Participatory investigation of important animal health problems amongst the Turkana pastoralists: Relative incidence, impact on livelihoods and suggested interventions

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Abbreviations

AHA	Animal Health Assistant
CAHWs	Community animal health workers
CBPP	Contagious bovine pleuropneumonia
CCPP	Contagious caprine pleuropneumonia
DIM	Disease Impact Matrix
DVO	District Veterinary Officer
DVS	Department of Veterinary Services
FAO	Food and Agriculture Organization of the United Nations
GoK	Government of Kenya
ILRI	International Livestock Research Institute
NGO	Non-Governmental Organization
NORAD	Norwegian Agency for Development
OXFAM	Oxford Committee for Famine Relief
PPR	Peste des petits ruminants
SNV	Stichting Nederlandse Vrijwilligers, i.e. Dutch Development Organization
TLDP	Turkana Livestock Development Program
VSF	Veterinaires Sans Frontieres

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Executive summary

This report describes a study of the principal animal health problems in central and southern parts of Turkana South District, with particular emphasis on their relative importance, factors that promote their occurrence and persistence, and the perceived impact of intervention measures applied previously by the Turkana Livestock Development Program (TLDP). The study was conceived and supported by VSF Belgium, a non-governmental organization (NGO) which is implementing the TLDP. The first phase of the program was implemented between 2000 and 2005, and the second phase was initiated in 2006. The overall objective of the first phase, which occurred largely in Turkana Central (Turkwell, Loima and Kerio Divisions), was to improve the livelihoods of vulnerable pastoral communities through enhanced livestock production, increased access to water, improved marketing opportunities and peace building initiatives. The second phase of the program builds on the achievements of the TLDP I and seeks to expand the target area to include Turkana South (Kainuk, Katilu, Lokichar and Lokori Divisions).

The study utilized participatory epidemiological techniques described by Mariner and Paskin (2000), Cleaveland et al. (2001), Catley and Mariner (2002), Catley (2003) and Catley and Admassu (2003) to capture and prioritize animal health problems observed in the target area. Focused group discussions took place at *adakars*[1] under the 'tree of men'. Groups were often divided based on gender. Information on the types, relative numbers and importance of livestock species kept by the Turkana, species-specific diseases, and relative prevalence and incidence and perceived impact of the diseases was collected. Some of the measures that had been implemented by TLDP in the recent past to control a number of endemic diseases were evaluated as well in a bid to identify ways of improving their delivery.

Of the livestock species kept, goats and camels were always ranked as the most important species for a family's survival. In order of importance, the participants ranked the benefits of keeping goats as food, dowry and money. Camels were mainly kept for food (milk, blood and rarely meat) and paying dowry. It is apparent that interventions targeted at improving the productivity of goats and camels would have the greatest immediate positive impact on the livelihoods of the Turkana pastoralists.

Livestock movements, limited access to veterinary services and sometimes insecurity were identified by the participants as being the main factors that contributed to the high prevalence and persistence of livestock diseases. In the previous year, the overall median morbidity rate in goats was 69%. This rate was higher in the central (69.5%) than in the southern (64%) Turkana ($P = 0.06$). The diseases that were perceived to be prevalent in goats included mange, PPR and CCPP while in camels, mange, diarrhoea and pneumonia were said to be prevalent. The participants said that most of these diseases were contracted in the dry season grazing areas where many *adakars* congregated to use the available (but few) grazing and watering points. The diseases were thought to be disseminated to the wet season grazing areas when the *adakars* retreated to their 'homes' at the onset of rains. In areas found in irrigation schemes, helminthoses in small

1. Functional decision-making units who move together to exploit grazing resources.

ruminants were perceived to be prevalent and relatively important with respect to their impact on livelihoods derived from these animals. In such areas, animals were often fed on crop residues. It is recommended that strategic intervention, for example mass vaccinations, implemented at the start of the dry season when *adakars* are settling in the dry season grazing areas could have a big impact in halting the dissemination of infectious diseases across seasonal grazing sites. The congregation of *adakars* at these times of the year enables the treatment of large populations of animals, hence a high level of coverage, compared to the levels that might be achieved in the wet season when *adakars* are dispersed. Vaccinations conducted late in the dry season are unlikely to achieve a desirable level of coverage because many herders believe that side effects associated with vaccination, e.g. abortions etc., occur more commonly at these times. Sedentary farmers in the irrigation schemes should also be advised to use feeding troughs instead of spreading crop residues on the ground as this might reduce contamination of the feed with fecal material. Strategic application of anthelmintics should be encouraged as well.

