimated since production costs were not available

[c] The cost considers only those derived from the interventions and no production costs were available for this scenario

[d] The net benefits are overestimated since production costs for the scenario with intervention were not available

Table 5:

Intervention	Breakeven point	Net present value of the intervention
One vaccination and treatment	Year 3-4	4,793,394
Repeated vaccinations and treatments	Year 3-4	12,090,034

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Chapter 6

Conclusions

S. O. Nyamwaro, D. J. Watson, B. Mati, A. Notenbaert, J. Mariner, L.C. Rodriguez and A. Freeman

6.1 Drought Coping Strategies:

Key conclusions to be drawn from this component of the research are as follows. First, with regard to whether or not the project's activities were likely to enhance the robustness of current drought coping strategies/mechanisms, the research findings suggest that both the veterinary and water interventions are supportive of current drought coping strategies of most of the households interviewed. The provision of livestock healthcare and strategic provision of water resources address key livelihoods challenges and major problems encountered during drought both directly and indirectly. The provision of livestock healthcare directly helps to redress livestock losses during both normal and drought conditions. The indirect benefits of livestock healthcare include; an enhanced capacity of livestock to trek further in search of water and pasture, as well as enabling livestock to trek to market and attain higher prices once they get their due to their healthier condition. Livestock healthcare and strategic water interventions are also in-line with what pastoralists deem as key livelihoods and livestock interventions. However, with regard to whether or not the project's activities will decrease pastoralists' vulnerability to future drought-related shocks, the intervention is likely to have mixed results. For example, the provision of strategic water resources will help to bolster the water component of pastoralists' drought coping strategies during both the current and, hopefully, future droughts. However, whilst the provision of livestock healthcare can greatly assist the drought coping and livelihoods strategies of pastoralists in the short to medium-term, unless it is part of an integrated system-based approach to enhancing pastoralists' drought coping strategies, the unilateral provision of livestock healthcare is unlikely to have a significant long-term impact.

Key recommendations from this component of the ILRI research are as follows. The success of emergency or development-focused interventions in pastoralist systems in drought prone areas depend on whether or not the intervention is part of an integrated multi-agency system-based approach. Future interventions should bolster existing drought coping strategies, and, where appropriate, endeavour to enhance them. Future interventions should seek to promote the development and institutionalisation of the market economy. Properly functioning livestock markets and the emergence of a more market oriented culture among pastoralist communities could serve to secure the livelihoods of many currently vulnerable pastoralists in the nine districts. Attention should also be turned to enhancing and broadening the general livelihood strategies of pastoralists, particularly those with few livestock assets, whose livestock-based livelihood is often on the edge of total collapse during severed droughts. Lastly, whether or not interventions into pastoralists' systems are emergency or development-based, it is imperative that future interventions are guided by high quality systems-based research.

Finally, on a cautionary note, whilst the district-level summaries, and the data provided in this report, provide significant insights into the perceived appropriateness of the aforementioned

project, it must be remembered that the general conclusions and recommendations drawn from this research are based on very small sample sizes, which can in no way be taken as fully representative of the districts in which the household surveys were conducted, and has been collected by individuals with little or no training in household survey techniques. Further research is required to validate the findings over time and space.

6.2 Water and Environment

Response to drought in emergency situations for pastoral communities can be complicated by the fragility and mortality of the major livelihood resource, livestock. This was especially so in the provision of emergency relief and response to communities and livestock faced by the drought of 2004-2005 in Northern Kenya. In this project to preserve pastoral livelihoods in northern Kenya during emergency drought situations, one of the major interventions involved the rehabilitation of strategic water facilities in four districts, viz. Isiolo, Marsabit, Moyale and Samburu. The water facilities rehabilitated at the 14 sources were chosen to be within the livestock routes and to reduce the longest distances traversed to watering during drought. By having strong community participation, and combining government, local and international NGOs having the right expertise and the scientific backstopping by ILRI, the project was implemented with a strong monitoring and evaluation component.

The total increment in water made available to livestock and communities was 617,400 litres per day, thereby meeting the target set before the project commenced. This helped improve the livelihoods of 15,000 pastoralist households of which 450 households were directly benefiting from drinking water. In general, each water facility, especially strategic boreholes, is normally utilized by about 1,000-5,000 households, 5,000-10,000 cattle, 20,000-30,000 shoats and 2,000-5,000 camels. The rehabilitation of shallow wells helped improve hygiene, safety and reduce siltation of the. With the water facilities improved, livestock and people will have access to water within reasonable distance in drought periods, thereby improving livelihoods.

6.3 Epidemiology:

The epidemiological impact assessment provided appropriate mortality estimates for all major diseases of all principal target species. This was done with a minimal investment of project time and financial resources. The consultant in charge of the epidemiological component knows of no other method that would have generated such a breadth of data and allowed the target diseases to be accurately assessed within the general context of all disease problems.

The approach adopted in assessing baseline mortality and then projecting the impact of interventions on the underlying mortality estimates was achievable given the resources available for the assessment. In the consultant's opinion this avoided a number of issues that are usually overlooked in the 'measurement' of project impact. Foremost among these is the problem of attribution of changes in impact indicators to the forces active in the project area.

In regard to training of the participatory facilitators, it is recommended that data quality could be improved a lot by investing more time in training and conducting field-based training of facilitators. In all previous projects where participatory epidemiological methods have been employed, field practical exercises have been *the major emphasis* of the training workshops. In

this project, training was not field-based due to budgetary constraints. The minimal increase in cost would be warranted in any future assessment.

The data collection was implemented vertically with each NGO responsible for data collection and data entry within its area of operation. Overall aggregate estimates derived from the epidemiological data were apparently appropriate at the project-wide level. However, variation was observed in the data between different regions. In future exercises, it is recommend that the ability to make useful spatial and cultural inferences would be greatly enhanced by implementing data collection though a more unified data collection and data entry structure.

Requiring each NGO to enter its own data resulted in a considerable workload for the consultant in terms of data cleaning. One NGO utilized a different version of the database with a different data structure from the other three. This meant that several days of the consultancy were essentially spent on clerical tasks. It is recommended that a unified data collection and data entry structure would lead to better standardization of the data.

The overall livelihoods importance scores assigned to small ruminants (63 out of 100) by the beneficiaries indicated that the project correctly identified small ruminants as the species for concentration of interventions.

The mortality scoring suggests that the project did an excellent job of selecting target diseases.

The projected mortality after the project intervention was 17.8 % (19.6 – 1.8). This estimate is based upon the perceptions of the beneficiaries. The 17.8 % mortality implies that the project kept the overall mortality below 20%.

Appendix 1

Appendix (1), Major problems encountered during drought situations (expressed by a minority of respondents)

Problems	**Number of respondents**
Increased human deaths	8
Tiredness, low productivity and anxiety	7
Lack of human drugs	3
Poor living standards	3
Predators	2
Lack of animal drugs	2
High workload	2
Lack of credit	2
Increased raids	2
Lack of community and or government assistance	2
Lack of animal food	1
Unable to get firewood	1
Lack of transport for livestock	1

Appendix 2

Appendix 2, Community drought preparation (expressed by a minority of respondents)

Nature of preparation undertaken	**No. of respondents**
Initiate small business	6
Borrow lactating animals during drought	5
Buy food for livestock	5
Dig wells	4
Await assistance from Gov, God and NGOs	4
Produce crops	4
Move to Lake Turkana to fish	2
Producing milk powder	2
Purchase drugs and water	2
Moving in with/borrowing money from affluent relatives	2
Produce cheese	1
Produce charcoal	1
Storing crops for human consumption	1
Restocking by relatives	1
Selling animals before drought	1

Appendix 3

Appendix (3), Expected livelihoods impact of veterinary intervention (expressed by a minority of respondents)

Expected livelihoods impact	No. of respondents
Capacity to marry another wife and/or provide a dowry	14
More income	10
Less work	9
Capacity to start another business	3
Improved nutrition	3
Livestock sales allow restocking during drought when prices are lowest	2
Markets remain open	2
More celebrations	2

Appendix 4

Appendix (4) Semi-structured Household Interview Format

Household questionnaire to assess impacts of drought induced veterinary interventions on human and social capital and livelihood coping strategies of pastoralists in Northern Kenya

Respondent's name: _____

Respondent's tribe/sub-tribe or clan: _____

Respondent's age (years): _____

Respondent's gender: _____

Respondent's health status
(Able bodied or unable to work)
N.B. This may be due to age/illness of infirmity): _____

1. Outside your immediate household, how many people would be willing to provide you with financial or material support?

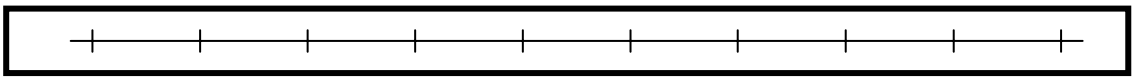
    1 No one (skip to question 5)
    2 One or two people
    3 Three or four people
    4 Five or more people

2. Of those people, how many do you think are currently <u>able</u> to provide this financial or material support?

3. Are most of these people of similar/higher/lower economic status?

   1 Similar
   2 Higher
   3 Lower

4. If you were ill for a day or two, could you count on members of your community to take care of your livestock?

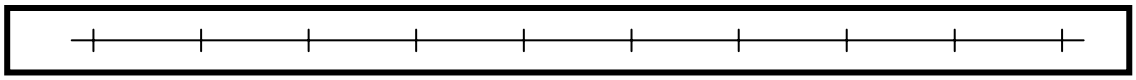


Definitely not Definitely

Trust and Solidarity

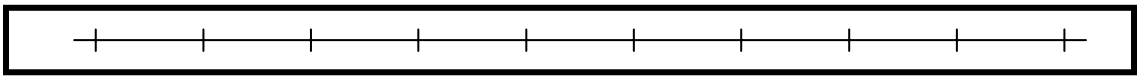
5. In general, do you agree or disagree with the following statements?

5.1. Most people who live in this community can be trusted



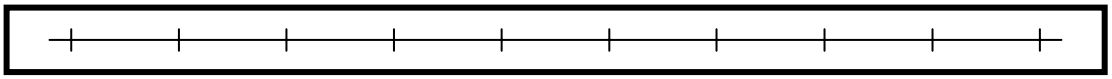
Disagree Strongly — Agree Strongly

5.2. In this community, people try to take advantage of you



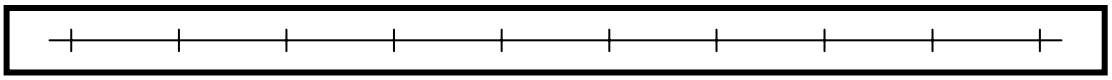
Disagree Strongly — Agree Strongly

5.3. Most people in this community are willing to help if you need it



Disagree Strongly — Agree Strongly

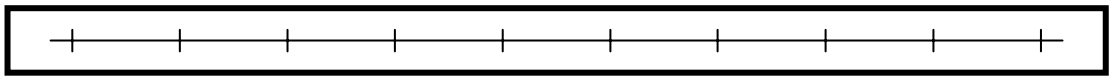
5.4. In this community, people generally do not trust each other in matters of lending and borrowing money



Disagree Strongly — Agree Strongly

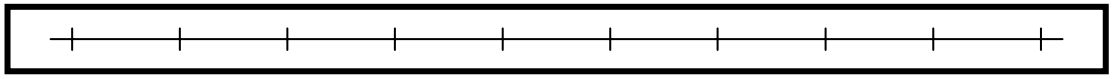
6. Now I want to ask you how much you trust different types of people.

6.1.How much do you trust people from your ethnic or linguistic group/race/caste/tribe?



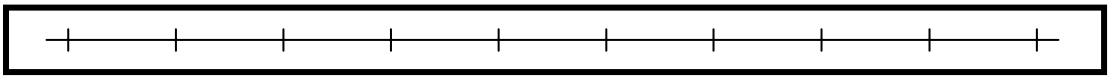
To a very small extent — To a very great extent

6.2.How much do you trust people from other ethnic or linguistic groups/race/caste/tribe?



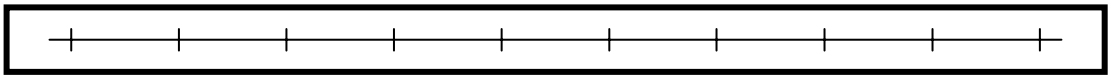
To a very small extent — To a very great extent

6.3.How much do you trust local government officials?



To a very small extent — To a very great extent

6.4.How much do you trust NGO staff?



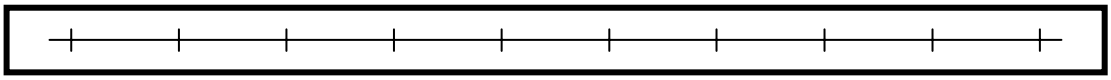
To a very small extent — To a very great extent

7. If a community project does not directly benefit you but benefits others in the community, would you contribute:

	Yes	No
Time		
Money		
Material support		

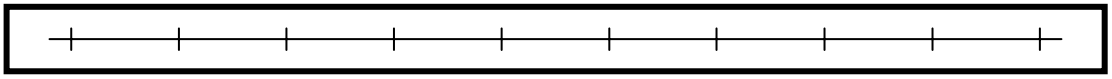
<u>Empowerment and Political Action</u>

8. In general, how happy do you consider yourself to be?



Very unhappy — Very happy

9. In general, how secure do you feel?



Very vulnerable

Very secure

Livelihoods related questions

10. List the top five things that negatively affect your livelihoods over which you have little or no control?

11. What are the major problems you encounter during drought situations?

12. How does your community prepare for drought?

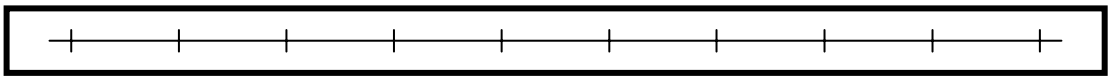
13. Who does this preparation involve?

14. What are you doing to better prepare your household for the next drought?

15. In times of drought, what are the most important things that external organisations/institutions could do in order to safeguard your livelihood?

16. In a drought situation, which livestock intervention(s) is/are likely to have the greatest positive impact(s), and why?

17. In time of drought, how important is the avoidance/control of disease with regard to coping strategies?



Almost irrelevant

Very important

18. What impact(s) do you expect that this veterinary-based livestock intervention will have on your drought coping strategy, and why?

19. What impact(s) do you expect that this veterinary-based livestock intervention will have on your wellbeing/livelihoods, and why?

Appendix 5

Appendix (5) Key Informant Interview Format

Secondary data checklist and key informant questionnaire to assess impacts of drought induced veterinary interventions on human and social capital and livelihood coping strategies of pastoralists in Northern Kenya

Important note:

The questions outlined below represent a quick and easy mechanism to extract complementary information essential for a robust social and (financial) capital assessment of the communities in which the household surveys are taking place. Much of this information can be ascertained from secondary data (including your own field reports). Where no appropriate secondary data exists, it would be helpful if each NGO could select at least one, but preferable three, key informants that possess extensive knowledge of the chosen communities. Indeed, one of the key informants could be a member of your NGO or the local DVO. Ideally, time and resources permitting, it would be both appreciated and extremely useful if, NGOs could conduct three key informant interviews per community as a matter of course, irrespective of the existence of secondary data.

Collective Action and Cooperation

1. In the past 12 months did people in the community come together to do some work for the benefit of the community?

    1. Yes
    2. No (skip to question 4)

    [ ]

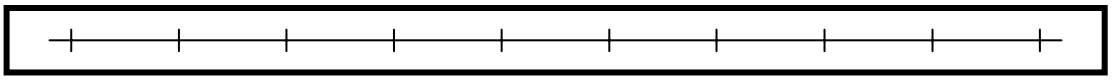
2. How many times in the past 12 months?

    [ ]

3. What were the three main such activities in the past 12 months? Was participation in these activities the individuals own decision or did your community require them to undertake them?

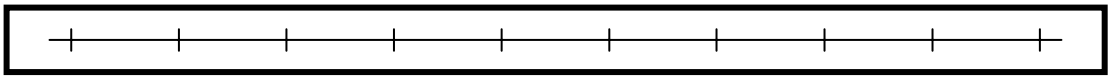
	Own decision	Required

4. How likely is it that people who do not participate in community activities will be criticized or disadvantaged some way?



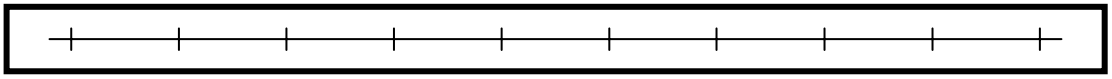
Very likely Very unlikely

5. How likely is it that people will cooperate to try to solve the problem?



Very likely Very unlikely

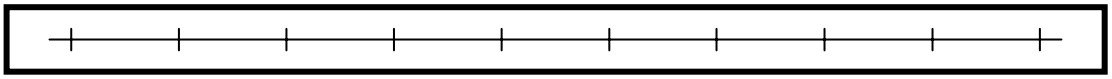
6. Suppose something unfortunate happened to someone in the community, such as a serious illness, or the death of a parent. How likely is it that some people in the community would get together to help them?



Very likely Very unlikely

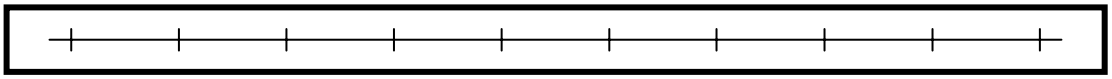
<u>Social Cohesion and Inclusion</u>

7. How strong is the feeling of togetherness or closeness in the community?



Very distant Very close

8. To what extent do differences (e.g., wealth, income, and social status, ethnic or linguistic background/race/caste/tribe) characterise the community?



To a very small extent To a very great extent

9. Do any of these differences cause problems?

   1. Yes ☐

2. No ⟶ go to question 12

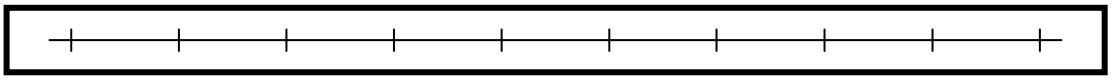
10. Which two differences most often cause problems?

1. Differences in access to grazing
2. Differences in access to and use of water
3. Differences in wealth/material possessions
4. Differences in social status
5. Differences between men and women
6. Differences between younger and older generations
7. Differences in ethnic or linguistic background/race/caste/tribe

11. Have these problems ever led to violence?

1. Yes
2. No

12. In general, how safe from crime and violence is the community?

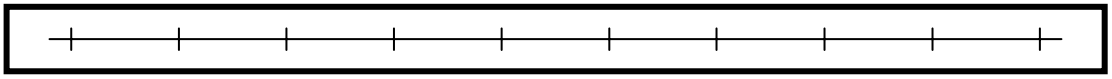


Very unsafe Very safe

Communal property rights

13. What are the local property rights/rules/traditions/norms associated with access to and use of common grazing?

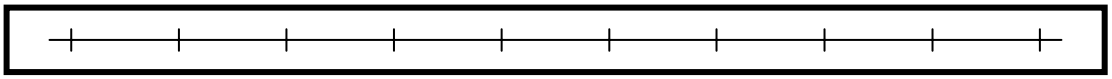
14. Is access to and use of common grazing:



Highly contested and unworkable

Relatively stable and open to many people

15. Is access to and use of water:



Highly contested and unworkable

Relatively stable and open to many people

16. Are there groups of people in the community who are prevented from or do not have access to any of the following?

→	1 Yes 2 No (skip to question 37)	How many are excluded? 1 Only a few people 2 Many people, but less than half of the community 3 More than half the community
A. Common grazing		
B. Bore-hole water		
C. Veterinary services/medicines		
D. Transportation		

17. Why are people excluded from access to and use of common grazing?

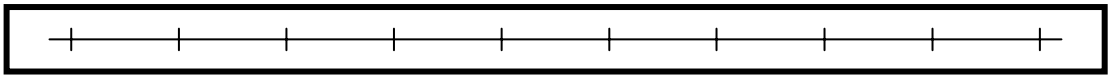
18. Why are people excluded from access to and use of bore-hole water?

19. Why are people excluded from access to and use of veterinary services and medicines?

20. Which cause of animal loss is the hardest to bear?

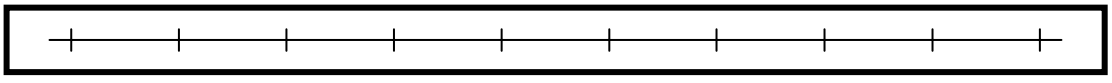
Disease = (1) Dehydration and malnourishment = (2) Predation = (3) Theft = (4)

21. How much control do the poorest members of the community have in making decisions that affect their everyday activities?