Most of the participants said they treated their own animals when they got sick. Even when CAHWs were available, the Turkana preferred to purchase drugs from them and administer the treatments themselves. For the treatment of CCPP, herders often used 20% Alamycin® (oxytetracyclin, Norbrook) administered intramuscularly at about 3–5 ml for an adult goat. This dosage is higher than the recommended level (of about 2 ml for a mature goat of about 30 kg). Most of the herders could, however, not properly identify the recommended dosages or the different concentrations of oxytetracyclines from the drug labels due to low literacy levels. Treatment of mange varied by area. In Turkana Central, most herders used acaricides alongside other substances including used engine oil, salt, vegetable oil etc. These other substances were typically rubbed on the skin lesions after being washed with acaricide formulations. In Turkana South, most herders used ivomectin and acaricides. One dose of about 1–2 ml of ivomectin administered subcutaneously was usually used. This dosage is also higher than the recommended level of 1 ml per 50 kg body weight. The drug use practices described by the participants indicate that interventions are needed to enhance the knowledge of the Turkana pastoralists with regard to the identification, estimation of dosage and administration of veterinary drugs. This could be achieved through training a small number of herders and community leaders, who would act as resource persons in their local communities, in the local farmer[2] field schools. Using the Community Animal Health Workers (CAHWs) to run the farmer field school would improve the recognition of these para-professionals as resource persons. Farmer field schools had already been started in Turkana Central and were being validated to match local conditions and expectations. Once established, the farmer field school methodology could be replicated in Turkana South.

The study found that most of the CAHWs were skilled in disease diagnosis and treatment. Their impact was however being hampered by their inability to access veterinary drugs. The study described two contrasting drug delivery and reporting systems involving CAHWs in Turkana Central and Turkana South. The system described in the south was considered to be more sustainable than that described in Turkana Central because the CAHWs in the south had been attached to a private veterinarian based in Kapenguria, West Pokot District. A few of these CAHWs owned private drug outlets. The CAHWs interviewed in Turkana Central indicated that they had to travel long distances

2. An appropriate nomenclature for farmer field schools is being sought as the Turkana are either nomadic or agro-pastoralists.

to purchase veterinary drugs. None of them owned a private drug store. A sustainable drug distribution system was therefore required in Turkana Central; this could be achieved by replicating the model observed in Turkana South by providing micro-loans to veterinarians and/or animal health assistants (AHAs) willing to establish veterinary drug outlets in the area. The CAHWs could also be encouraged to establish linkages with livestock marketing associations as this might help them to secure better markets for the goats they use to purchase drugs. Pharmaceutical companies could be involved in the development of a sustainable drug supply system. VSF Belgium should convene workshops involving the relevant companies to discuss ways of developing and sustaining the drug supply system in the area.

CAHWs have in the past made key unsolicited reports that led to the detection of OIE List A diseases (Mariner, et al. 2002). They have also been shown to strengthen disease surveillance systems in Tanzania (Allport et al. 2005). In Turkana, CAHWs had not contributed much to disease surveillance because of a weak linkage between them and the DVS. The CAHWs interviewed in Turkana Central said they channelled information on disease occurrence to the DVO through chiefs, assistant chiefs, and occasionally in person when they travelled to Lodwar. Those interviewed in Turkana South said they delivered information through the private vet stationed in Kapenguria. The sensitivity of the overall system appeared to be low given the long time it took for the DVS to respond to PPR outbreak in Turkana. In fact herders in Lokiriama, Loima Division accused the CAHWs of not informing the DVS of the outbreak when it occurred in the area. A confounding factor is that CAHWs no longer kept up to date records on diseases they treated. Paradoxically, the DVS and CAHWs worked closely in vaccination campaigns as the DVS was understaffed, therefore preferred to work with CAHWs to gain access to the community. The CAHWs also represented a source of low cost labour. The CAHWs, on the other hand, were motivated by the allowances they got by participating in such campaigns. This type of collaboration was not structured in ways that could enhance the services and sustainability of CAHWs as well as the establishment of a strong surveillance system.

For surveillance systems to be sustainable, livestock owners and CAHWs involved must derive benefits from the outputs of the system. The professionals in the DVS would benefit from access to timely surveillance intelligence. The DVS should encourage the participation of CAHWs in the system by supporting and providing regular refresher training workshops for CAHWs, the curriculum of which should always include surveillance, in addition to diagnostic and curative skills. Through such a relationship, the DVS would obtain reports directly or indirectly from the CAHWs on local problems, and the CAHW would be guided and provided with a referral system for use when difficult cases were encountered. The community would need to be sensitized through farmer field schools on the importance of surveillance and the role the CAHWs play in disease reporting so as improve the overall sensitivity and specificity of the system. VSF Belgium should encourage community leaders to establish oral contracts with CAHWs to ensure that the CAHWs are supported (i.e. prompt payments following treatments and provision of information) in their work.

Previous intervention strategies by the DVS/VSF Belgium involving vaccination against CCPP (in 2005) and mass treatment of mange (in 2006) were perceived by herders to have had desired

impacts although the coverages were low. These interventions were implemented as emergency programs. The low coverage realized in the CCPP vaccination was said to have resulted from the campaign being carried out in dry season when many *adakars* had migrated out of their traditional areas, the exercise being carried out over a short period of time, some elders refusing to avail a significant proportion of their animals due to traditional beliefs that barred the exposure of good looking animals to strangers, and the campaign being carried out alongside distribution of famine relief food. A previous study that evaluated mass veterinary interventions showed that emergency programs aimed at reducing animal morbidity and mortality, even when executed properly, have limited impact and the risk of untoward effects on sustainable access to services may be greater than the direct health benefits (Mariner 2006). The same study estimated that relief interventions delivered through CAHWs had 10 times more impact than mass interventions because they were targeted to sick animals. It is thus recommended that interventions should be designed towards strengthening sustainable privatized community-based delivery systems that promote cost-recovery on the interventions provided, rather than the centralized DVS-led programs that are often administered as mass emergency interventions.

This study also identified direct and indirect ways in which conflicts influenced the spread of livestock diseases. The participants were often not open to discussing issues related to cattle rustling. Key informants including the DVO and community animal health workers indicated that diseases such as PPR, CCPP, CBPP and LSD had, at one time or another, been acquired through cattle rustling. The latest outbreak of PPR in small ruminants was associated with a raid that was carried out by Turkana pastoralists in Sudan. Conflicts were also known to reduce access to veterinary services as herders occasionally avoid presenting large herds of animals for vaccination. CAHWs interviewed said they avoid working in areas that are prone to conflicts. Some CAHWs reported losing some of the goats they received in exchange for drugs through rustling. Key informants revealed that conflict resolution efforts usually involved community elders yet the youth were often involved in raids. VSF Belgium should partner with other institutions and projects that focus on conflict resolution, particularly those that seek to involve the youth and women in conflict resolution processes. Reconciliation meetings should also be held within the areas of conflicts instead of transporting participants to other sites, as some key informants indicated that meetings held outside the conflict zones tended to involve non-warring parties.

Pastoralism in Turkana contributed to disease transmission and persistence in three primary ways, promotion of contact leading to transmission, pathogen dissemination, and reduced access to veterinary services. Guidelines for CAHW selection, including investiture in a pastoral livelihood, needed to be adhered to so as to ensure that the system provides CAHWs willing to move with their *adakars*. Privatized community animal health systems, such as those supported by VSF Belgium's TLDP, had positive impacts on the livelihoods in remote pastoral systems such as Turkana, as they ensure the widespread delivery of sustainable animal health services.

1 Background

Between 2000 and 2005, VSF Belgium implemented the first phase of Turkana Livestock Development Program (TLDP I) whose goal was to reduce the vulnerabilities of the Turkana community who depend on livestock as their main source of livelihood support. The program focused on: (i) improving the delivery of animal health services through community-based approaches linked to the Department of Veterinary Services (DVS) and the private sector, (ii) developing water resources in the dry season grazing areas for pastoralists using subsurface dams and environmentally friendly technologies, (iii) promoting markets for livestock and livestock products, (iv) encouraging peace building and conflict mitigation among the Turkana and neighbouring pastoralists communities through peace initiatives in partnership with other organizations. The second phase (TLDP II) of the program began in October 2005 and it will run until 2010. The current program will also be implemented in some parts of Turkana South that had not been covered under TLDP I.

Before instituting specific animal health interventions in the target area, VSF Belgium planned and allocated resources for a baseline study to collect information on the epidemiology and impact on livelihoods of important livestock diseases. Based on previous studies, experience and recommendations from the program partners, VSF Belgium made suggestions on areas that the study needed to focus on. These are:

- The epidemiology of mange and CCPP in goats and camels in central and southern parts of Turkana, its impacts on the livelihoods of the people and recommendations on best control methods,
- Relationship of the nomadic livestock production system and the occurrence of transboundary diseases in goats and cattle in border areas of Turkana,
- The social-economic impacts of livestock related conflicts on the spread of transboundary diseases and delivery of animal health services in Turkana and cross border areas of the Karamoja Region.