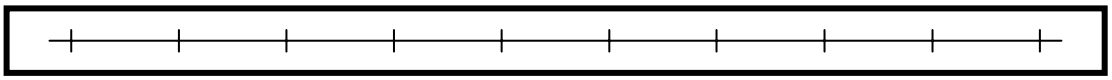
No control — Control over all decisions

22. How much control do the poorest members of the community have over making important life changing decisions?



Totally unable to change life — Totally able to change life

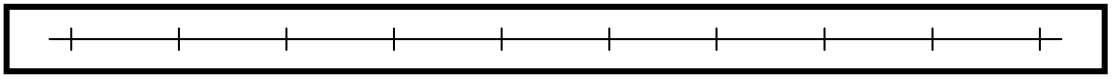
23. To what extent do local government and local leaders take into account concerns voiced by the poorest members of the community?



Not at all A lot

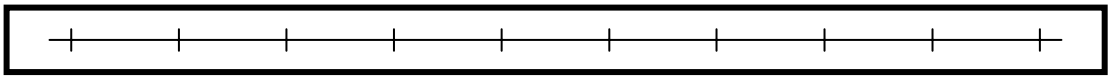
24. In your opinion, how honest are the officials and staff of the following agencies?

24.1. Local government officials



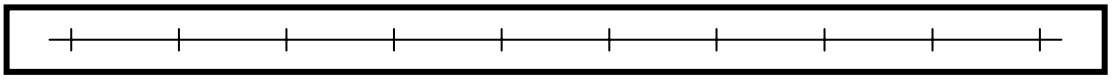
Very dishonest Very honest

24.2. Traditional community leaders



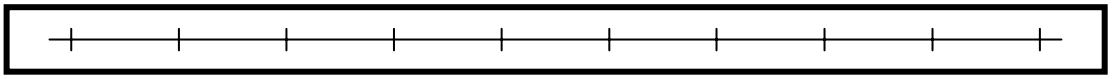
Very dishonest Very honest

24.3. Teachers and school officials



Very dishonest Very honest

24.4. NGO staff



Very dishonest Very honest

25. What is the approximate size and species composition of the community's livestock herds/flocks?

	Camels	Cattle	Sheep	Goats
Estimated number of animals				
Estimated percentage species composition				

26. Describe the social structure of the community (this should include social structure/hierarchies and principal divisions of labour, and at least some idea of the power dynamics and distribution of assets/resources).

ANNEX 6. Detailed Reports of Water Sources Visited

1. Marti borehole

Marti borehole is a strategic borehole in Samburu District, Baragoi Division, Marti Location, Kalele sub location. It serves a population of about 3,500, some 10,000 cattle, 20,000 shoats and 5,000 camels. Before the current rehabilitation work, the borehole was operational, yields a lot of water but was in need of major repairs. The borehole is used by people from as far as 50 km during drought periods. Moreover, livestock have to get water in shifts with 2-3 days between waterings. At the time of the visit, land degradation was not evident, partly because it was at the end of the rainy season, and few animals were using the borehole. Work on the components requiring replacement was progressing well and the condition of the major components are described below:

- Borehole – okay and yielding water
- Pump – Okay but needs to be checked
- Pump house – Dilapidated and requires to be re-built
- Genset- In disrepair, leaking oil and requiring replacement (diesel engine)
- Control panel – in disrepair, requires replacement
- Piping – Most of them were corroded, leaking and requiring replacement
- Watering toughs – Only one available and inadequate for the large number of animals during drought periods. The second watering trough was under construction
- Water tank-One tank is available for human water near Marti market, but livestock water is delivered directly from pump to trough. The storage tank for livestock water was under construction at the time of the visit.
- Fencing – Poor, requires replacement

2. Lesirkan borehole

Lesirkan borehole is in Samburu District, Baragoi Division, Lesirkan Location, Lesirkan sub location. The borehole is not operational but used to serve a population of about 4,426, some 50,000 head of livestock. Its major problem is that before it broke down, it used to yield mud then failed as formation is believed to have collapsed. The condition of the borehole is so bad that what is required is a replacement borehole. This will be done within two metres of the old borehole and therefore is expected to yield as much as the old borehole. Due to a request by NEMA, an Environmental Impact Assessment formed part of the evaluation and was done. It was found that the area around the borehole is in good condition (no soil erosion, there is vegetation cover) while the community indicated that livestock are grazed far from the borehole. Among the people interviewed was the Chairman of the Water Users Association, Mr. Robert Lenyewa who indicated that the community would like the borehole rehabilitated as they had no water, the next nearest source being Masikita about 20 km away. The condition of the major components were as follows:

- Borehole condition – closed and non-operational. Blocked well shaft. Requiring replacement borehole to be drilled
- Pump – Not known and needs to be replaced
- Pump house – Dilapidated and require to be re-built
- Genset- In disrepair, not operational and requiring replacement
- Control panel – lacking requires replacement
- Piping – Most of them were corroded, and requiring replacement
- Watering toughs – Not available, but currently under construction
- Water tank-Originally none. But currently under construction
- Fencing – Very poor condition, requires replacement

3. Karatina shallow wells

Karatina shallow wells are in Marsabit District close to the town. There are about 20 individually owned wells, some of which have been improved by CIFA/Cordaid. ILRI/COOPI project plans to improve about 5 wells. The un-improved wells run the risk of sedimentation during the rainy season collapse of the well walls, high contamination and danger of falling in by the users accessing water. In addition, the unimproved wells require 6-8 persons to draw water compared to improved wells, which require 3-5 people. Although these wells are close to town, they serve as a strategic reserve during the dry season, for a catchment about 50 km radius, and therefore, their rehabilitation is very important. At the time of the visit, COOPI's work had not started. The proposed interventions will include

- Well condition – open and un-improved. require improvement
- Well capping – Not capped, require capping
- Watering toughs – very small. Require improved design of troughs.

4. Harsilwa borehole

Harsilwa borehole is in Marsabit District, Laisamis Division, Korr Location, Korr sub location. It was still non-operational at the time of visit and the local people say it had once been vandalized. The borehole has as flow rate of 6.7 m^3/hr and can serve a population of about 1,800, and 12,000 cattle, 30,000 shoats and 4,000 camels. The pump and genset are actually operational but in storage. Originally, it used to run on a windmill which has since broken down. The water quality is slightly saline but good for livestock, and it was used exclusively as a strategic borehole for livestock watering. Its rehabilitation requires installation of pump, genset, replacement of pipes, and repair of pump housing and fencing. However, there are conflicts with the interests of the local community who have said that they prefer that the shallow wells at Korr be improved instead. Efforts by CIFA to meet the local community were frustrated by poor attendance until when the meetings were called to discuss the shallow wells is when they turned up. There are 10 shallow wells selected for the ILRI/COOPI project. My own interviews confirmed that the community prefers the shallow wells to borehole rehabilitation. This is because the borehole serves other communities beyond their vicinity while the wells serve only the local residents. I raised this issue with the District Water Engineer, but he said the District Water office prefers to rehabilitate the borehole because its yield is good and will serve more animals, as strategic boreholes should. He promised to investigate the differences in preferences for which water sources to be rehabilitated. Similarly, it would be prudent for ILRI/COOPI to do further socio-economic investigations if the proposal to go ahead with rehabilitating this borehole are to be implemented. Technically, the condition of the major components were as follows:

- Borehole condition – closed and non-operational, requires installation of pumping units
- Pump – Available and in good condition
- Pump house – Dilapidated and require to be re-built
- Genset- Available in storage.
- Control panel – lacking requires replacement
- Piping – Most of them were corroded, and requiring replacement
- Watering toughs – In good condition
- Water tank- Used to leak, requires repair
- Fencing – Lacking, requires replacement

5. Korr wells

Korr shallow wells are in Marsabit District, Laisamis Division, Korr Location, Korr sub location, about 5 km from Harsilwa borehole. The wells are family-owned and serve a population of about 1000. The water is slightly saline, but is used for domestic and livestock watering. There are over 100 shallow wells, some of which have been improved through other projects, the most recent being Cordaid. The main problem with

unimproved wells is that they get silted up during the rainy season and have to be desilted every season. In addition, water gets easily contaminated, livestock have no drinking troughs, and well shaft is earth and dangerous to climb when reaching the water down below. Unimproved wells require 5-8 persons to bring the water up, while improved ones require 3-5 persons. The local community interviewed at Korr indicated that they prefer well rehabilitation to the borehole, as the wells are closer to their homes (10 km away, Harsilwa is 15 km away), and the ownership aspect. The main improvements required include reshaping the well shaft, landing level space, small depression to pour in water temporarily before it's transferred to containers and/or troughs, lining the well shaft and landings, construction of a short wall, about 60 cm high to protect the well from runoff and livestock from falling in, and general improvement in safety. The ILRI-COOPI project will rehabilitate 10 shallow wells at Korr. The condition of these wells at the time of visit showed that:

- Well condition – open, earthen shaft, silted up – Requires desilting, reshaping
- Water access areas – Earthen, un-improved and dangerous, require concrete lining and wall.
- Watering toughs – very small. Require improved design of troughs.

6. Mlango borehole

Mlango borehole is in Isiolo District, Central Division. It is an abandoned borehole with much of the infrastructure showing signs of neglect and vandalism. It used to serve about 18,000 cattle and 20,000 goats. The water from the borehole is slightly saline but good for livestock, although the local people say it used to be very dirty. None of the major components of the borehole are functional and all of them require rehabilitation. In addition, some members of the community (at Longopito) mentioned the need to be careful with Mlango borehole because they claimed it is used my many ethnic groups and could trigger insecurity in the area if it is rehabilitated. There is a need for ILRI/COOPI to do more social-economic surveys to determine the truth or otherwise of such allegations. From an engineering perspective, the condition of the components at the time of visit were as follows:

- Borehole condition – closed and non-operational, but can yield water
- Pump – None-requires replacement
- Pump house – Dilapidated and require to be re-built
- Genset- None- Requires replacement
- Control panel – lacking requires replacement
- Piping – Most of them were corroded, and requiring replacement
- Watering toughs – In poor condition, require rehabilitation
- Water tank- Cracked, requires repair or replacement
- Fencing – Lacking, requires replacement

7. Longopito sand dam

Longopito sand dam is being constructed across the Longopito laga in Isiolo District, Ol Donyiro Division, Ol Donyiro Location, Ol Donyiro Sub location. The choice of this intervention is based on the success of other sand dams in the area, which number about five. It is a new project in which the community was involved in identifying the intervention as well as the site. It is expected to serve a population of about 2,500, 10,000 cattle, 30,000 shoats and 2,000 camels. The current site is very good because it shows the presence of a natural dyke in the reservoir area of the dam. At the time of this visit, women were obtaining water from the sand ahead of the dam under construction. Only the foundation had been done, but the reinforcements for the dam wall were already in place. The dam has a maximum height of 2 m at the spillway, which is a natural rock. In cross-section, the retaining wall is 3 m high, 1 m bottom width, 0.5 m top width and a foundation that is 1 m deep. The dam wall runs 32 m across the valley, but the valley widens upstream with a mean width about 60 m, for a length of 200 m. The dam has an estimated physical volume of about 20,000 m^3, and is expected to hold about 7,000 m^3 of water wall (the rest being occupied

by sand). In general, the work was progressing well, the site was good, and the community members are in agreement with the project.

8. Longopito Borehole

Due to a request by some community members, I visited the Longopito borehole, which is about 5 m from the sand dam. This borehole used to be owned by the government under the former LMD (Livestock Marketing Department) and therefore, used to have expansive infrastructure until the 1980s when operations stopped. What is seen on the ground now are remnants of the former borehole, pipes, foundations of water tanks, dilapidated watering troughs, a cattle dip and several vandalized buildings. The borehole could support a population of about 1,000 residents and 500 non-residents, 5,000 cattle, 20,000 shoats and 1,000 camels. Although the borehole is strategic in terms of its location, water yield and the possibility of reviving the former infrastructure, some members in the community have indicated that they do not want it revived, since it would cause overgrazing as well as insecurity due to congregation of livestock. Moreover, nearly all the components of the borehole require replacement. If ILRI/COOPI were to rehabilitate this borehole, a social-economic survey is first required to determine if it will be meeting the needs of the community and not causing a security threat.

9. Namelok sand dam

Namelok sand dam is in Isiolo District, Ol Donyiro Division, Ol Donyiro Location, Longopito sub location. It is also a new project expected to benefit a population of about 700, with about 1,000 cattle, 5,000 shoats, 50 camels. The site selection looks good for a sand dam offering a good volume: cross-sectional areas ratio. Like at Longopito, the physical dimension of the sand dam are the same, i.e. in cross-section, the retaining wall is 3 m high, 1 m bottom width, 0.5 m top width and a foundation that is 1 m deep, while the spillway has a maximum height of 2 m. The dam wall runs 32 m across the valley, which widens upstream with a mean width about 40 m, for a length of 150 m. The estimated total volume is 15,000 m^3. Since this is a sand dam, and assuming $^1/_3$ of the voids will hold water, the water storage is expected to be about 5,000 m^3. At the time of the visit, only the foundation had been excavated. In general, the work was progressing well, the site was good, and the community members are in agreement with the project

10. Daaba shallow wells

Daaba shallow wells are in Isiolo District, Central Division, Ngare Mara Location, Ngare Mara sub location. There are many wells at Daaba but ILRI/COOPI is rehabilitating only four. Two of these were visited; at Ngiru-Erupe and at Akunoit. At Ngiru-Erupe, the well will benefit a human population of 240, 260 cattle, 3,000 shoats and 120 camels; while at Akunoit, the respective numbers are 500 people, 240 cattle, 2,000 shoats and 600 camels. Both wells were at the initial stages of improvement, which was excavation to increases well depth, widening well shaft, and shaping up of the landing bays. There is therefore much work required before they are completed. One observation was that the pastoralists do not want hand pumps installed in the wells. They claim that hand pumps give low yield that cannot match livestock demands during watering and that manual water withdrawals were faster. Upon improvement, each well still requires 5-6 persons to hand each-other water, which still does not feel very efficient. In addition, there is the risk of accessing water inside the wells which are over 10 m deep. There is need to bring hand pumps with higher outputs and to sensitize the community on the merits of pumping water. Overall, the rehabilitation of shallow wells at Daaba was proceeding well and is an important intervention especially in improving the safety of the wells.

Annex 7. Technical details of the rehabilitated water facilities

Samburu District – Rift Valley Province			
Location	**Activities carried out**	**Technical Details**	**Significance**
Marti	**Borehole Rehabilitation**		
	• Construction of water tank	• Capacity - $25m^3$	• Enhance storage and hence improve and optimize the quality of water distribution system, • Improve the pumping regime and hence reduce stress on the equipment, • Pump house provide security and protection of the power supply equipment including the generator and control panels, • Repair of generator sets and provision of appropriate/standby generators reduced the risk of death of livestock as a result of breakdown of one generator set, • Improvement of hygiene and sanitation by construction of tap stand for watering points used by human and livestock. Additional troughs: • reduce the watering time for livestock as many herds can water concurrently, • reduce stress on the environment around the watering point as the animals spend less time at the water facilities, • improve and optimize the quality of water distribution system.
	• Construction of a new cattle trough	• Dimensions10m X 1.5m X 0.9m	
	• Rehabilitation of pump house, old trough & reticulation network • Construction of wellhead protection chamber and construction of tap stand	• re-plastering the internal and external walls • applying cement grout finish on the inside walls • widening the apron to a width of 2m • installation of assorted dilapidated pipes and fittings • construction of control chambers	
	• . Repair of the current generator.	• Genset model – Lister Petter TS3, 10 KVA	
	• Provision & installation of a new standby generator set	• Genset model – Lister Petter TR2, 11.5 KVA	
Masikita	**Borehole Rehabilitation**		
	• Construction of a new pump house	• Dimensions – 10 x 7 ft	
	• Construction of a new cattle trough	• Dimensions10m X 1.5m X 0.9m	
	• Rehabilitation of water tank, old trough & reticulation network • Construction of wellhead protection chamber and Construction of tap stand	• re-plastering the internal and external walls • applying cement grout finish on the inside walls • widening the apron to a width of 2m • installation of assorted dilapidated pipes and fittings • construction of control chambers	
	• Repair of the current generator.	• Genset model – Lister Petter TS3, 10 KVA	
	• Provision & installation of a new standby generator set	• Genset model – Lister Petter TR2, 11.5 KVA	
Lesirikan	**Borehole Rehabilitation**		• Increase the availability of water significantly, • Reduced the distance between strategic functional permanent water sources by 69%, Significance of rehabilitation/ construction of pump house, cattle trough, reticulation network and provision/installation of gensets is as stated above.
	• Drilling of a replacement borehole	• Depth – 96m, WSL – 68 m	
	• Construction of a new pump house	• Dimensions – 10 x 7 ft	
	• Construction of a new cattle trough	• Dimensions10m X 1.5m X 0.9m	
	• Rehabilitation of old trough & reticulation network	• re-plastering the internal and external walls • applying cement grout finish on the inside walls • widening the apron to a width of 2m • installation of assorted dilapidated pipes and fittings • construction of control chambers	
	• Provision & installation of a new generator set and pump	• Genset model – Lister Petter TR2, 11.5 KVA	

Marsabit District, Eastern Province			
Location	**Activities carried out**	**Technical Details**	**Significance**
Bubisa	**Borehole Rehabilitation**		
	• Rehabilitation of the water tank, troughs, and piping network and construction of control chambers	• re-plastering the internal and external walls • applying cement grout finish on the inside walls • widening the apron to a width of 2m • installation of assorted dilapidated pipes and fittings	• Enhance storage and hence improve and optimize the quality of water distribution system. • Improve the pumping regime and hence reduce stress on the equipment • Rehabilitation of livestock trough improve and optimize the quality of water distribution system • Provision of appropriate standby generator reduces the risk of death of livestock as a result of breakdown of one generator set.
	• Provision & installation of a new standby generator set	• Model - Perkins, 3SRD 27(water cooled)	
Burgabo	**Borehole Rehabilitation**		
	Provision and installation of a new standby generator set	• Model - Perkins, 3SRD 27(water Cooled)	• Repair of generator sets and provision of appropriate/standby generators reduced the risk of death of livestock as a result of breakdown of one generator set Rehabilitation/construction of troughs • reduce the watering time for livestock as many herds can water concurrently. • reduce stress on the environment around the watering point as the animals spend less time at the water facilities. • Improve and optimize the quality of water distribution system
	• Repair of the current generator	• Model - Perkins, 3SRD 27(water Cooled)	
	• Construction of a new trough	• Dimensions10m X 1.5m X 0.9m	
	• Rehabilitation of the troughs and Piping network and construction of control chambers	• re-plastering the internal and external walls • applying cement grout finish on the inside walls • widening the apron to a width of 2m • installation of assorted dilapidated pipes and fittings	
Khorr	**Shallow wells rehabilitation**		
	• Protection of 16 wells	• construction of a wall of 1.4m a.g.l • construction of a trough extending from the well. The troughs are constructed 2 m away from the well with a connection from the mouth of the well. • Dimensions of the trough - 4m length, 0.3 m deep and 0.5 m wide	• Protection of the wells eliminate the risk of loosing them as a result of silting during rainy seasons • Reduce the risk of water contamination by entry of contaminated surface effluents during rainy seasons • Reduce the risk of fatal accidents whereby human beings and animals are reported to have fallen in the open wells.
Sagante	**Shallow wells rehabilitation**		
	• Protection of 5 wells	• removal of loose surface formation around the well and a making concrete pad • construction of a wall built above the ground level to prevent siltation. • rehabilitation of the existing trough extending from the well.	

Moyale District, Eastern Province			
Location	**Activities carried out**	**Technical Details**	**Significance**
Rawana	**Borehole Rehabilitation**		
	• Test pumping of 1 borehole at Rawana.	• Tests executed are step-drawdown test for 4 hours and continuous discharge test for 24 hours • Safe yield – 5m3/hr	• Pumping tests provided details for appropriate equipment for boreholes • Provision of appropriate pumps optimized wells production • New tank enhance storage and hence improve and optimize the quality of water distribution system. • Improve the pumping regime and hence reduce stress on the equipment • Pump house provide security and protection of the power supply equipment including the generator and control panels. • Repair of generator set is significant in functionalising the borehole Additional troughs • reduce the watering time for livestock as many herds can water concurrently. • reduce stress on the environment around the watering point as the animals spend less time at the water facilities. • Improve and optimize the quality of water distribution system among the livestock
	• Provision and installation of a new pump.	• Pump type – Grundfos, SP 8A 25	
	• Construction of a pump house for the new borehole.	• Dimensions – 10 x 7 ft	
	• Rehabilitation of the old troughs and piping network	• re-plastering the internal and external walls • applying cement grout finish on the inside walls • widening the apron to a width of 2m • installation of assorted dilapidated pipes and fittings • Construction of control chambers	
	• Construction of a water tank.	• Capacity - 25m3, Dimensions – Ø 4060 mm X 1800 m	
	• Repair of the current generator.	• Genset model – Lister Petter TS3, 10 KVA	
Dabel	**Borehole Rehabilitation**		
	• Test pumping of the borehole.	• Test done are step-drawdown test for 4 hours and continuous discharge test for 24 hours • Safe yield – 7.2m3/hr	
	• Repair of two existing generators.	• Model - Perkins (3-Pistons) Power rating 27 KVA, 21.6 KW, 415 Volts • Model - TS3 Lister Petter, 15 KVA	
Amballo	**Borehole Rehabilitation**		
	• Test pumping of the borehole.	• Test done are step-drawdown test for 4 hours and continuous discharge test for 24 hours • Safe yield – 14m3/hr	
	• Construction of a new pump house	• Dimensions – 10 x 7 ft	
	• Piping network.	• installation of assorted dilapidated pipes & fittings • construction of 3 control chambers	
	• Provision and installation of a new pump and generator.	• Pump type – Grundfos, SP 14A 18 • Model - Lister Petter, TR3 18 KVA (Air Cooled)	
Golole	• Technical inspection of the borehole status to diagnose the defect after detachment of the pump	• Measurement of the exact depth of blockage at 70m	• Significant in providing details on the required measures to functionalise the borehole

Isiolo District, Eastern Province			
Location	**Activities carried out**	**Technical Details**	**Significance**
Mlango	**Borehole Rehabilitation**		
	• Drilling of a replacement borehole.	• Depth – 102m, WSL – 68 m,	• Increased the availability of water • Reduced the distance between strategic functional permanent water sources by 20% • Reduce the risk of death of animals as a result of persistent drought when no surface water is available. • Pump house provide security and protection of the power supply equipment including the generator and control panels. • Tank enhances storage and hence improves and optimizes the quality of water distribution system. • Improvement of the pumping regime and hence reduce stress on the equipment • Rehabilitation of livestock trough improve and optimize the quality of water distribution system • Improvement of livestock production by provision of water within a livestock holding ground
	• Rehabilitation of the pump house, water tank, staff houses, trough, toilet and a bathroom& piping network	• replacement of the roof and two doors of the pump house • re-plastering the internal and external walls of the tank • Replacement of the roof and doors for three staff house • applying cement grout finish on the inside walls of the trough • widening the apron of the trough to a width of 2m • replacement of the roof, doors and vent pipe for toilet/ bathroom • installation of assorted dilapidated pipes and fittings	
	• Provision & installation of a new generator set and pump	• Pump type – Grundfos, SP 8A 25 • Model - Lister Petter TR2, 11.5 KVA)	
Daaba	**Construction of 3 shallow wells** **Rehabilitation of 1 shallow well**		
		• Diameter of rehabilitated well • Lining wells to 3 steps using blocks • Construction of troughs extending from the well	• Protection of the wells eliminated the risk of loosing them as a result of silting during rainy seasons • Reduced the risk of water contamination by entry of contaminated surface water during rainy seasons • Reduced the risk of fatal accidents whereby human beings and animals are reported to have fallen in the open wells.

ANNEX 8: Water & Environment Assessment Field Visit

Date (June 2005)	**Activity/ Water source**	**Overnight at**	**Host Institution**	**Contact person**
19 –Sun	Travel Nairobi - Maralal	Maralal		
20 – Mon	Visit Ramati offices (i) Marti borehole (ii) Lesirkan borehole	Baragoi	Ramati (Samburu)	Moses Lanoorkulas & Mark (MoweI)
21 – Tue	Travel all day Baragoi-Maralal-Wamba-Great North Road-Marsabit *(on advise due to security, could not use shorter routes)*			
22 – Wed	Visit CIFA offices (iii) Karatina shallow wells (iv) Harsilwa borehole (v) Korr shallow wells	Marsabit	CIFA (Marsabit)	Ibrahim Aden
23 – Thu	Visit Ministry of Water offices, Marsabit Travel Marsabit- Isiolo			Robert Munyua
24 – Fri	Visit CARITAS offices (vi) Mlango borehole (vii)Oldonyiro sand dam (viii) Longopito borehole (ix) Namelok sand dam	Isiolo	CARITAS (Diocese of Isiolo)	Joseph Samar & Steve Olate
25 – Sat	(x) Daaba shallow wells	Isiolo	CARITAS	Steve Olate
26 – Sun	Travel Isiolo-Nairobi	Nairobi		

EPIDEMIOLOGY – ANNEXES 9 and 10

Annex 9: DRP Participatory Impact Assessment

Interview Checklist

Interview Plan:

It has been agreed that each NGO will select four community sites representative of major beneficiary groups within the NGO's project area.

At least one group meeting will held in each community to obtain an overview of the community. Thereafter at least ten household level interviews will be completed in each community.

Handouts with step-by-step instructions and examples are provided for each of the scoring exercises.

Community Group Interview Checklist:

- Introductions
- Size and structure of the community
- Disease problems
- Mapping
    - Geographic extent of local community
    - Typical transhumance patterns
    - Local resources
    - Disease problem areas (i.e. tsetse, swamps, etc.)
    - Location and distance to markets
- Herd Age Structure Proportional Piling (see handout) for principal species

Household Interview Checklist:

Introduction and Characterization of Respondents (about 15 minutes):

- Name
- Community
- Migration pattern
- Household size
- Herd Composition
- Location name and GPS coordinates

General information on situation (about 15 minutes in all interviews):

- Milk price and quantities consumed by the household and sold
    - Probe trends relative to drought
- Prices of animals
    - Probe trends relative to drought
- Pasture/Water conditions
- Service availability
    - If DRP mentioned note, but probe at end of interview
- Condition of animals

Topics to be investigated in detail in a subset of interviews (see handouts)

1. Livelihoods activity scoring (at least 3 times per community)
2. Benefits of livestock species matrix scoring (at least 3 times per community)
    a. Principal species kept, but make sure some exercises in each site are completed for goats and sheep
3. Relative disease incidence scoring by dividing piles (at least 7 times per community)
    a. Disease impact scoring Principal species kept, but make sure some exercises in each site are completed for goats and sheep
4. Disease impact scoring (at least 5 times per community)
    a. Principal species kept, but make sure some exercises in each site are completed for goats and sheep

Conclusion:

- Perceptions of DRP
- Other issues raised by the participants

Annex 10: Scoring Methodologies

Livelihoods Proportional Piling

1. Have your questions clear in your own mind and right them down in your notebook.

2. To develop the list items for scoring, begin with an open-ended question:

   For example: What activities do you practice to earn your livelihood or improve your well-being?

3. Probe the responses.

   Ask for descriptions and clarifications.

4. Explain that you want to do an exercise to better understand what you are learning about their activities. Draw circles on the ground in a line. Draw one circle for each livelihoods activity mentioned and place a drawing or card next to each circle that illustrates the livelihoods activity.

5. Give them one hundred counters and ask to divide them according to your piling question. Record the question now if you haven't already.

   For example: Ask them to divide the beans to represent the benefit they receive from each livelihoods activity.

6. Explain the whole exercise. As you list categories draw their attention to each circle and drawing and make sure that they recognize each category

7. Give them time to discuss and divide the piles by consensus. Ask your translator to tell you what they are discussing as they divide the piles. When they appear to be finished, ask them if they all agree on the result.

8. Count the beans, but leave them in place.

9. Probe the results.

   Why did they make the choices they did?

Benefits of Livestock Matrix Scoring

An example for livestock

Steps:

1. Open ended question: What livestock species do you keep?

   Establish a list of species.

2. Open ended question: What are the benefits that you obtain from your livestock?

   Establish a list of benefits and probe each benefit as it is mentioned. Examples are cash, milk, meat, hides, traction, manure, gifts and loans, bride wealth, hides, calves, and more.

3. Conduct a simple proportional piling exercise to score the benefits of livestock keeping.

Benefit	Score
Milk	34
Meat	14
Cash	19
Bride wealth	23

4. Begin to construct the matrix. Extend the first row (milk) by drawing a number of circles equal to the number of species identified by the herders. Place a drawing or picture above each circle that represents the species for that circle. Ask the respondents to divide the number beans that they gave as the benefit score in step 3 between the circles to represent the relative contribution of each species has on the benefit. Example for the first benefit:
5.

	Benefit Score	Camels	Cattle	Sheep	Goats
Milk	34	12	14	0	8

6. Repeat the process for each benefit by extending a row of the matrix. Probe the result briefly after each row is added. Example after the second round:

	Benefit Score	Camels	Cattle	Sheep	Goats
Milk	34	12	14	0	8
Meat	14	2	2	4	6

7. When all the benefits have been done, sit back with the farmers and discuss/probe the entire matrix.

	Benefit Score	Camels	Cattle	Sheep	Goats
Milk	34	14	12	0	8
Meat	14	2	2	4	6
Cash	19	3	2	6	8
Bride wealth	23	15	6	0	2

8. Total the columns and you have an aggregate score for each species that is weighted by benefit. Probe the result.

	Benefit Score	Camels	Cattle	Sheep	Goats
Milk	34	14	12	0	8
Meat	14	2	2	4	6
Cash	19	3	2	6	8
Bride wealth	23	15	6	0	2
Total	100	34	22	10	24

Relative Disease Incidence Scoring

1. Open-ended question: Specify a species and ask what disease problems have you had in the last year. List and probe to obtain a clear definition of each local disease term.

2. Give the respondents a pile of 100 counters. Explain that you want them to think about the last year and divide the pile to represent what part of their herd became sick and what part remained healthy.

3. Draw a circle for each disease and one circle for ‘other diseases.’ Make a drawing on the ground or on a card for each disease and place it next to the corresponding circle. Make sure the meaning of the drawings is clear. Ask them to divide the pile of those ‘became sick’ into piles according to what portion got each disease.

4. Draw three circles under each disease pile. One circle is for those that died, one circle is for those that recovered and the third circle is for those that are still sick. Ask them to divide the pile for each disease accordingly.

5. Probe the results after step.

Disease Impact Matrix Scoring

This exercise should be carried out for one species. The example is for goats

Steps:

9. Open ended question: What are the major disease problems that occur in goats?

   Establish a list of diseases.
   Probe each disease term to until the meaning is clear.

10. Open ended question: What are the benefits that you obtain from your goats?

    Establish a list of benefits and probe each benefit as it is mentioned. Examples are cash, milk, meat, hides, manure, gifts and loans, bride wealth, hides, kids, and more.

11. Conduct a simple proportional piling exercise to score the benefits of livestock keeping.

Benefit	Score
Milk	34
Meat	14
Cash	19
Bride wealth	23

12. Begin to construct the matrix. Extend the first row (milk) by drawing a number of circles equal to the number of diseases identified by the herders. Place a drawing or picture above each circle that represents the disease for that circle. Ask the respondents to divide the number beans that they gave as the benefit score in step 3 between the circles to represent the relative impact each disease has on the benefit. Example for the first benefit:

	Benefit Score	GP	CCPP	Worms	Mange
Milk	34	12	14	2	6

13. Repeat the process for each benefit by extending the row of the benefit. Probe the result briefly after each row is added. Example after the second round:

	Benefit Score	GP	CCPP	Worms	Mange
Milk	34	12	14	2	6
Meat	14	2	2	4	6

14. When all the benefits have been done, sit back with the farmers and discuss/probe the entire matrix.

	Benefit Score	GP	CCPP	Worms	Mange
Milk	34	14	12	2	6
Meat	14	2	2	4	6
Cash	19	3	2	6	8
Bride wealth	23	15	6	0	2

15. Total the columns and you have an aggregate score for each species that is weighted by benefit. Probe the result.

	Benefit Score	GP	CCPP	Worms	Mange
Milk	34	14	12	2	6
Meat	14	2	2	4	6
Cash	19	3	2	6	8
Bride wealth	23	15	6	0	2
Total	100	34	22	12	22

Annex …….. Spatial Analysis

1. Introduction

A geographically referenced database was compiled for the nine districts of the project area. A wide scope of thematic layers from a variety of sources was collected, cleaned and combined into one consistent database. From this spatial database, a set of maps was produced.

Section 1 of this document describes the spatial database in detail. In section 2 small versions of the maps used in the planning stage of the project are shown.

2. The spatial database

Different thematic areas have been covered:

1. Administrative Capital
2. Natural Capital
3. Physical Capital
4. Human Capital

Each of these thematic areas contains the layers in geographical and UTM projections for ease of use. The datasets have been sourced from the ILRI database and GTZ range management handbook.

2.1. Natural Capital

2.1.1 Agro-climatic zones

This is a coverage derived from the Exploratory Soil Survey Report number E1, Kenya Soil survey, Nairobi 1982 and shows the principle Agro-Climatic Zones of Kenya based on a combination of both moisture availability zones (I-IV) and temperature zones (1-9).

2.1.2 Contour

The coverage shows the elevation of Northern Kenya according to Almanac Characterization Tool (ACT) database. It is at an interval of 1000 meters.

2.1.3 Bush

This is a coverage showing location of bushes used in a GTZ project on producing a handbook for northern Kenya by JICA.

2.1.4 Camel Distribution

The coverage shows the camel distribution in Northern Kenya according to GTZ

It is based on aerial sample census between 1989 and 1994.The figures indicated do not reflect actual numbers of animals per district per year but the numbers within the sampled area.

2.1.5 Location of Cliffs

This is a coverage showing location of cliffs used in a GTZ project on producing a handbook for northern Kenya by JICA.

2.1.6 Wetland

This coverage shows the wetlands in Northern Kenya according to International Union for Conservation of Nature (IUCN)
The wetlands are inclusive of lakes, rivers, saltpans, fresh water marshes, mangroves and alkaline/ saline lakes.

2.1.7 Elevation

This is a coverage showing elevation used in a GTZ project on producing a handbook for northern Kenya by JICA.

2.1.8 Forests and Forest ranges

Forests

The coverage shows the Northern Kenya forests according to Food and Agriculture Organization of the United Nations (FAO)

Forest_ranges

This coverage shows the major forest ranges in Northern Kenya according to International Union for Conservation of Nature (IUCN).
There is also a supplemental coverage called Kenya_forests.shp done by Food and Agriculture Organization, which only shows the actual forests within Kenya as opposed to the forest ranges shown in this coverage.
This coverage shows the forest ranges that in many cases cover more than one forest.

2.1.9 Land

This is a coverage showing elevation used in a GTZ project on producing a handbook for northern Kenya by JICA.

2.1.10 Landuse

Coverage showing general land use classes derived from 1980 landsat data by the Japan International Co-operation Agency, JICA, National Water Master Plan, Kenya

2.1.11 Marsh

This is a coverage showing marshlands used in a GTZ project on producing a handbook for northern Kenya by JICA.

2.1.12 Protected_area

This coverage shows the Northern Kenya protected areas. It is a subset of the Africa protected areas database from the World Conservation Monitoring Center's (WCMC), which manages a database on the worlds protected areas.

2.1.13 Rainfall_distribution

This coverage shows the annual rainfall distribution in millimeters per year for Northern Kenya.
It was done by the Japanese International Co-operation Agency (JICA), National Water Master Plan, Kenya

2.1.14 Rivers

This coverage shows the rivers of Northern Kenya done by Japan International Cooperation Agency (JICA), National Water Master Plan, Kenya.

2.1.15 Soils

This coverage shows the soils and its characteristics.

2.1.16 Tsetse distribution

This is a coverage showing tsetse distribution in Kenya produced by combining three maps:

- rapnts.shp: showing presence of brown ear ticks based on published sources.
- lrapoly.shp: showing presence (1) of brown ear ticks based on expert opinion.
- Lecfparv.shp: showing presence (1) of theileriosis and theileriosis antibodies (2)

The source is Lesssard, et al., 1990

2.1.17 Vegetation

This is a coverage showing soils used in a GTZ project on producing a handbook for northern Kenya by JICA.

2.1.18 Water point

The coverage shows distribution of lakes, reservoirs and water points in Northern Kenya as described in the Almanac Characterization Tool (ACT) database.

2.2 Physical Capital

2.2.1 Rainstations1890-1985

The coverage shows 110 rainfall stations with data recorded between 1890-1985. There are continuous data between 1890 and 1991 for one station and good data for 23 stations between 1961 and 1985

2.2.2 Towns and Roads

Roads

This coverage shows the road networks of Northern Kenya derived from topographic map sheets (1978-1997) of scale 1:50,000

Towns

The coverage shows the towns and urban centers in Northern Kenya derived from the Kenya topographic sheets of scale, 1:250,000 for Northern Kenya. There are approximately 100 towns and urban centers captured in this layer.

2.2.3 Village

This is a point coverage showing the villages in Northern Kenya according to Almanac Characterization tool (ACT) database.

2.3 Human Capital

2.3.1 1979 Population Density

Coverage showing the 1979 population census done at the 4th administrative (location) level

2.3.2. 1989 PopulationDensity

The coverage showing total population numbers, population density, as well as households and household densities done up to the fifth administrative level (sub location) in 1989 for Northern Kenya

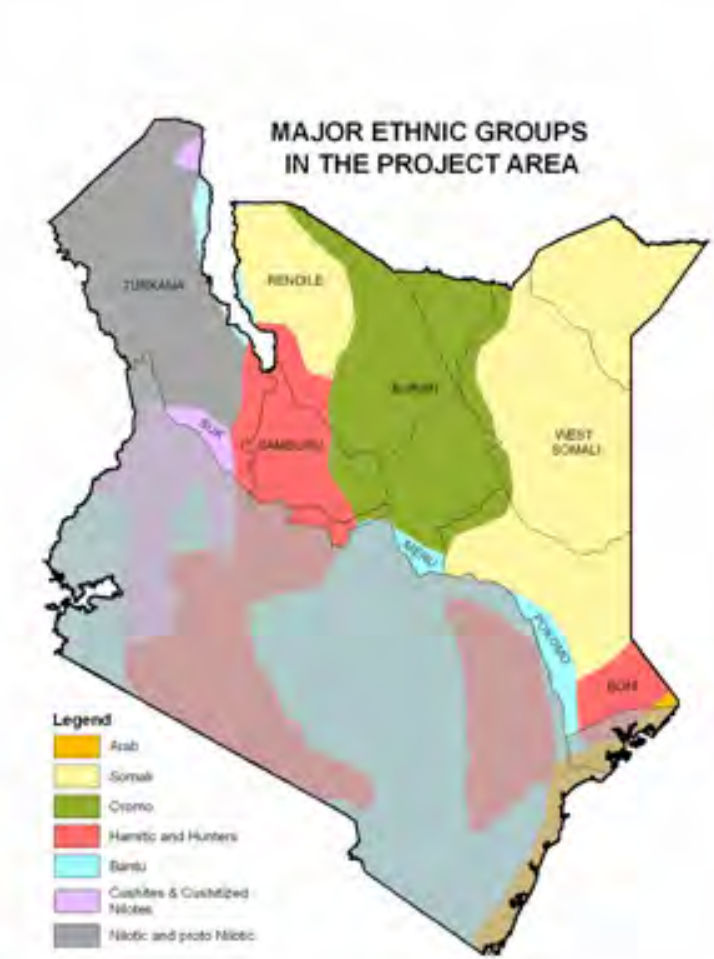
2.4 Administrative Capital

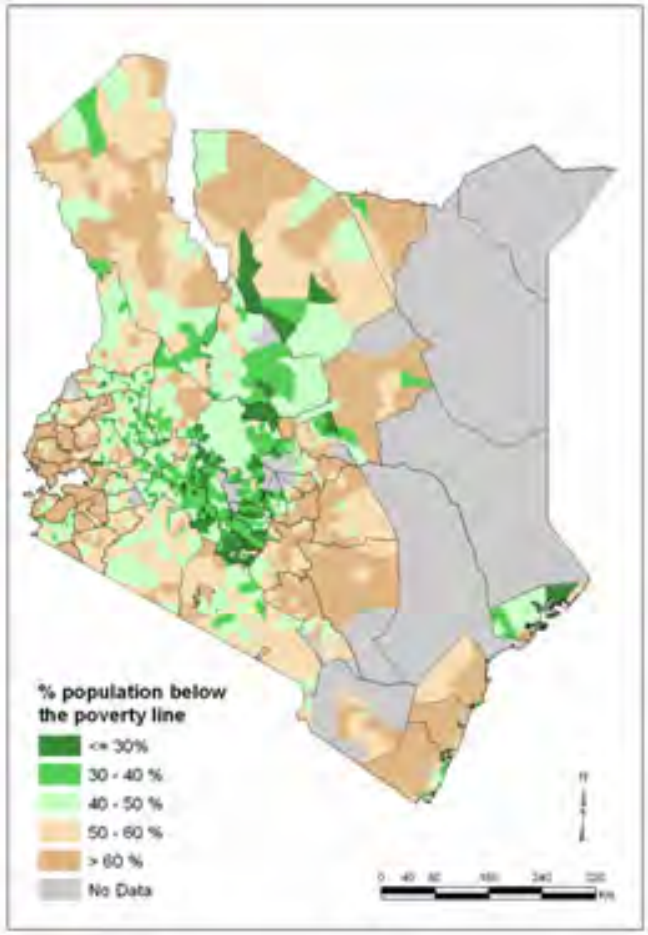
2.4.1 District/Division/Location and Sublocation Boundary

Coverages represents second to fifth level of administrative boundaries (districts) in Northern Kenya and their respective names, population figures and poverty figures where applicable.