Specific tasks

Specifically, the study was to:

1. Conduct assessment in the central and southern parts of Turkana and document the importance and extent of mange in goats and camels, and assess the efficacy and impact of current control measures within the context of the community-based animal health care delivery system. Give recommendations on how to improve the efficacy and impact of interventions against mange both in terms of technical treatment methods and delivery mechanisms.
2. Conduct assessment in the central and southern parts of Turkana and document the importance and extent of contagious caprine pleuropneumonia (CCPP) in goats, and assess the efficacy and impact of current control measures within the context of the community-based animal health care delivery system. Give recommendations on how to improve the efficacy and impact of interventions against CCPP both in terms of technical treatment or prevention methods and delivery mechanisms.

3. Analyse how the nomadic way of life has contributed to emergence and spread of common diseases in goats and cattle in Turkana.
4. Assess the relationship between conflict and the incidence of transboundary diseases in Karamojong communities.

2 Review of literature

2.1 The study area

The study was carried out in Turkana South District, the area of operation of VSF Belgium, which together with Turkana North constitutes the former Turkana District. Turkana South District occupies the northwestern part of Kenya and borders Turkana North to the north, Marsabit to the east, Samburu to the southeast, Baringo and West Pokot to the south and Uganda to the west. Both Turkana North and Turkana South Districts cover an area of 77 thousand km^2 with human population estimated at 450,860 people (CBS 2001). The districts fall in arid and semi-arid area receiving annual rainfall of about 120 mm. The temperatures range between 24 and 38°C (CBS 1999).

2.2 Livestock diseases

Livestock diseases and drought largely remain the major constraints limiting livestock production in these districts (DVO Turkana Annual Report 2000). High animal mortalities and impaired productivity contribute to people's poverty and increase their vulnerability. Mochabo et al. (2005) and Eregae (2003) described the main diseases that affect livestock in Turkana South District. The diseases identified as being important include: trypanosomosis, mange, tick infestation, haemorrhagic septicaemia and non-specific diarrhoea in camels; anthrax, contagious bovine pleuropneumonia and rabies in cattle; anthrax, contagious caprine pleuropneumonia, pox in sheep and goats and anthrax, black quarter, trypanosomosis and impaction in donkeys. A recent cross sectional survey carried out by Wafula (2006) in Turkana North showed that mange and contagious caprine pleuropneumonia (CCPP) are important diseases in goats. Their average prevalences were 37 and 7.6%, respectively. The constraints that hinder effective animal health service delivery include: poor infrastructure, vastness of the area, harsh climatic conditions and nomadic pastoralism (Hubl et al. 1998).

2.2.1 CCPP

CCPP is an infectious disease which affects only goats. The environment plays an important role in its epidemiology as the disease spreads when animals congregate at grazing and watering points. Infective *Mycoplasma capricolum* subsp *capripneumoniae*, the causative agent, may persist in chronic, latent carriers, such as goats which have recovered from infection without becoming bacteriologically sterile. Latent carriers are considered to be responsible for the perpetuation of the disease in a herd (Thiaucourt and Bšlske 1996; Wesonga et al. 1998). The prevalence of CCPP is particularly high in areas bordering Uganda and Sudan (Wafula 2006). Breed and sex do not appear to be important factors but age is; mortality is also higher among the young (http://www.fao.org/AG/AGAINFO/subjects/en/health/diseases-cards/ccpp.html#control). A vaccine that can give protection for approximately a year following a single application has been developed (Rurangirwa et al. 1984).

2.2.2 Mange

Sarcoptes scabiei var *scabiei* is commonly isolated from skin scrapings from goats that have mange in Turkana (Wafula 2006). The parasite can affect a wide range of mammalian species, and humans

are usually infested in crowded poor living conditions (Walker 1994). Other parasitic mites that cause debilitating dermatitis include *Psoroptes* spp, or non-burrowing mites; *Chorioptes* spp infesting the lower extremities, i.e. the legs, tail or scrotum; *Otodectes* spp which cause parasitic otitis; *Demodex* spp infesting the hail follicles, sebaceous and meibomian glands in a number of mammalian species. In small ruminants, mange causes economic loss mainly through mortality, reduced productivity, and skin rejection and down grading (Mekonnen et al. 1999). The disease responds well to two doses of ivermectin given at seven day intervals (Manurung et al. 1990). A single treatment can be effective against psoroptic mange, but less so against chorioptic mange (Soll et al. 1987). In goats, treating the skin and superficial ear lesions with malathion or gamma-BHC has been shown to be successful although sarcoptic mange mites survive in the proximal parts of the ear canal to cause re-infestation after treatment (Munro and Munro 1980).