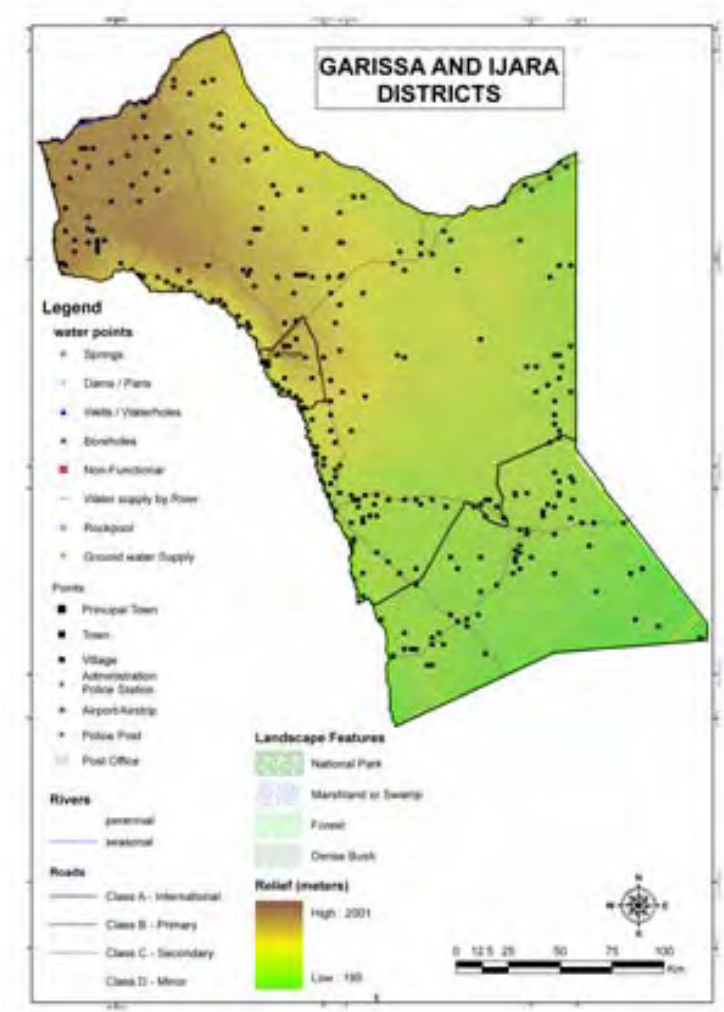
3. Maps used in planning stage

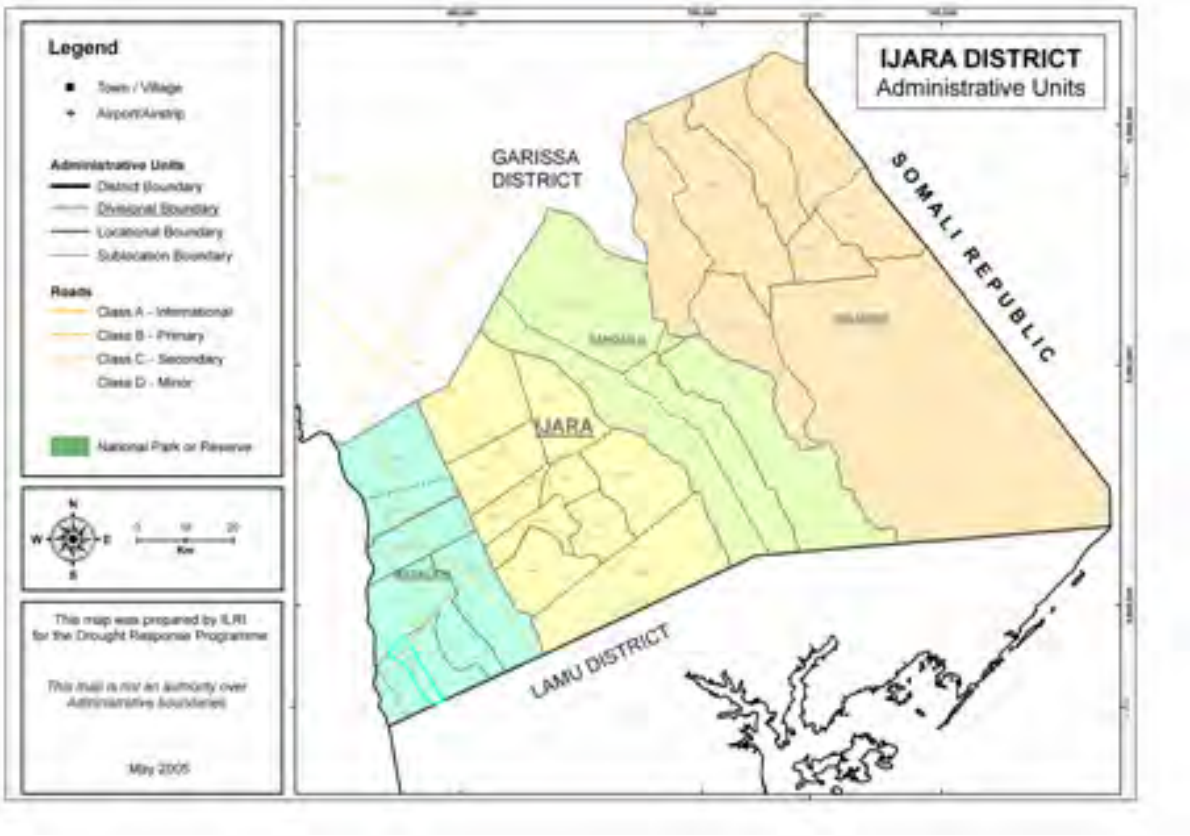
3.1 Kenya



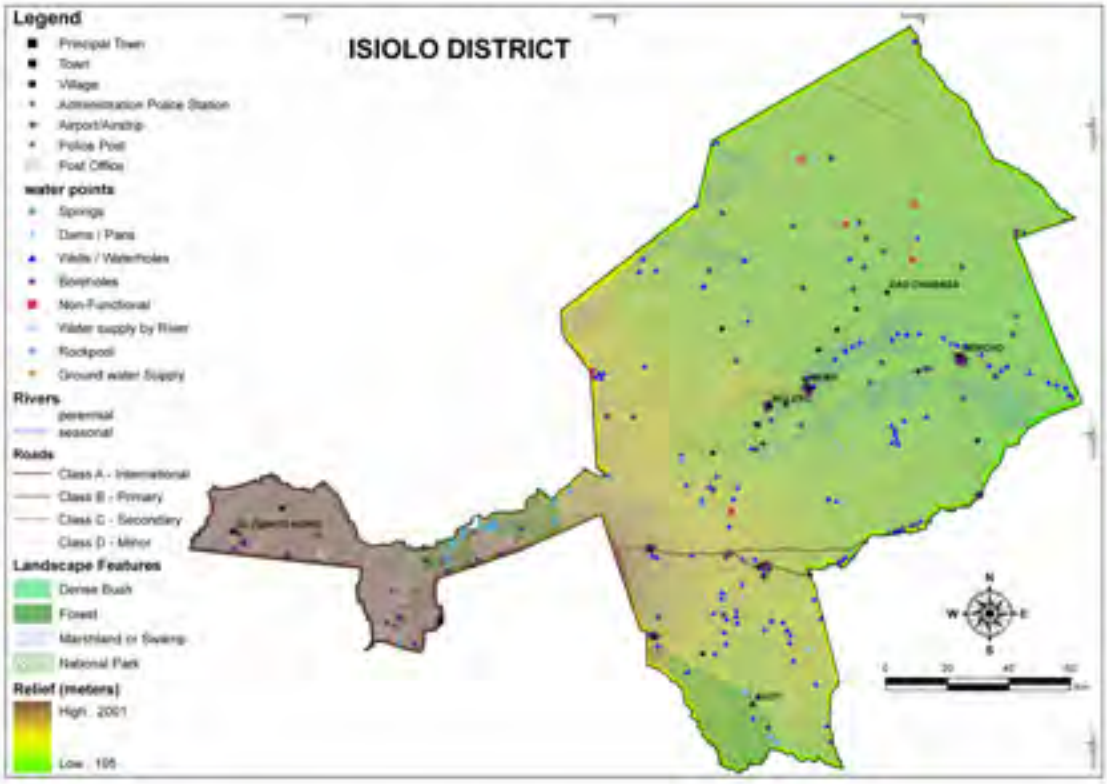


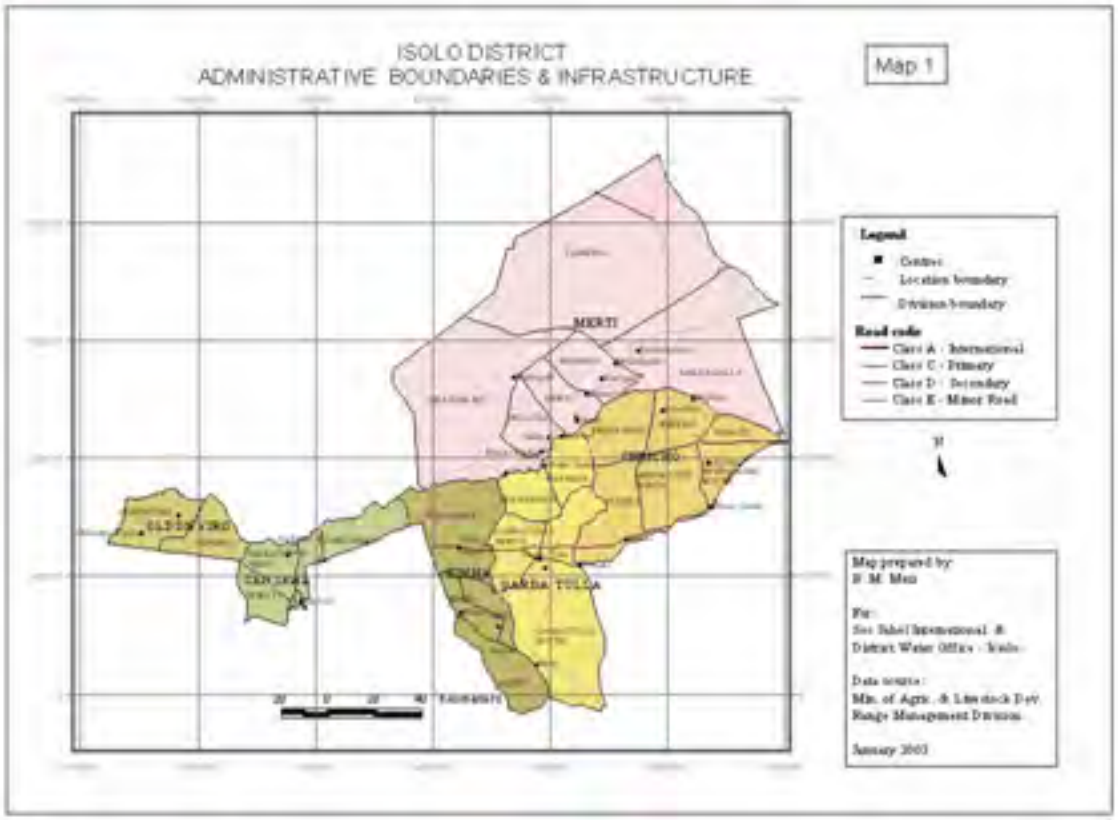
3.2 Garissa and Ijara

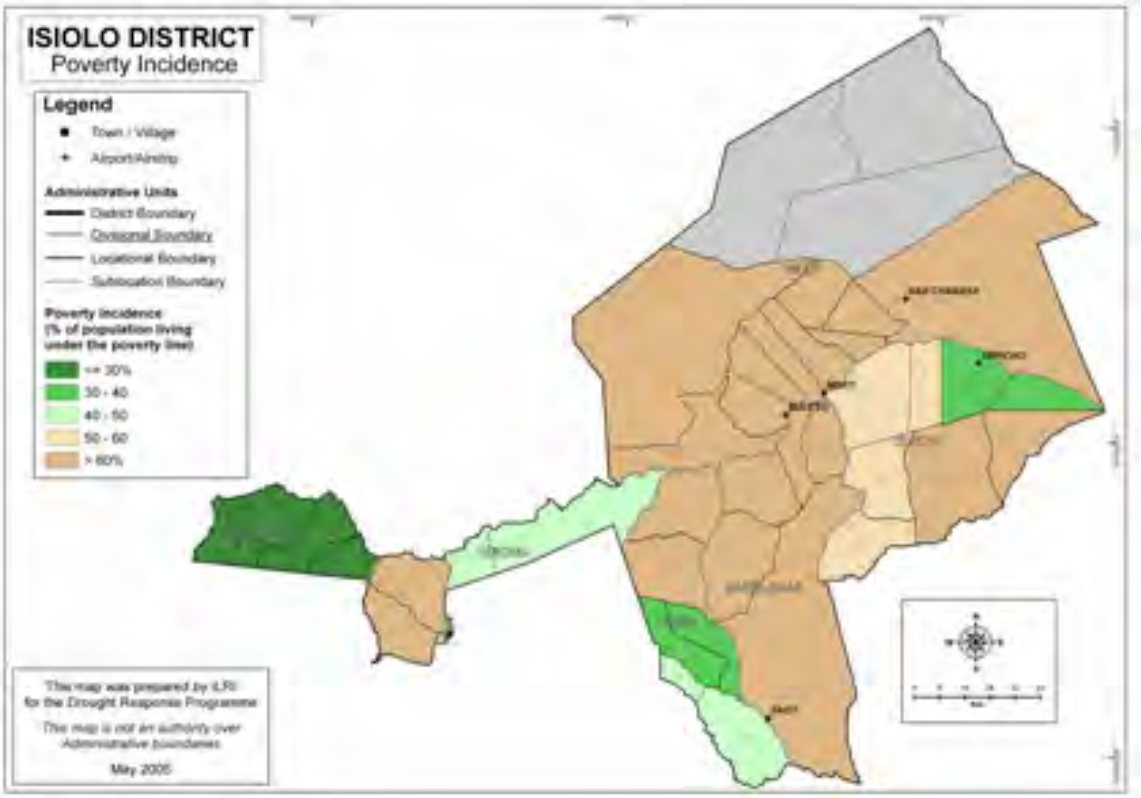


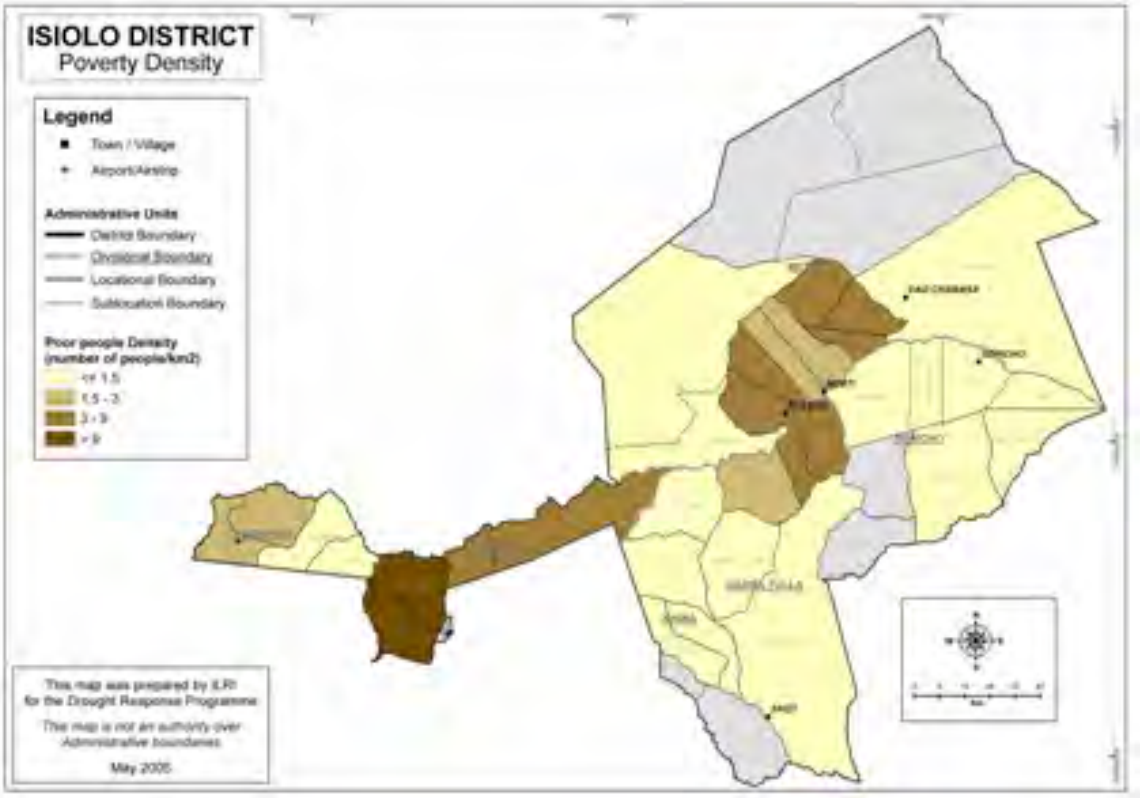

Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
National Park or Reserve
N
W
E
S
This map was prepared by ILRI for the Drought Response Programme
This mail is nor an authority over Administrative boundaries
May 2005
IJARA DISTRICT
Administrative Units
GARISSA DISTRICT
SOMALI REPUBLIC
IJARA
LAMU DISTRICT

3.3 Isiolo

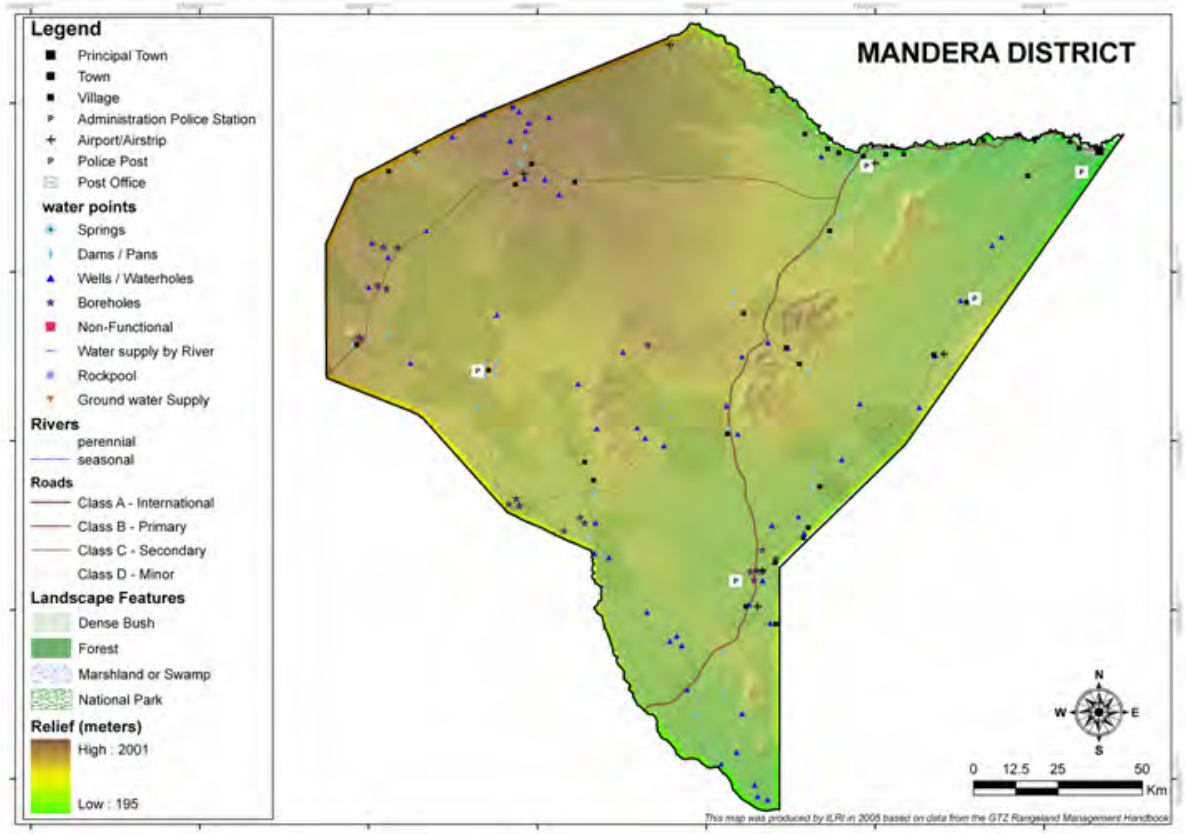

ISIOLO DISTRICT
Legend
Principal Town
Town
Village
Administration Police Station
Airport/Airstrip
Police Post
Post Office
water points
Springs
Dams / Pans
Wells / Waterholes
Boreholes
Non-Functional
Water supply by River
Rockpool
Ground water Supply
Rivers
perennial
seasonal
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
Landscape Features
Dense Bush
Forest
Marshland or Swamp
National Park
Relief (meters)
High : 2001
Low : 195
N
W
E
S