2.3 Nomadic pastoralism and occurrence of livestock diseases

Nomadic and transhumant pastoralism are the most dominant and efficient low-cost methods of animal husbandry in arid and semi arid areas of Africa. Because of the harsh climatic conditions, limited availability of water and pasture, and the reliance on livestock as the sole source of livelihoods support, nomads have developed special cultural and social patterns where natural resources are collectively owned by clans or tribes. In these areas, movements become important adaptive measures used to meet the demands of seasonally available water and pasture (Scoones 1994).

Disease causing pathogens benefit greatly from dynamic states created by animal movements (Kock et al. 2002) because infected and susceptible animals come into contact as they share common resources, e.g. watering points, salt licks or grazing fields. Bedelian et al. (2007) reported that risks of ECF and FMD as well as predation increase with cattle movement among the Maasai pastoralists in Isinya, Kajiado District. A study conducted by Wafula (2006) involving Turkana pastoralists showed that 53% of those interviewed attributed the spread of diseases to seasonal movements while 23.5% cited social gifts. Movements also cause separation of families because household members travel with cattle. Families are therefore forced to incur extra costs of running dispersed households (Bedelian et al. 2007). Livestock markets, on the other hand, aid in the dissemination of diseases such as foot and mouth, bovine tuberculosis and trypanosomosis because they act as contact nodes between infected and susceptible herds (Fèvre et al. 2006).

Conversely, some diseases, such as helminthiasis and malnutrition, become more problematic when transhumance becomes less frequent. And decreased movements are cited in the literature as causing increased social instability and livelihoods vulnerability by interfering with social norms such as trade, gifting, drought adaptation etc.

2.4 Conflicts

Conflicts are prevalent in many dryland areas of East Africa where pastoralism is practised (Eriksen and Lind 2005). Livestock theft is central to insecurity problems in such areas. In Kenya, approximately two million people have been affected (Ruto et al. 2003), and it is feared that the

number of armed conflicts has been increasing over the last few years due to an increase in the accessibility of firearms and ammunition from southern Sudan, Somalia and northern Uganda. Between 1999 and 2002, cattle raids deprived the national economy of Kenya Shilling (KES)[3] 15 billion (ITDG 2004).

It has been argued that conflicts form part of structural processes to gain control over resources and strengthen livelihoods (Eriksen and Lind 2005). It is also deemed to be an adaptive strategy to restock after droughts (http://www.oxfam.org.uk). In Turkana, major raids occur along the frontiers of the districts' involving tribes within Kenya and those from Uganda and Sudan. There are also organized Turkana bandits, usually referred to as *ngoroko*. The nature of violence involving *ngoroko* affect women and children more than the inter-tribal raids because *ngoroko* engage in systematic rape of young girls and women, demand grain and take away young girls as wives (Eriksen and Lind 2005). Generally, violence centred on livestock theft has led to depletion of livelihood assets for individuals, households and communities. The Turkana have adapted to this by diversifying their livelihood strategies as one way of reducing vulnerability to endemic conflicts and drought. Examples of the emerging livelihood activities include fishing in Kalokol, basket making by women, gold mining and selling scrap metals (Eriksen and Lind 2005). Supportive structures, for example, provision of credit facilities, establishment of markets and creation of cooperative societies, among others, should be instituted to promote the expansion of the emerging livelihood activities.

3. Kenya Shilling (KES). In December 2008, USD 1 = KES 79.05.

3 Methodology

3.1 Workplan

A study inception meeting between the researchers and VSF Belgium's representatives, including the Regional Director and Manager, was held to review the objectives and scope of the study. Thereafter, data collection instruments were developed and a reconnaissance trip made to the study area to collect background information and develop a survey program. Project documents were also obtained from VSF Belgium's regional office in Nairobi. Based on the baseline information collected during the reconnaissance trip, the target area was demarcated into two geographical zones. These were: (a) Turkana Central where VSF Belgium has been implementing most of its development programs through the TLDP I, and (2), Turkana South, an area where VSF Belgium was planning to incorporate in the new program (TLDP II). The study was commenced in Turkana Central and the mobilization of the community was primarily carried out by VSF Belgium through the chiefs and *adakar* elders.

3.2 Selection of *adakars*

In this study, an *adakar* was regarded as a sampling unit. A list of *adakars* together with information on the distribution of CAHWs was obtained from the technical personnel based at the VSF Belgium's local office and used in building a sampling frame (Appendix III). The number of *adakars* that could be recruited was constrained by the amount of time that was available for field work and the distances that needed to be covered in the survey. Accordingly, 32 *adakars* distributed equally between central and southern Turkana was taken to be a convenient sample size. The *adakars* were stratified by division and a stratified random sampling technique used to identify the ones that were recruited for the study. The information on the distribution of CAHWs, where available, also used to further stratify the *adakars* before selection. This was purposefully done to allow for the assessment of the impact of CAHWs on the prevalence of livestock diseases. However, the information on the distribution of CAHWs was only available in Turkana Central. All the sites used in the study were geo-referenced.

3.3 Data collection

The study employed participatory epidemiological techniques described by Mariner and Paskin (2000) to identify and rank livestock species by numbers and importance to livelihoods, identify livestock diseases and rank them according to prevalence and impact and evaluate interventions that have often been used to control the diseases. Examples of applications of these methods have been described by Catley and Mariner (2002), Cleaveland et al. (2001), Catley (2003) and Cartley and Admassu (2003). All the scoring exercises utilized 100 beans. These techniques were guided by predetermined checklist shown in Appendix IV. The checklist was pre-tested and adjusted accordingly using four *adakars* that were not in the study. When there was adequate time to conduct multiple interviews per session, the respondents were always separated by gender into two groups. Each group of respondents had at least 10 people and interviews were conducted through an interpreter. Key informants i.e. CAHWs, chiefs and *adakar* elders were always interviewed independently before or after the main sessions.

3.3.1 Identification and ranking of livestock species by numbers and importance to livelihoods

The first activity always involved the identification of livestock species that were kept within an *adakar*. This was followed by two successive exercises using proportional piling technique of: (a) ranking the livestock species by numbers, and (2) ranking them by their importance to family's survival. The exercises were preceded by circles representing livestock species being drawn on the ground and respondents being guided to link each circle to an animal species. It was always verified, before proceeding to the subsequent stages, whether the participants could delineate the circles. They were then given the beans and asked to distribute them to the livestock species based on numbers, then importance to family's survival. The higher the numbers/importance attached to a species the more beans it got. After each exercise, the participants were notified of the outcome and asked if the results were accurate. They were further asked to give reasons that could support the scores obtained and whether that had varied over the last 5 to 10 years.

3.3.2 Disease incidence

The participants were asked to give a list of diseases that affected specific livestock species in the last year. When responses provided were not specific, probing was used in a bid to characterize the syndrome while avoiding leading the respondents towards a specific diagnosis. The five most important diseases were then identified through pairwise ranking and their relative incidences determined through disease incidence scoring. The first step in this exercise was to ask the respondents to divide 100 beans into two groups representing 'sick animals in the last year' and 'healthy animals in the last year'. As soon as the respondents accepted the scores given, they were asked to give reasons that explained the patterns described by the scores. Thereafter, the respondents were asked to subdivide the pile of the sick animals to show the relative numbers of animals that suffered from each of the five diseases identified above. An extra circle representing other diseases was always provided. Finally, the respondents were asked to further divide the piles for each disease into the numbers of animals that were still alive and those that had died for estimation of case fatality rates. No distinction was made between the animals that had been treated versus not treated while determining the numbers of animals that died from each disease.

Disease incidence scoring was always followed by discussions on ways in which the most prevalent diseases were being managed by the stock owners. In this regard, sources of veterinary services and drugs were elucidated and ranked according to frequency of use. Herders that had treated their own animals in the past year were identified and asked to describe the diseases they treated, the drugs used and the amounts administered, estimations of dosages, and responses to the treatment. Herders were also asked to indicate whether they could tell the difference between the different concentrations of commonly used drugs, particularly oxytetracyclines.

3.3.3 Capturing the effect of season on disease occurrence

Seasonal calendars and participatory mapping were often used in combination to capture seasonal migratory patterns and occurrence of diseases. There were times when seasonal calendar could be used singly, particularly when the respondents could follow the western calendar.