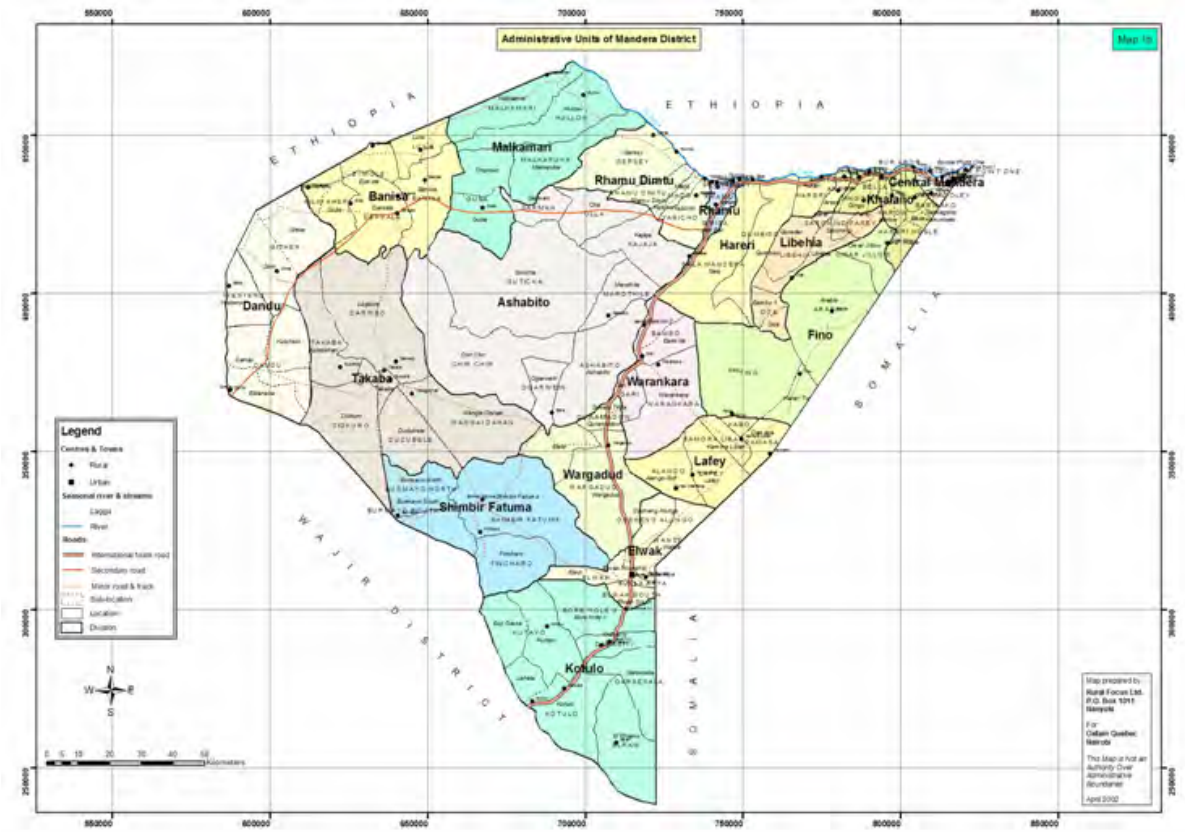

ISOLO DISTRICT
ADMINISTRATIVE BOUNDARIES & INFRASTRUCTURE
Map 1
Legend
Centres
Location boundary
Division boundary
Road code
Class A - International
Class C - Primary
Class D - Secondary
Class E - Minor Road
MERTI
GARBA TULLA
Map prepared by:
P. M. Mati
File:
Data source:
Min. of Agric. & Livestock Dev.
Range Management Division
January 2003


ISIOLO DISTRICT
Poverty Incidence
Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Poverty incidence
(% of population living
under the poverty line)
<= 30%
30 - 40
40 - 50
50 - 60
> 60%
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005

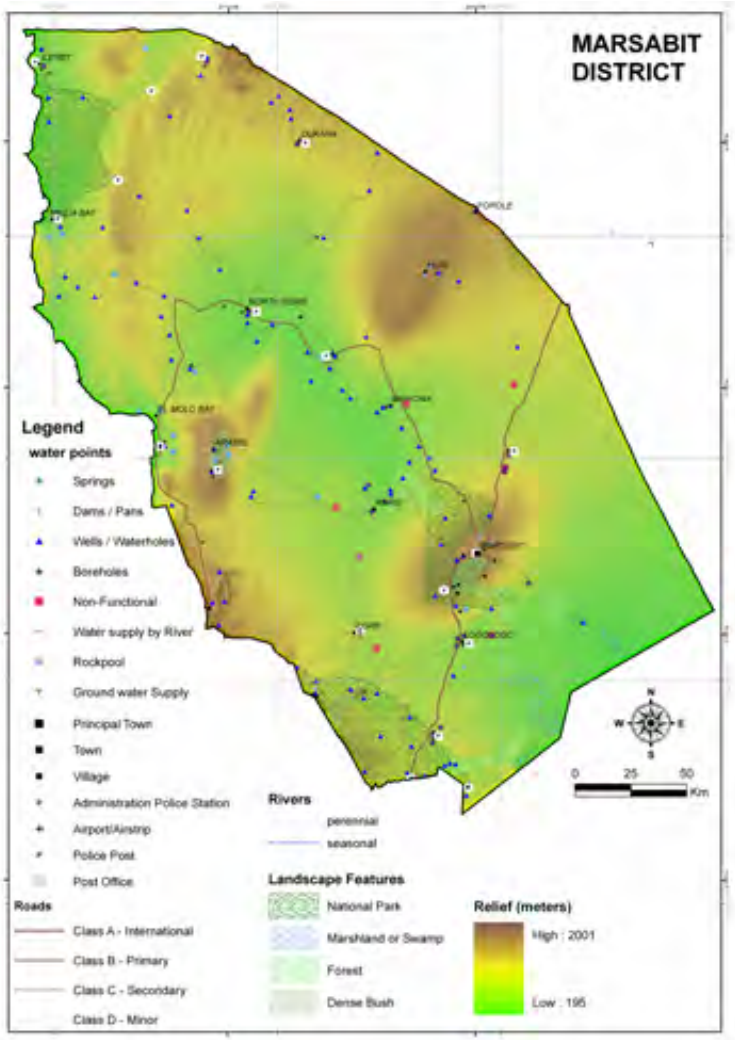

ISIOLO DISTRICT
Poverty Density
Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Poor people Density
(number of people/km2)
<= 1.5
1.5 - 3
3 - 9
> 9
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005

3.4 Mandera

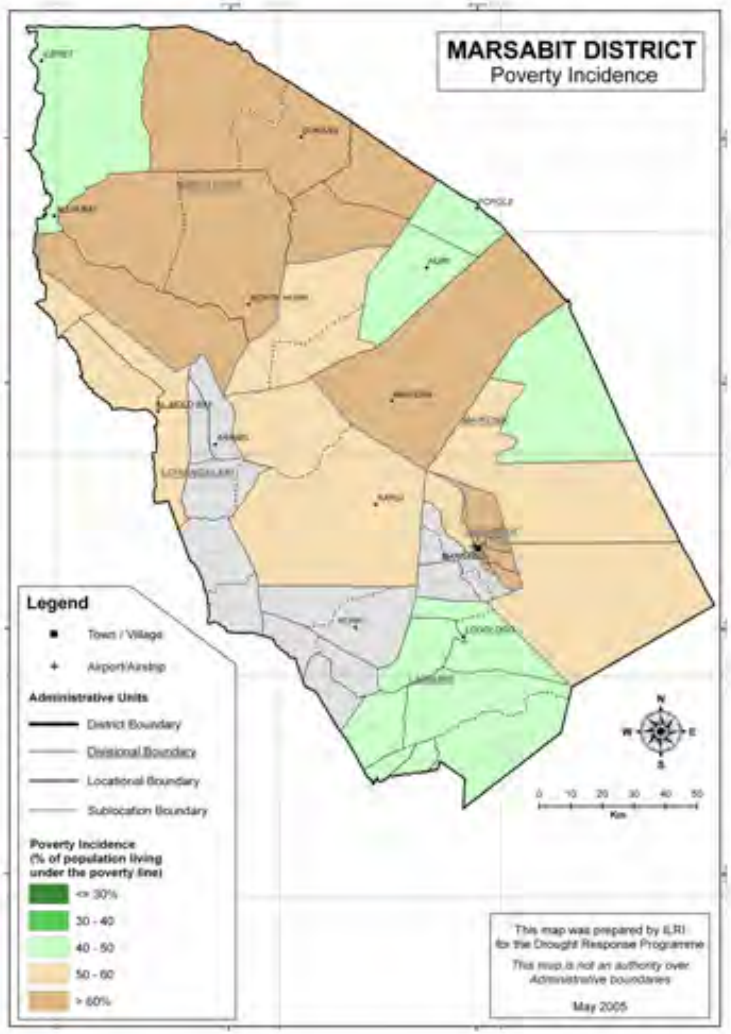

Legend
Principal Town
Town
Village
Administration Police Station
Airport/Airstrip
Police Post
Post Office
water points
Springs
Dams / Pans
Wells / Waterholes
Boreholes
Non-Functional
Water supply by River
Rockpool
Ground water Supply
Rivers
perennial
seasonal
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
Landscape Features
Dense Bush
Forest
Marshland or Swamp
National Park
Relief (meters)
High : 2001
Low : 195
MANDERA DISTRICT
N
W
E
S
0 12.5 25 50
Km
This map was produced by ILRI in 2005 based on data from the GTZ Rangeland Management Handbook

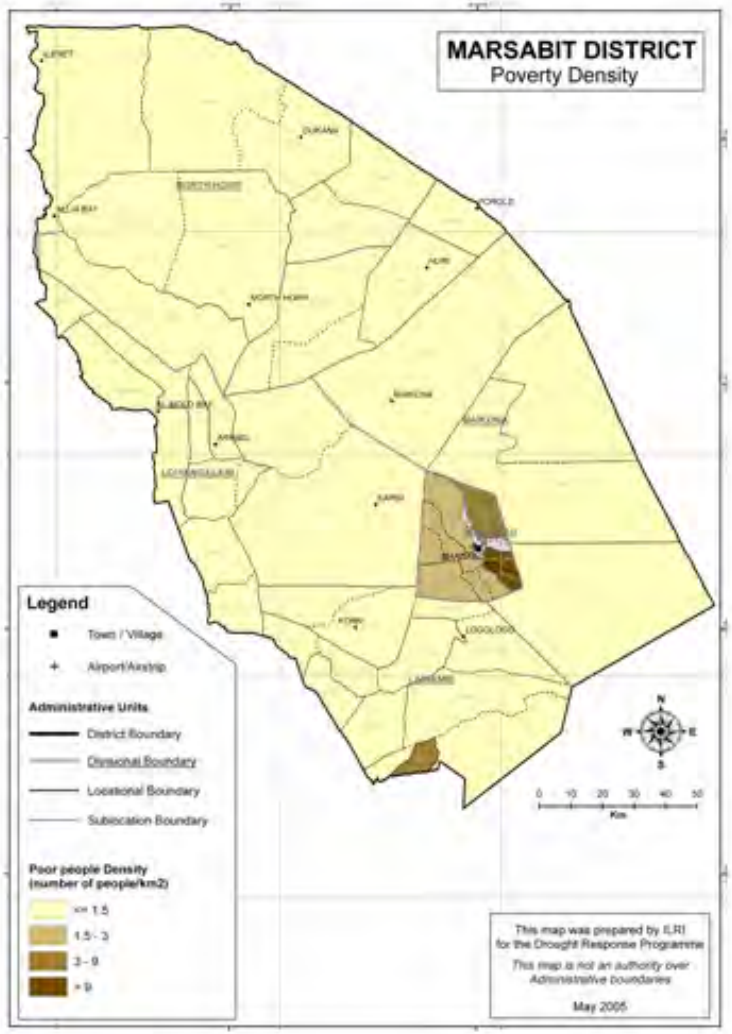

Administrative Units of Mandera District
ETHIOPIA
SOMALIA
Malkamari
Banisa
Rhamu Dimtu
Rhamu
Central Mandera
Khalalio
Hareri
Libehia
Ashabito
Dandu
Fino
Takaba
Warankara
Lafey
Wargadud
Shimbir Fatuma
Elwak
Kotulo
WAJIR DISTRICT
Legend

3.5 Marsabit

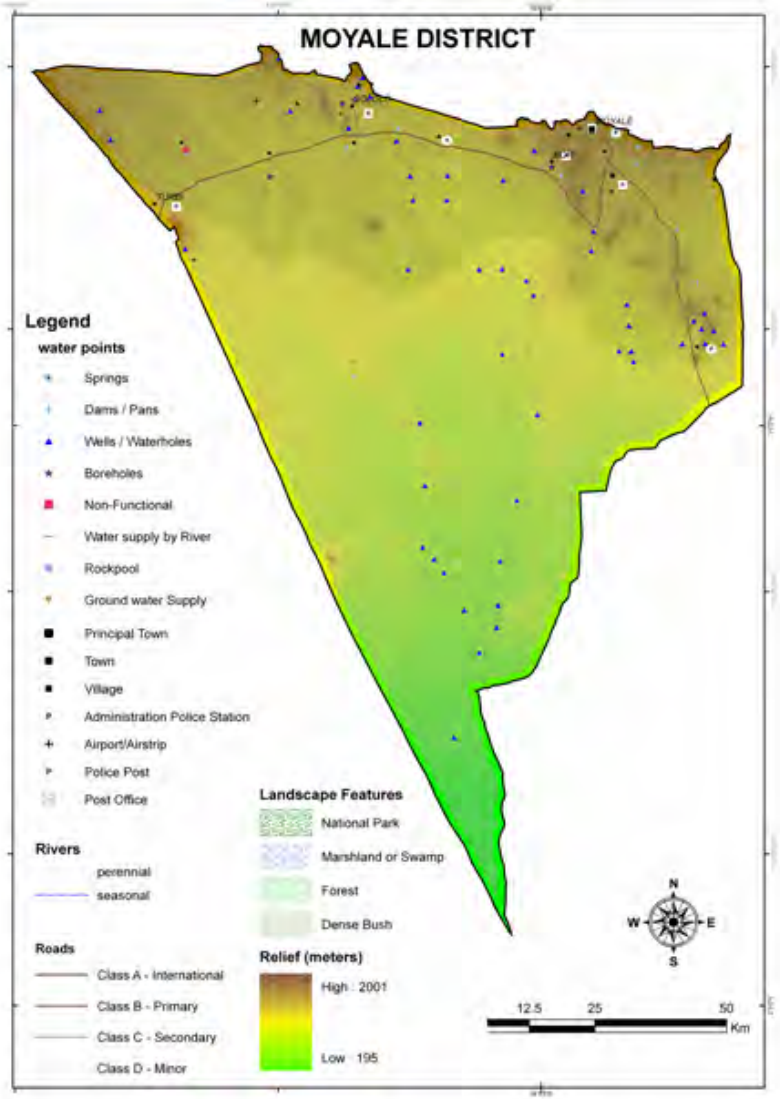

MARSABIT
DISTRICT
Legend
water points
Springs
Dams / Pans
Wells / Waterholes
Boreholes
Non-Functional
Water supply by River
Rockpool
Ground water Supply
Principal Town
Town
Village
Administration Police Station
Airport/Airstrip
Police Post
Post Office
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
Rivers
perennial
seasonal
Landscape Features
National Park
Marshland or Swamp
Forest
Dense Bush
Relief (meters)
High : 2001
Low : 195
0 25 50
Km

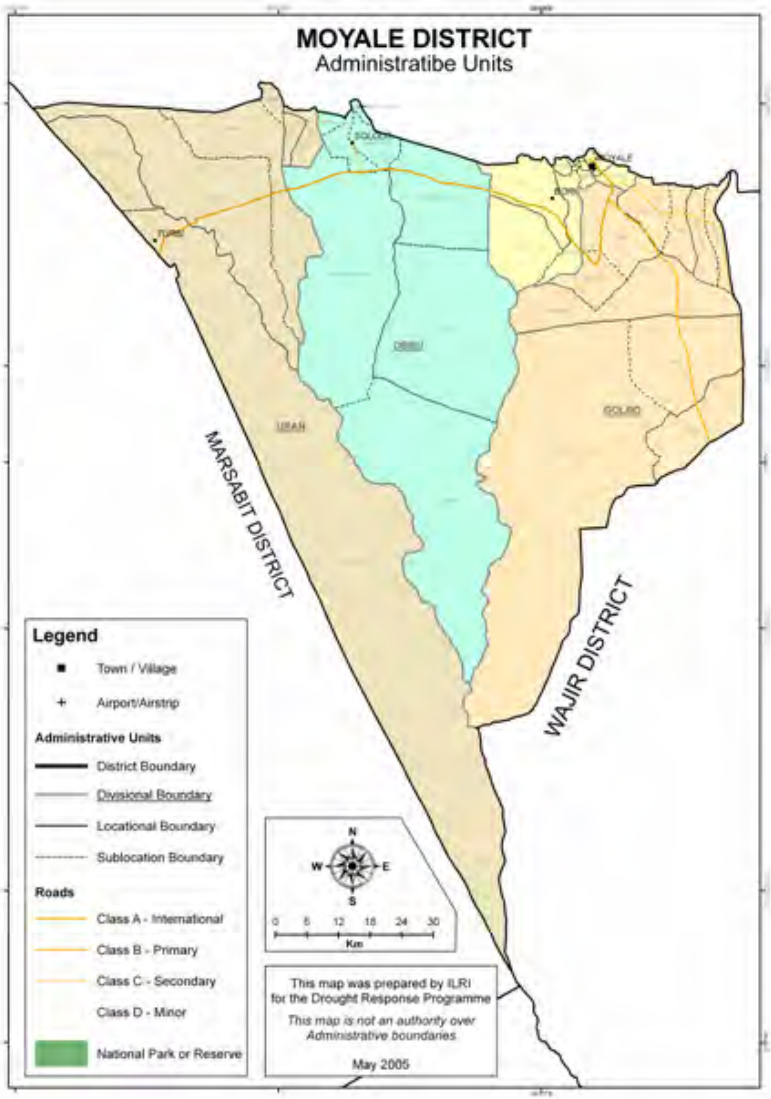

Administrative Units of Marsabit District
Lake
Turkana
E T H I O P I A

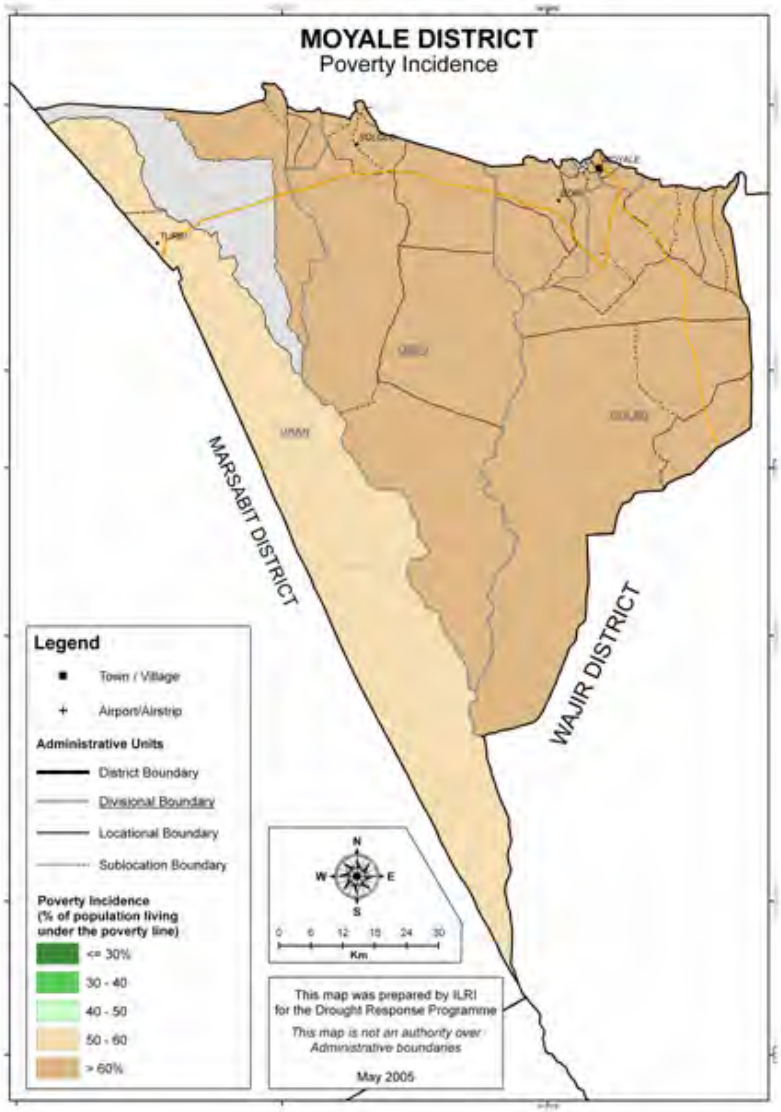

MARSABIT DISTRICT
Poverty Incidence
Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Poverty Incidence
(% of population living
under the poverty line)
<= 30%
30 - 40
40 - 50
50 - 60
> 60%
N
W
E
S
0 10 20 30 40 50
Km
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005