3.3.4 Disease impacts

Disease Impact Matrix Scoring (DIM) was used to rank the diseases of goats according to their perceived importance. Goats were used for this exercise because they were always ranked as being important for the livelihoods of the Turkana. At least one matrix was constructed in each division, although two were completed in Turkwell Division as the division could be subdivided into southern and northern Turkwell based on the ecological conditions. *Adakars* classified into southern Turkwell include Naipa, Kalemnyang, Turkwell and Lokamichura and those classified into northern Turkwell include Lomil and Napeililim.

The participants were first asked to enumerate and rank the benefits of keeping goats according to their importance to family's survival. The ranking used 100 beans with the most important one getting more beans. A matrix was then drawn on the ground by putting the diseases identified above as being important on the x-axis and the benefits on the y-axis. Participants were then asked to rank the diseases according to their effects on each of the benefits using the beans that had been given to the benefit being considered. There was usually much discussion amongst the participants while doing the exercise, and after the completion of each row the participants were asked to confirm whether the scores given were accurate. When scoring was finished, all the benefit scores for each of the disease considered were summed and the participants asked to give reasons that could explain the patterns observed. The DIMs used across *adakars* were not standardized. This approach was used to capture variation in disease impacts and benefits derived from goats across *adakars*.

3.3.5 Evaluation of previous interventions against CCPP and other diseases

The impact of some of the previous emergency interventions conducted by the DVS in collaboration with VSF Belgium against some of the important diseases, particularly a vaccination program against CCPP, was evaluated. This was aimed at seeking information on how such interventions could be effectively administered. This exercise was carried out only if the participants got the service and were able to differentiate the various campaigns that have been carried out in the past two years. First, herders were asked to enumerate the interventions that had been carried out against CCPP and mange over the past two years. For each of the mentioned interventions, the participants were asked to describe the treatments that were given and the institution that provided the service. Participants were then asked to focus on the mentioned CCPP vaccination and use 100 beans to show the proportion of goats that was vaccinated versus not vaccinated in that campaign. Subsequently, the respondents were asked to divide the beans within each group (vaccinated and not vaccinated) into those that got sick or remained healthy within a period of about 6 months after the vaccination. Finally, the respondents were asked to divide the beans in the sick categories into two: the proportion of goats that were perceived to have been affected by CCPP and those that had other diseases. At each level, herders were asked to give reasons for scores given.

3.3.6 Conflicts and occurrence of disease

In areas where armed conflicts were prevalent, an attempt was made to assess the impacts of conflicts on livestock husbandry and occurrence and persistence of livestock diseases. To determine

the frequency of occurrence, a calendar of the previous year was drawn on the ground and participants asked to mark the months when conflicts occurred. Thereafter, the participants were asked to state the diseases that were observed just after the conflicts and the reasons that could explain their occurrence. District Veterinary Officer, chiefs and administration officers were also interviewed independently in a bid to obtain more understanding on issues related to conflicts.

3.3.7 Data management and analysis

The semi-quantitative data generated from the study were entered into MS Excel database and exported to STATA version 8.2 for analysis. Non parametric statistical tests were used to determine whether there were significant differences between the levels of the variables assessed because the sample size used was small and the statistical distributions of the variables were not known. Specifically, median test was used to test the equality of medians. The Pearson chi square statistics generated from this analysis were not adjusted based on the Yate's continuity correction functions as these are more suited for one-sided tests that compare the observed contingency and the next strongest contingency in the same direction (Haber 1982). Our analyses were based on two-sided comparisons.

4 Results

All the 32 *adakars* recruited for the study were visited. These *adakars* are equally distributed across the study zones (Turkana Central and Turkana South).

4.1 Livestock species and benefits received from them

4.1.1 Types of livestock species kept

Goats, sheep, cattle, camels, chicken and dogs were the common livestock species kept by the Turkana pastoralists, although their distribution varied across *adakars*. Goats, sheep and donkeys were typically raised by all the *adakars* but the distribution of the other species, particularly cattle, was irregular. Cattle were always found in *adakars* that inhabited wet areas like irrigation schemes and permanent river courses. The *adakars* that did not have cattle at the time of the survey indicated that the animals had been driven to areas where pasture and water were available. Specifically, such areas were found along rivers: Turkwell, Kerio and Lake Turkana. Figure 1 gives the results of ranking of livestock species by population and importance to family's survival. These results do not vary by area (Table 1). Goats and sheep were the most abundant species whereas chickens and dogs were the least. The reasons given by the participants for the relatively high population of goats compared to the other livestock species included the fact that goats always gave birth twice in a year, matured faster compared to camels and cattle, could be cheaply acquired or given by friends, were drought resistant, could get browse or feed locally including feeding on acacia pods, could not be driven fast compared to cattle by rustlers, and that an ideal environment for keeping goats existed in the District. This includes hills, river valleys, abundant acacia shrubs and salty soils. The majority of the respondents regarded poultry keeping as not being important and that there were many predators that reduced their population. The predators mentioned included dogs and carnivorous birds. Poultry were also thought to compete with humans for food at the household level.