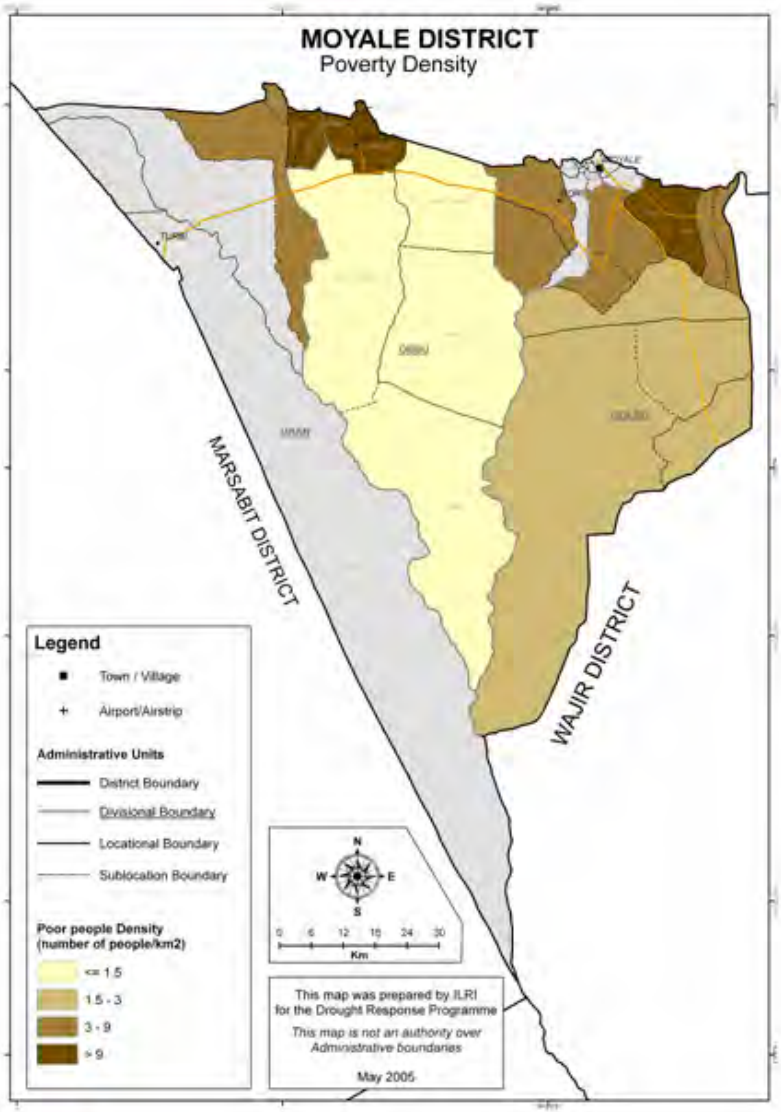

MARSABIT DISTRICT
Poverty Density
Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Poor people Density
(number of people/km2)
<= 1.5
1.5 - 3
3 - 9
> 9
N
W
E
S
0 10 20 30 40 50
Km
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005

3.6 Moyale

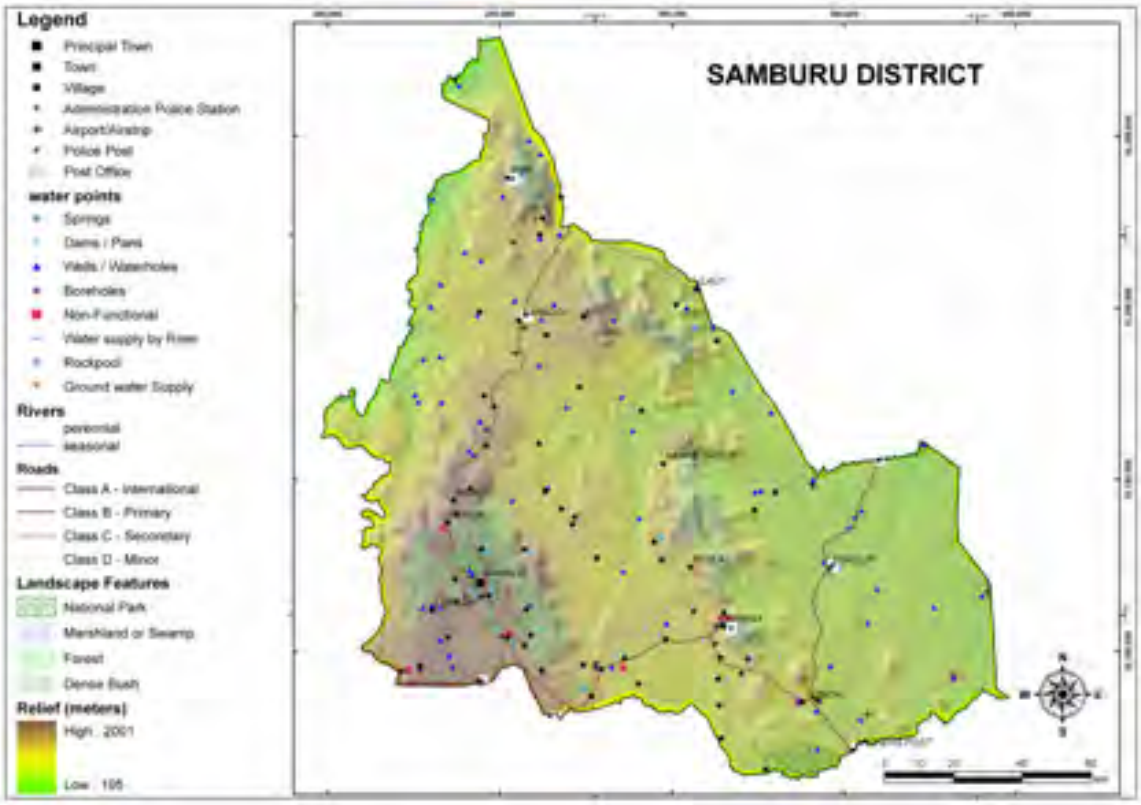

MOYALE DISTRICT
Legend
water points
Springs
Dams / Pans
Wells / Waterholes
Boreholes
Non-Functional
Water supply by River
Rockpool
Ground water Supply
Principal Town
Town
Village
Administration Police Station
Airport/Airstrip
Police Post
Post Office
Rivers
perennial
seasonal
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
Landscape Features
National Park
Marshland or Swamp
Forest
Dense Bush
Relief (meters)
High : 2001
Low : 195
N
W
E
S
12.5
25
50
Km

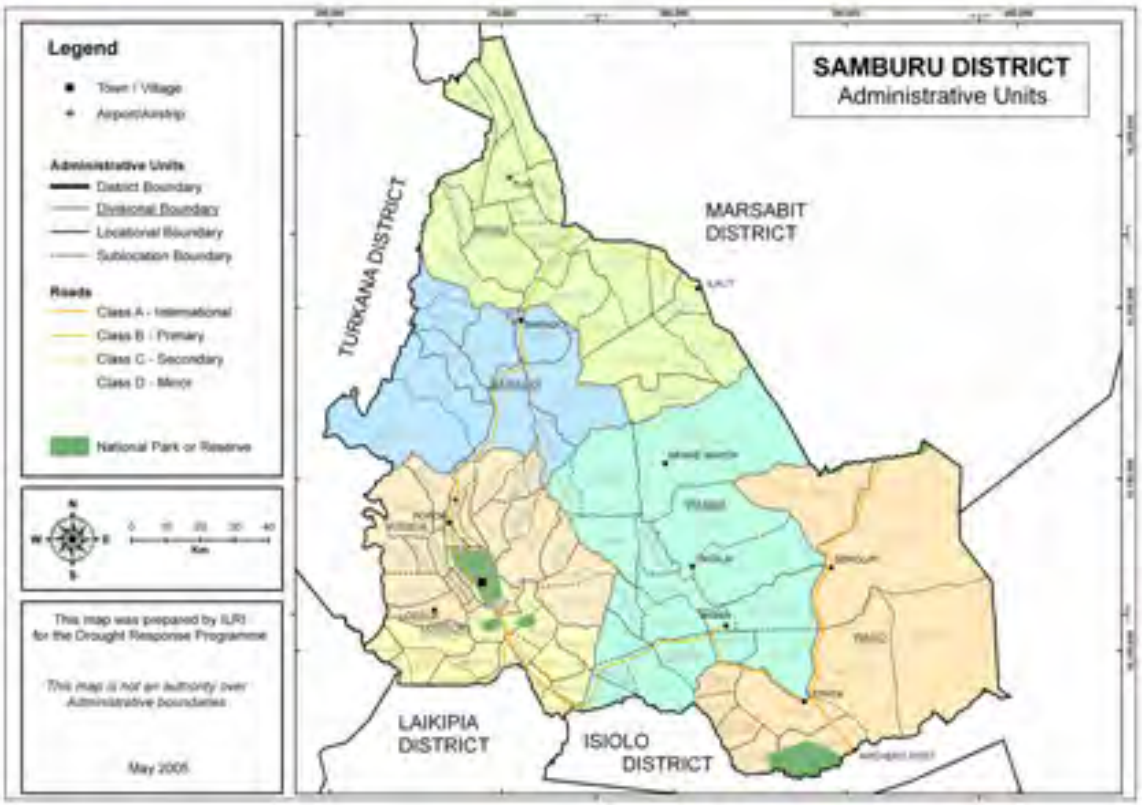

MOYALE DISTRICT
Administratibe Units
MARSABIT DISTRICT
WAJIR DISTRICT
Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
National Park or Reserve
N
W
E
S
0
6
12
18
24
30
Km
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005

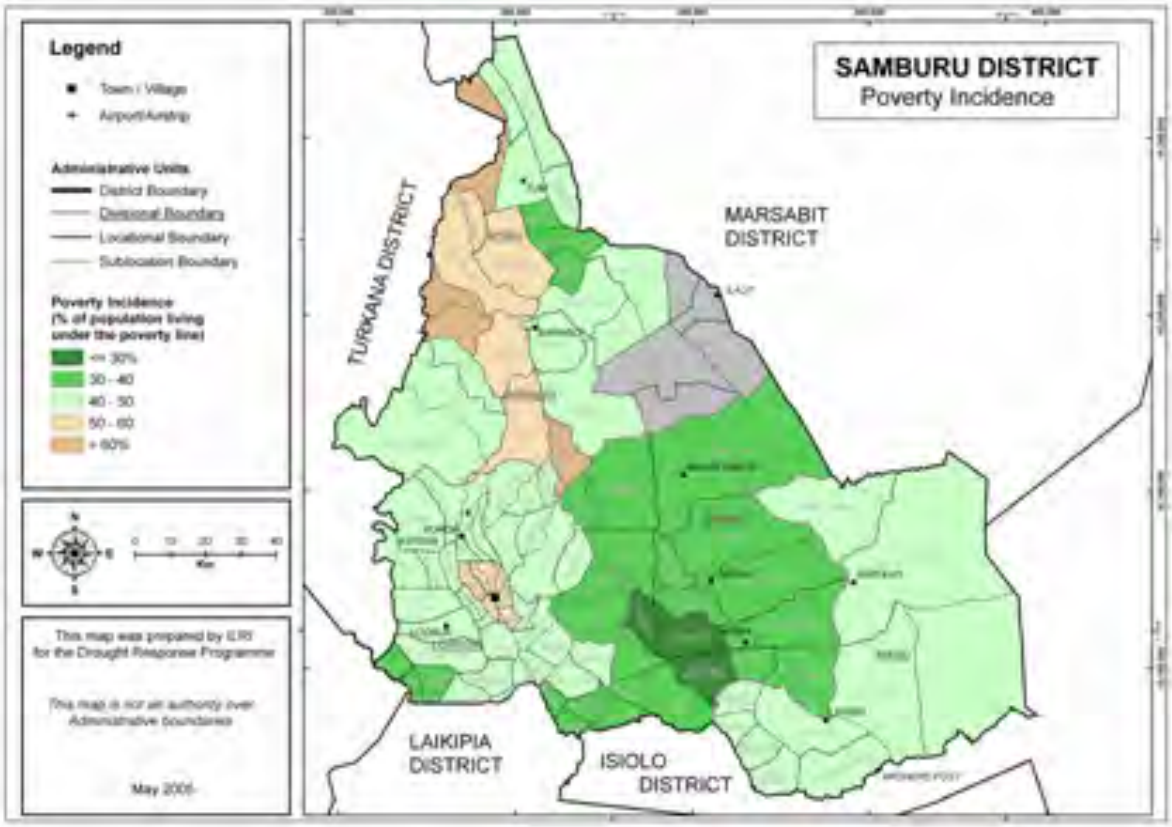

MOYALE DISTRICT
Poverty Incidence
MARSABIT DISTRICT
WAJIR DISTRICT
Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Poverty Incidence
(% of population living
under the poverty line)
<= 30%
30 - 40
40 - 50
50 - 60
> 60%
N
W
E
S
0 6 12 18 24 30
Km
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005

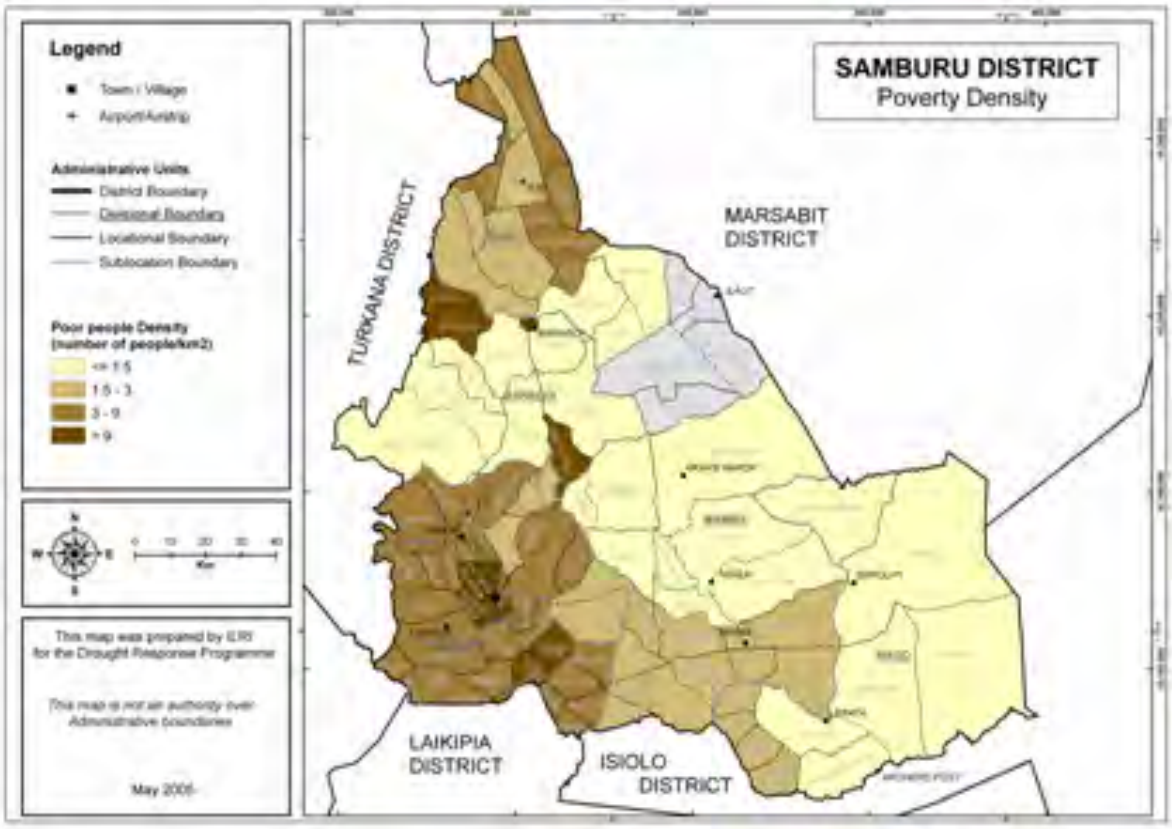

MOYALE DISTRICT
Poverty Density
MARSABIT DISTRICT
WAJIR DISTRICT
Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Poor people Density
(number of people/km2)
<= 1.5
1.5 - 3
3 - 9
> 9
N
W
E
S
0 6 12 18 24 30
Km
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005

3.7 Samburu

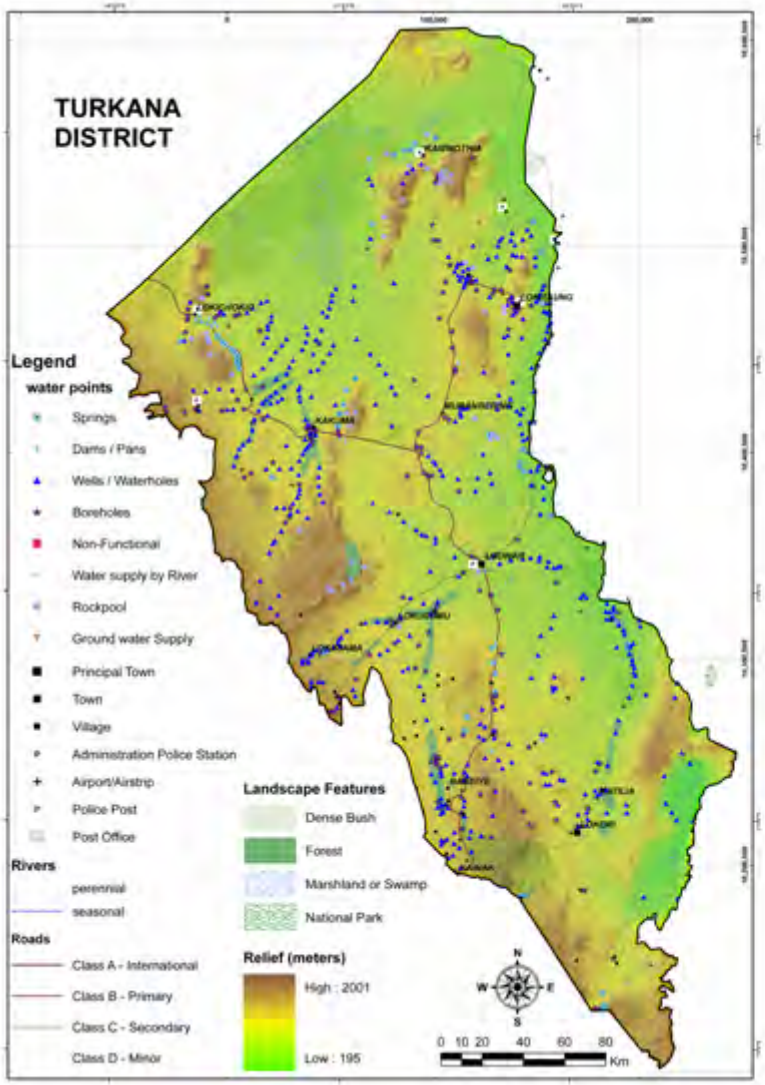

Legend
Principal Town
Town
Village
Administration Police Station
Airport/Airstrip
Police Post
Post Office
water points
Springs
Dams / Pans
Wells / Waterholes
Boreholes
Non-Functional
Water supply by Rows
Rockpool
Ground water Supply
Rivers
perennial
seasonal
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
Landscape Features
National Park
Marshland or Swamp
Forest
Dense Bush
Relief (meters)
High : 2001
Low : 195
SAMBURU DISTRICT

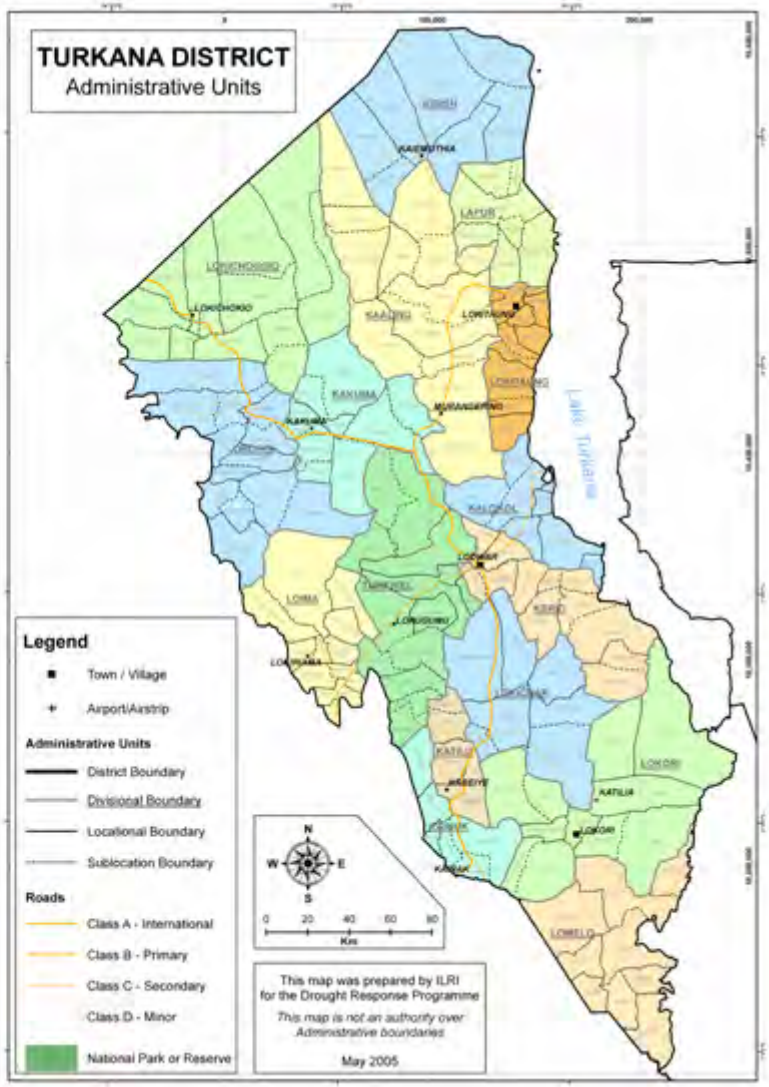

Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
National Park or Reserve
This map was prepared by ILRI for the Drought Response Programme
This map is not an authority over Administrative boundaries
May 2005
SAMBURU DISTRICT
Administrative Units
TURKANA DISTRICT
MARSABIT DISTRICT
LAIKIPIA DISTRICT
ISIOLO DISTRICT

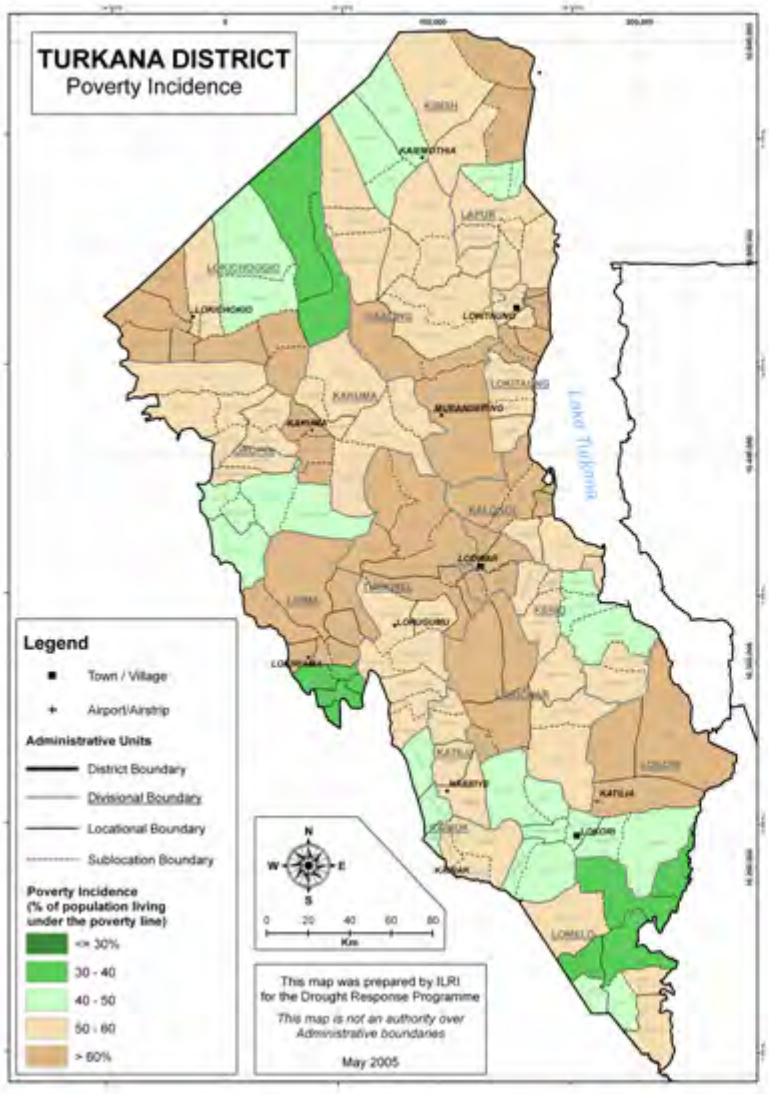

Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Poverty Incidence
(% of population living
under the poverty line)
<= 30%
30 - 40
40 - 50
50 - 60
+ 60%
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005
SAMBURU DISTRICT
Poverty Incidence
TURKANA DISTRICT
MARSABIT
DISTRICT
LAIKIPIA
DISTRICT
ISIOLO
DISTRICT

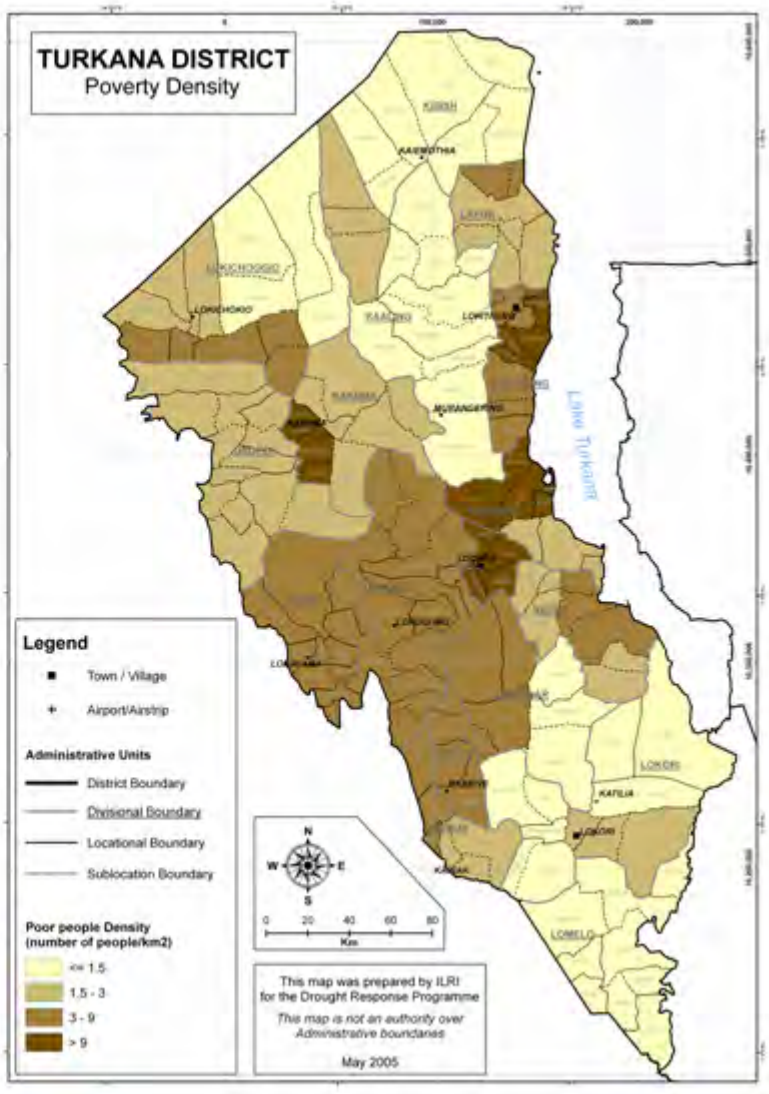

Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Poor people Density
(number of people/km2)
<= 1.5
1.5 - 3
3 - 9
> 9
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005
SAMBURU DISTRICT
Poverty Density
TURKANA DISTRICT
MARSABIT
DISTRICT
LAIKIPIA
DISTRICT
ISIOLO
DISTRICT

3.8 Turkana

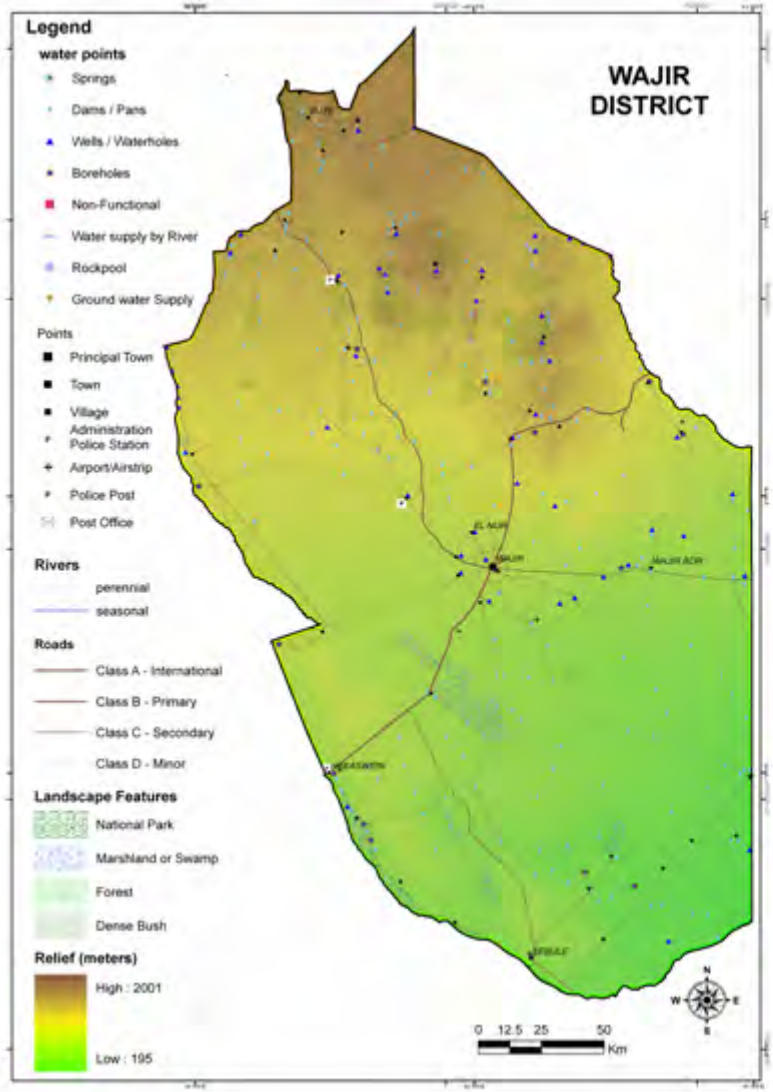

TURKANA
DISTRICT
Legend
water points
Springs
Dams / Pans
Wells / Waterholes
Boreholes
Non-Functional
Water supply by River
Rockpool
Ground water Supply
Principal Town
Town
Village
Administration Police Station
Airport/Airstrip
Police Post
Post Office
Rivers
perennial
seasonal
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
Landscape Features
Dense Bush
Forest
Marshland or Swamp
National Park
Relief (meters)
High : 2001
Low : 195
N
W
E
S
0 10 20 40 60 80
Km

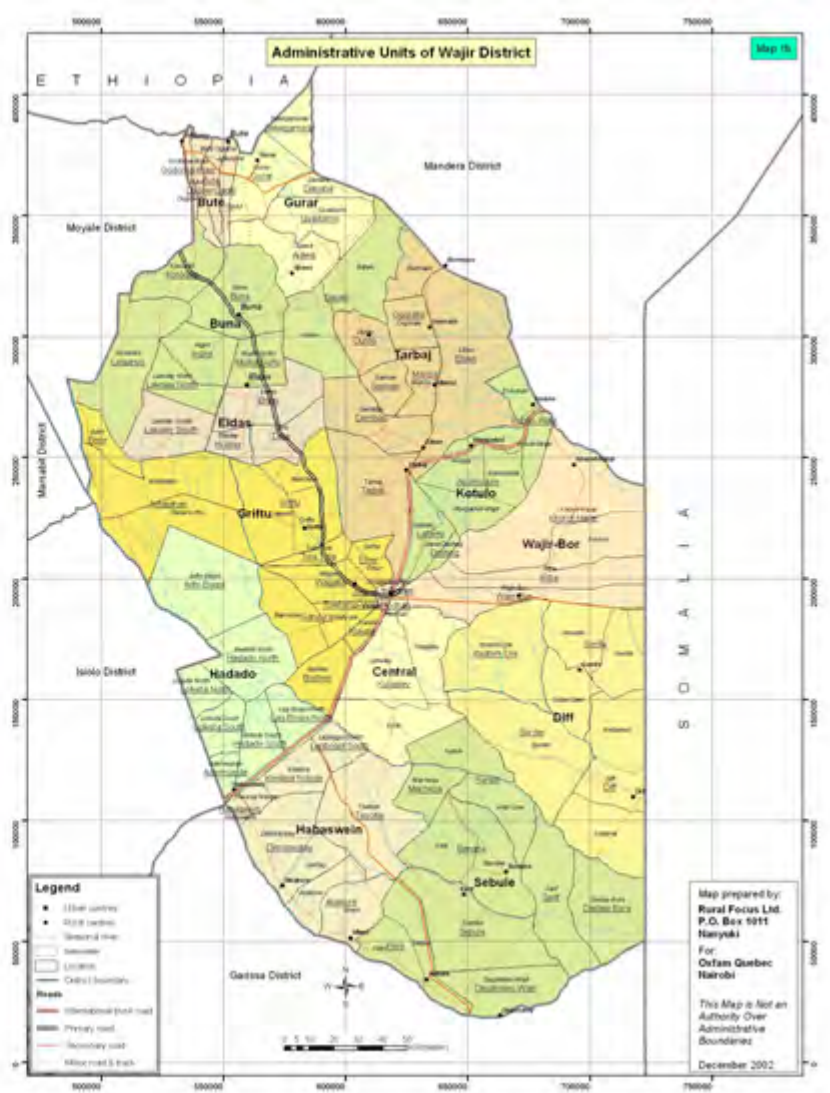

TURKANA DISTRICT
Administrative Units
Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
National Park or Reserve
N
W
E
S
0 20 40 60 80
Km
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005


TURKANA DISTRICT
Poverty Incidence
Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Poverty Incidence
(% of population living under the poverty line)
<= 30%
30 - 40
40 - 50
50 - 60
> 60%
Lake Turkana
N
W
E
S
0 20 40 60 80
Km
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005


TURKANA DISTRICT
Poverty Density
Legend
Town / Village
Airport/Airstrip
Administrative Units
District Boundary
Divisional Boundary
Locational Boundary
Sublocation Boundary
Poor people Density
(number of people/km2)
<= 1.5
1.5 - 3
3 - 9
> 9
Lake Turkana
N
W
E
S
0 20 40 60 80
Km
This map was prepared by ILRI
for the Drought Response Programme
This map is not an authority over
Administrative boundaries
May 2005

3.9 Wajir


Legend
water points
Springs
Dams / Pans
Wells / Waterholes
Boreholes
Non-Functional
Water supply by River
Rockpool
Ground water Supply
Points
Principal Town
Town
Village
Administration Police Station
Airport/Airstrip
Police Post
Post Office
Rivers
perennial
seasonal
Roads
Class A - International
Class B - Primary
Class C - Secondary
Class D - Minor
Landscape Features
National Park
Marshland or Swamp
Forest
Dense Bush
Relief (meters)
High : 2001
Low : 195
WAJIR DISTRICT
0 12.5 25 50
Km


Administrative Units of Wajir District
E T H I O P I A
S O M A L I A
Mandera District
Moyale District
Marsabit District
Isiolo District
Garissa District
Bute
Gurar
Buna
Tarbaj
Eldas
Griftu
Ketulo
Wajir-Bor
Hadado
Central
Diff
Habaswein
Sebule
Legend
Map prepared by:
Rural Focus Ltd.
P.O. Box 1011
Nanyuki
For
Oxfam Quebec
Nairobi
This Map is Not an Authority Over Administrative Boundaries
December 2002

Appendix 12 List of persons contacted / visited with

Names of Persons	Contact Address	Remarks
1. Shariff Mohammed Abdi	Ijara District	Key Informant (KI)
2. Ahmed Kore Abdi	Garissa District	KI
3. Mohamed Haji Abdi	Wajir District	KI
4. Reuben Lemunyete	Samburu District	KI
5. Adan Bosso Wario	Isiolo District	KI
6. James Njru	Moyale District	KI
7. Daud Tamasot	Samburu District	KI
8. Michael A. Ikmat	Turkana District	KI
9. Francesca Tarsia	COOPI	NGO Representative
10. Attilio Bordi	COOPI	NGO Representative
11. Ilona	VSF-Suisse	NGO Representative
12. Sief Maloo	VSF-Suisse	NGO Representative
13. Senait Petros	VSF-Belgium	NGO Representative
14. Marco de	Terra-Nuova	NGO Representative
15. Federico Veronesi	Terra-Nuova	NGO Representative
16. FD Wesonga	Terra-Nuova	NGO Representative
17. Ade Freeman	ILRI	Consultant
18. Bruno Minjauw	ILRI	Consultant
19. Jeffery Mariner	ILRI	Consultant
20. David Watson	ILRI	Consultant
21. Bancy Mati	ILRI	Consultant
22. An Notenbaert	ILRI	Consultant
23. Albert Waudo	ILRI	Administrative Assistant
24. Vincent Oduor	ILRI	Consultant
25. Manga	DVS	Veterinary Epidemiologist
26.	MLFD, HQs	SLMO
27. F.M. Wangila	Isiolo District	DVO
28. M.M. Missi	Isiolo District	DDVO
29. Mugambi	Isiolo District, Central Division	VO
30. Ibrahim Adam	Isiolo District	DLPO
31. Muriithi Kangi	Isiolo District	DC
32. Abdulrazaq A. Ali	ENNDA	MD
33. Omar Sheikh	ENNDA	Senior Livestock Officer
34. George Keya	KARI, Marsabit	CD
35. K.M. Katee	Marsabit District	DC
36. Machira	Marsabit District	DVO
37. Mutai	Marsabit District, Laisamis division	VO
38. Gurret	Marsabit District	DLPO

Appendix 13 Computed average going prices (Kshs) of various types (species) of livestock

Livestock species and classes	**Sum** (Kshs)	**Average** (Kshs)	**Min** (Kshs)	**Max** (Kshs)
Cattle:				
1. Breeding Bull	82,000.00	10,250.00	5.500.00	15,000.00
2. Breeding Cow	61,000.00	7,625.00	5,500.00	10,000.00
3. Big Steer	37,500.00	4,687.50	2,500.00	6,000.00
4. Young Steer	3,000.00	3,000.00	3,000.00	3,000.00
5. Heifer	47,000.00	5,875.00	3,000.00	8,000.00
6. Total	230,000.00	31,437.50	19,000.00	42,000.00
7. Average	46,100.00	**6,287.50**	3,800.00	8,400.00
Camels:				
1. Breeding Female	38,000.00	12,666.67	11,000.00	15,000.00
2. Breeding Female	43,000.00	10,750.00	9,000.00	12,000.00
3. Breeding Male	72,000.00	10,285.71	5,000.00	18,000.00
4. Heifer Camel	54,000.00	7,785.71	6,000.00	10,000.00
5. Steer Camel	41,500.00	5,928.57	4,000.00	7,000.00
6. Total	248,500.00	47,416.70	35,000.00	62,000.00
7. Average	49,700.00	**9,483.30**	7,000.00	12,400.00
Sheep:				
1. Breeding Female	5,100.00	728.57	500.00	1,000.00
2. Breeding Male	7,000.00	875.00	400.00	1,200.00
3. Ewe	2,250.00	450.00	250.00	600.00
4. Young Female	3,200.00	1,066.67	500.00	1,500.00
5. Young Male	1,600.00	533.33	300.00	800.00
6. Total	19,150.00	3,653.60	1,950.00	5,100.00
7. Average	3,850.00	**730.70**	390.00	1,020.00
Goats:				
1. Breeding Female	8,350.00	1,043.75	550.00	1,800.00
2. Breeding Male	9,700.00	1,212.50	500.00	2,000.00
3. Kid Female	2,700.00	540.00	300.00	800.00
4. Kid Male	2,250.00	450.00	250.00	600.00
5. Young Female	2,800.00	933.33	600.00	1,200.00
6. Young Male	2,700.00	900.00	500.00	1,400.00
7. Total	28,500.00	5,079.60	2,700.00	7,800.00
8. Average	4,750.00	**846.60**	450.00	1,300.00
Donkeys:				
1. Breeding Female	36,100.00	4,512.50	1,500.00	7,000.00
2. Breeding Female	36,600.00	4,450.00	2,000.00	9,000.00
3. Heifer	12,400.00	2,480.00	900.00	4,000.00
4. Steer	10,800.00	2,160.00	800.00	4,000.00
5. Young Heifer	6,500.00	3,250.00	1,500.00	5,000.00
6. Young Male	5,000.00	2,500.00	1,000.00	4,000.00
7. Total	107,400.00	19,352.50	7,700.00	33,000.00
8. Average	17,900.00	**3,225.40**	1,283.00	5,500.00

Source: Computed from Appendix Tables 3 and 4, 2005

Appendix 14 Livestock and nominal prices

Types of Livestock	Sum of gong Prices (Kshs)	Avg of going prices (Kshs)	Min of going prices (Kshs)	Max of going prices (Kshs)
Beef Meat (1kg)	760.00	108.57	80.00	150.00
Beef Meat (Kg)	100.00	100.00	100.00	100.00
Breeding Bull (Cattle)	82,000.00	10,250.00	5,500.00	15,000.00
Breeding cow (Cattle)	61,000.00	7,625.00	5,000.00	10,000.00
Breeding Female Camel	38,000.00	12,666.67	11,000.00	15,000.00
Breeding female camel	43,000.00	10,750.00	9,000.00	12,000.00
Breeding female donkey	36,100.00	4,512.50	1,500.00	7,000.00
Breeding female goat	8,350.00	1,043.75	550.00	1,800.00
Breeding female sheep	5,100.00	728.57	500.00	1,000.00
Breeding Male camel	72,000.00	10,285.71	5,000.00	18,000.00
Breeding male donkey	35,600.00	4,450.00	2,000.00	9,000.00
Breeding male goat	9,700.00	1,212.50	500.00	2,000.00
Breeding male Sheep	7,000.00	875.00	400.00	1,200.00
Camel Hide	1,000.00	500.00	500.00	500.00
Camel meat (1kg)	570.00	81.43	60.00	100.00
Camel milk	205.00	29.29	15.00	60.00
Chevon (1kg)	120.00	120.00	120.00	120.00
Chevon (kg)	850.00	121.43	70.00	160.00
Cow milk (1ltr)	245.00	30.63	20.00	60.00
Donkey Heifer	12,400.00	2,480.00	900.00	4,000.00
Donkey Steer	10,800.00	2,160.00	800.00	4,000.00
Ewe	2,550.00	510.00	300.00	800.00
Heifer (Cattle)	47,000.00	5,875.00	3,000.00	8,000.00
Heifer Camel	54,500.00	7,785.71	6,000.00	10,000.00
Heifer Young female	3,000.00	3,000.00	3,000.00	3,000.00
Heifer Young female (donkey)	6,500.00	3,250.00	1,500.00	5,000.00
Hide	780.00	390.00	80.00	700.00
Hide Camel	100.00	100.00	100.00	100.00
Kid Female	2,700.00	540.00	300.00	800.00
Male kid	2,250.00	450.00	250.00	600.00
Manure	45.00	45.00	45.00	45.00
Manure (1ton)	60.00	30.00	20.00	40.00
Mutton (1kg)	820.00	117.14	60.00	160.00
Mutton (1kg)	120.00	120.00	120.00	120.00
Skin	1,150.00	143.75	40.00	350.00
Skin (Cattle)	300.00	300.00	300.00	300.00
Steer (cattle)	37,500.00	4,687.50	2,500.00	6,000.00
Steer (Camel)	41,500.00	5,928.57	4,000.00	7,000.00
Steer (Ewe)	2,250.00	450.00	250.00	600.00

Types of Livestock	Sum of gong Prices (Kshs)	Avg of going prices (Kshs)	Min of going prices (Kshs)	Max of going prices (Kshs)
Steer Young male	3,000.00	3,000.00	3,000.00	3,000.00
Steer Young male (donkey)	5,000.00	2,500.00	1,000.00	4,000.00
Young female - kid	2,800.00	933.33	600.00	1,200.00
Young female sheep	3,200.00	1,066.67	500.00	1,500.00
Young male - kid	2,700.00	900.00	500.00	1,400.00
Young male sheep	1,600.00	533.33	300.00	800.00

Appendix 14 Livestock and nominal prices

Types of Livestock	Sum of ID	Avg of ID	Min of ID	Max of ID	Sum of going prices (Kshs)	Avg of going prices (Kshs)	Min of going prices (Kshs)	Max of going prices (Kshs)	Count of Livestock & prices
Beef Meat (1kg)	35	5	2	8	760.00	108.57	80.00	150.00	7
Beef Meat (Kg)	1	1	1	1	100.00	100.00	100.00	100.00	1
Breeding Bull	36	4.5	1	8	82,000.00	10,250.00	5,500.00	15,000.00	8
Breeding cow	36	4.5	1	8	61,000.00	7,625.00	5,000.00	10,000.00	8
Breeding Female Camel	11	3.67	2	5	38,000.00	12,666.67	11,000.00	15,000.00	3
Breeding female camel	24	6	3	8	43,000.00	10,750.00	9,000.00	12,000.00	4
Breeding female donkey	36	4.5	1	8	36,100.00	4,512.50	1,500.00	7,000.00	8
Breeding female goat	36	4.5	1	8	8,350.00	1,043.75	550.00	1,800.00	8
Breeding female sheep	32	4.57	1	8	5,100.00	728.57	500.00	1,000.00	7
Breeding Male camel	35	5	2	8	72,000.00	10,285.71	5,000.00	18,000.00	7
Breeding male donkey	36	4.5	1	8	35,600.00	4,450.00	2,000.00	9,000.00	8
Breeding male goat	36	4.5	1	8	9,700.00	1,212.50	500.00	2,000.00	8
Breeding male Sheep	36	4.5	1	8	7,000.00	875.00	400.00	1,200.00	8
Camel Hide	12	6	5	7	1,000.00	500.00	500.00	500.00	2
Camel meat (1kg)	35	5	2	8	570.00	81.43	60.00	100.00	7
Camel milk	35	5	2	8	205.00	29.29	15.00	60.00	7
Chevon - (1kg)	1	1	1	1	120.00	120.00	120.00	120.00	1
Chevon - goat meat (kg)	35	5	2	8	850.00	121.43	70.00	160.00	7
Cow milk (1ltr)	36	4.5	1	8	245.00	30.63	20.00	60.00	8
Donkey Heifer	25	5	1	8	12,400.00	2,480.00	900.00	4,000.00	5
Donkey Steer	25	5	1	8	10,800.00	2,160.00	800.00	4,000.00	5
Ewe	25	5	1	8	2,550.00	510.00	300.00	800.00	5
Heifer	36	4.5	1	8	47,000.00	5,875.00	3,000.00	8,000.00	8
Heifer Camel	35	5	2	8	54,500.00	7,785.71	6,000.00	10,000.00	7
Heifer Young female	2	2	2	2	3,000.00	3,000.00	3,000.00	3,000.00	1
Heifer Young female(donkey)	9	4.5	4	5	6,500.00	3,250.00	1,500.00	5,000.00	2
Hide	8	4	1	7	780.00	390.00	80.00	700.00	2
Hide Camel	8	8	8	8	100.00	100.00	100.00	100.00	1
Kid Female	25	5	1	8	2,700.00	540.00	300.00	800.00	5

Types of Livestock	Sum of ID	Avg of ID	Min of ID	Max of ID	Sum of going prices (Kshs)	Avg of going prices (Kshs)	Min of going prices (Kshs)	Max of going prices (Kshs)	Count of Livestock & prices
Male kid	25	5	1	8	2,250.00	450.00	250.00	600.00	5
Manure	4	4	4	4	45.00	45.00	45.00	45.00	1
Manure (1ton)	9	4.5	3	6	60.00	30.00	20.00	40.00	2
Mutton - sheep meat (1kg)	35	5	2	8	820.00	117.14	60.00	160.00	7
Mutton (1kg)	1	1	1	1	120.00	120.00	120.00	120.00	1
Skin	36	4.5	1	8	1,150.00	143.75	40.00	350.00	8
Skin (Cattle)	5	5	5	5	300.00	300.00	300.00	300.00	1
Steer	36	4.5	1	8	37,500.00	4,687.50	2,500.00	6,000.00	8
Steer Camel	35	5	2	8	41,500.00	5,928.57	4,000.00	7,000.00	7
Steer Ewe	25	5	1	8	2,250.00	450.00	250.00	600.00	5
Steer Young male	2	2	2	2	3,000.00	3,000.00	3,000.00	3,000.00	1
Steer Young male (donkey)	9	4.5	4	5	5,000.00	2,500.00	1,000.00	4,000.00	2
Young female - kid	11	3.7	2	5	2,800.00	933.33	600.00	1,200.00	3
Young female sheep	11	3.7	2	5	3,200.00	1,066.67	500.00	1,500.00	3
Young male - kid	11	3.7	2	5	2,700.00	900.00	500.00	1,400.00	3
Young male sheep	11	3.7	2	5	1,600.00	533.33	300.00	800.00	3

Appendix 16 Poverty incidences and inequalities in some of the 210 Kenyan Constituencies, 2005

Constituencies	Estimated Constituency Population	Estimated No. of Poor	Percent Poor
1. Kabete	185,570	30,576	16.48
2. Kiambaa	177,566	34,222	19.27
3. Limuru	103,880	23,093	22.23
4. Mathira	147,969	36,170	24.44
5. Githunguri	129,421	31,851	24.61
6. Ndaragwa	81,748	20,706	25.33
7. Othaya	85,339	23,005	26.96
8. Kieni	145,108	41,064	28.30
9. Kiharu	173,824	49,586	28.53
10. Mathioya	92,130	26,810	29.10
11. Bura	63,782	19,461	30.51
12. Gatundu South	111,704	34,333	30.74
13. Lari	105,715	32,738	30.97
14. Kigumo	116,978	36,461	31.17
15. Westlands	188,107	58,826	31.27
16. Mukurweini	85,385	26,718	31.29
17. Kangema	79,532	24,894	31.30
18. Tetu	79,438	25,088	31.58
19. Ndia	91,444	29,125	31.85
20. Kerugoya Kutus	101,859	33,525	32.91
21. Ol Kalou	143,645	48,043	33.45
22. Subukia	151,756	50,922	33.56
23. Gichugu	117,270	40,249	34.32
24. Ntonyiri	171,081	58,870	34.41
25. Mvita	71,108	24,544	34.52
26. Gatanga	170,187	58,942	34.63
27. Maragwa	105,002	37,810	36.01
28. Kandara	152,910	55,466	36.27
29. Gatundu North	97,400	36,009	36.97
30. Kinangop	139,848	52,921	37.84
31. Keiyo South	85,764	32,538	37.94
32. Naivasha	236,519	90,989	38.47
33. Juja	237,709	92,698	39.00
34. Kajiado North	185,591	73,219	39.45
35. Samburu East	**32,746**	**13,033**	**39.80**
36. Langata	271,111	108,617	40.06
37. Laisamis	**36,314**	**14,628**	**40.28**
38. Kipipiri	73,283	29,633	40.44
39. Embakasi	408,921	166,608	40.74
40. Keiyo North	54,984	22,426	41.00
41. Marakwet East	74,188	30,733	41.43
42. Marakwet West	63,640	26,483	41.61
43. Mwea	132,370	55,293	41.77
44. Galole	**46,094**	**19,297**	**41.86**
45. Lamu East	16,796	7,088	42.20
46. Eldoret East	161,680	68,298	42.24

47. Garsen	66,392	28,160	42.41
48. Kuresi	170,711	72,692	42.58
49. Baringo North	79,277	33,758	42.58
50. Baringo Central	114,606	49,121	42.86
51. Molo	230,127	99,078	43.05
52. South Imenti	151,806	65,473	43.13
53. Nyeri Town	91,813	39,702	43.24
54. Rongai	135,714	58,853	43.37
55. Laikipia East	121,152	53,322	44.01
56. Central Imenti	123,961	53,999	43.56
57. Rongo	161,081	70,415	43.71
58. Laikipia West	182,997	79,574	44.00
59. Starehe	205,225	90,430	44.06
60. North Imenti	209,242	92,374	44.15
61. Likoni	99,582	44,452	44.64
62. Ainaimoi	126,828	56,778	44.77
63. Nakuru Town	221,467	99,737	45.03
64. Mosop	117,456	53,034	45.15
65. Engwen	162,775	73,519	45.17
66. Changamwe	178,184	81,012	45.47
67. Saku	34,881	15,861	45.47
68. Kisauni	244,739	111,688	45.64
69. Dagoretti	229,612	104,934	45.70
70. Kamkunji	183,468	84,050	45.81
71. Kipkelion	169,153	78,410	46.35
72. Kacheliba	58,991	27,466	46.56
73. Saboti	256,627	120,170	46.83
74. Isiolo North	**73,463**	**34,499**	**46.96**
75. Migori	139,077	65,487	47.09
76. Eldama Ravine	89,762	42,326	47.15
77. Kasarani	320,739	151,592	47.26
78. Kajiado Central	84,444	40,241	47.65
79. Nyatike	106,502	51,585	48.44
80. Cherangany	140,129	67,908	48.46
81. Aidai	124,687	60,620	48.62
82. Buret	121,517	59,151	48.68
83. Uriri	85,666	41,779	48.77
84. Belgut	159,449	77,836	48.82
85. Eldoret South	173,731	84,808	48.82
86. Sotik	133,529	65,779	49.26
87. Kajiado South	113,348	56,666	49.99
88. Samburu West	**98,365**	**49,273**	**50.09**
89. Amagoro	175,877	88,443	50.29
90. Narok North	151,198	76,630	50.68
91. Mogotio	44,364	22,611	50.97
92. Kwanza	147,829	75,507	51.08
93. Bomet	174,471	90,059	51.62
94. Bumula	127,240	65,908	51.80

95. Konoin	127,536	66,092	51.82
96. Turkana South	**68,835**	**36,181**	**52.56**
97. Kapenguria	127,836	67,232	52.59
98. Matuga	118,470	62,524	52.78
99. Manyatta	136,124	72,236	53.07
100. Sigor	114,469	61,117	53.39
101. Eldoret South	262,884	141,558	53.85
102. Isiolo South	**18,144**	**9,860**	**54.34**
103. Kibwezi	192,827	105,040	54.47
104. Taveta	51,411	28,096	54.65
105. Mt. Elgon	133,353	73,399	55.04
106. Lamu West	55,713	31,032	55.70
107. Baringo East	61,743	34,438	55.78
108. Malava	191,438	107,248	56.02
109. Chepalungu	116,757	65,495	56.10
110. Tinderet	154,617	87,278	56.45
111. Igembe	182,534	103,297	56.59
112. Nyaribari Chache	106,920	60,996	57.05
113. Vihiga	81,048	46,242	57.06
114. Muhoroni	122,739	70,670	57.58
115. Nyaribari Masaba	103,172	59,591	57.76
116. Sirisia	177,793	103,242	58.07
117. Nithi	201,586	117,507	58.29
118. Runyenjes	131,182	76,533	58.34
119. Voi	78,883	46,177	58.54
120. Kathiani	136,131	79,772	58.60
121. Mwatate	54,632	32,042	58.65
122. Kangundo	186,145	109,643	58.90
123. Kilgoris	165,790	97,683	58.92
124. Gachoka	97,963	57,789	58.99
125. Hamisi	133,354	78,733	59.04
126. Makadara	184,541	109,001	59.07
127. Matungu	107,425	63,463	59.08
128. Webuye	166,484	99,164	59.56
129. Dujis	**96,440**	**57,643**	**59.77**
130. Emuhaya	158,876	95,196	59.92
131. Kimilili	223,898	134,450	60.05
132. Sabatia	114,419	68,711	60.05
133. Tigania East	123,071	74,398	60.45
134. Kanduyi	155,205	94,054	60.60
135. Ugenya	171,801	104,558	60.86
136. Turkana North	**153,793**	**93,610**	**60.87**
137. Malindi	161,138	98,361	61.04
138. Msambweni	203,650	124,574	61.17
139. Kilome	80,688	49,378	61.20
140. Tigania West	112,551	68,976	61.28
141. South Mugirango	122,806	75,630	61.58
142. Fafi	**46,135**	**28,436**	**61.64**

143. Kisumu Town East	200,466	124,088	61.90
144. Moyale	**50,342**	**31,223**	**62.02**
145. North Horr	**39,604**	**24,638**	**62.21**
146. Mwingi North	162,447	101,185	62.29
147. Mandera West	**71,242**	**44,478**	**62.43**
148. Mumias	164,783	102,882	62.43
149. Mwingi South	136,171	85,073	62.48
150. Yatta	122,707	76,797	62.59
151. Wajir West	**68,466**	**42,856**	**62.59**
152. Lurambi	216,004	135,304	62.64
153. Bomachoge	166,189	104,292	62.76
154. Wajir East	**95,027**	**59,667**	**62.79**
155. Bobasi	158,340	99,456	62.81
156. Ijara	**35,939**	**22,612**	**62.92**
157. Bahari	227,554	143,362	63.00
158. Tharaka	98,613	62,249	63.12
159. Nyakach	109,744	69,758	63.56
160. Wundanyi	52,249	33,219	63.58
161. Masinga	104,681	66,581	63.60
162. Butere	109,782	69,840	63.62
163. Lugari	167,536	106,695	63.68
164. Khwisero	87,361	55,692	63.75
165. Mwala	150,057	96,233	64.13
166. Lagdera	74,082	47,513	64.14
167. Turkana Central	**147,691**	**94,928**	**64.27**
168. Kitutu Chache	180,922	116,795	64.56
169. Mandera East	**75,990**	**49,178**	**64.72**
170. Kitutu Masaba	166,752	108,469	65.05
171. Gwassi	73,212	47,846	65.35
172. Mbooni	168,698	110,347	65.41
173. Kaiti	110,594	72,557	65.61
174. Nyando	106,329	69,761	65.61
175. Kisumu Town West	123,971	81,821	66.00
176. Makueni	200,865	132,988	66.21
177. Mandera Central	**91,687**	**60,894**	**66.42**
178. Shinyau	132,177	89,658	67.83
179. Mutito	89,021	60,512	67.97
180. West Mugirango	130,249	88,909	68.26
181. Alego	161,413	110,266	68.31
182. Wajir South	**75,815**	**51,822**	**68.35**
183. Mbita	78,576	53,720	68.37
184. Gem	134,360	91,879	68.38
185. Nambale	143,244	97,963	68.39
186. Magarini	108,160	74,316	68.71
187. Siakago	70,010	48,628	69.46
188. Funyula	73,111	50,824	69.52
189. Budalangi	51,092	35,557	69.59
190. Kisumu Rural	121,343	84,513	69.65

191. Butula	94,111	65,991	70.12
192. Bondo	118,265	83,139	70.30
193. Wajir North	**59,834**	**42,207**	**70.54**
194. N. Mugirango Borabu	186,160	132,250	71.04
195. Karachuonyo	123,202	88,284	71.66
196. Ikolomani	90,407	64,847	71.73
197. Kasipul Kabondo	174,324	125,059	71.74
198. Rangwe	145,274	104,335	71.82
199. Kitui Central	159,372	114,696	71.97
200. Ndhiwa	128,462	93,244	72.58
201. Rarienda	110,220	81,008	73.50
202. Bonchari	84,182	61,881	73.51
203. Kaloleni	190,669	140,797	73.84
204. Kinango	160,301	120,254	75.02
205. Kitui South	115,574	87,597	75.79
206. Kuria	145,250	117,414	80.84
207. Ganze	110,536	92,826	83.98

Source: Republic of Kenya (2005)