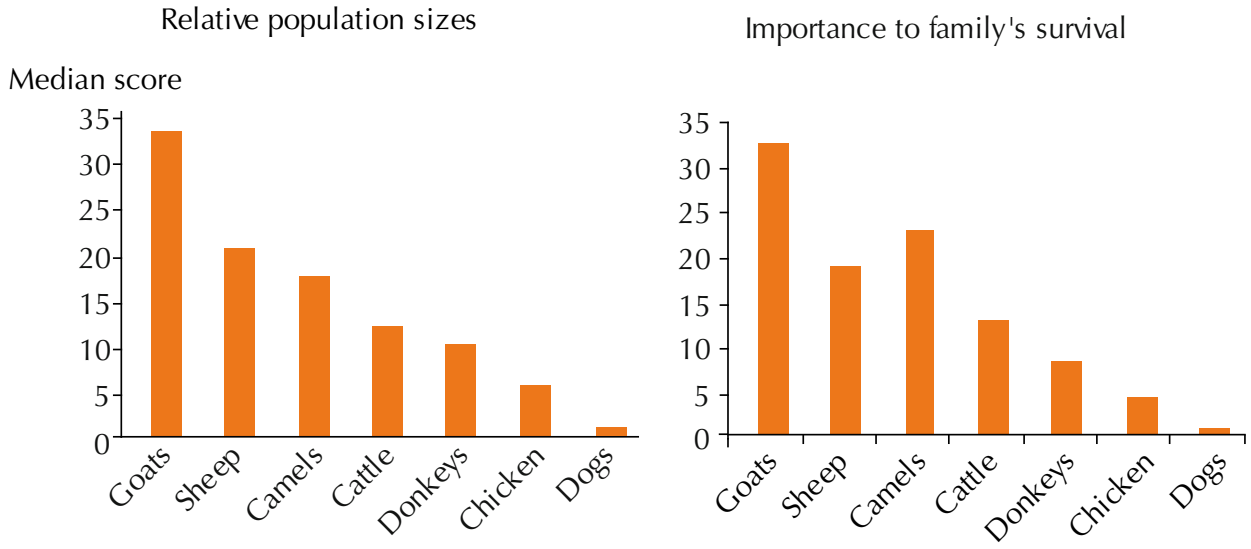

Figure 1. *Ranking of livestock species by numbers and importance to family's survival by 32 randomly selected* adakars *in Turkana South District (March–April 2007).*

Table 1. *Median scores indicating the relative population sizes and importance to family's' survival of the livestock species kept by Turkana pastoralists in Turkana Central and Turkana South (May–April 2007)*

Livestock species	Turkana Central[a]		Turkana South[b]	
	Population	Family's survival	Population	Family's survival
Goats	34.5	31	31	33
Sheep	20.5	17	20.5	20
Camels	19.5	23	14.5	20
Cattle	12	8	13	14
Donkeys	10	8	9	7
Chicken	0	0	7	5
Dogs	0	0	2	2

a. Turkana Central comprises Kerio, Turkwell and Loima Divisions.
b. Turkana South comprises Kainuk, Katilu, Lokichar, Lokori Divisions.

4.1.2 Uses of the different livestock species

Goats and camels were ranked as the most important livestock species with regard to family's survival (Figure 1). Compared to camels, sheep were more abundant because of their shorter generation interval and could be acquired at a lower cost, just like goats. Camels, however, were perceived to be more important than sheep because they could be milked or bled throughout the year and when slaughtered, its meat could be shared amongst many families. Goats, sheep and camels could all be used for dowry, but goats were more frequently used in this regard than the other animals.

The relative importance of the benefits that could be derived from goats, by division, is given in Table 2. The number and types of benefits varied by division but food, money and skin (for clothing) were common across the areas. The most important benefits, however, were food, dowry and money, with the later being ranked third most of the time. The participants pointed out that goats and sheep were often being slaughtered for home consumption, but cattle and camels were rarely slaughtered or sold. Goats also provide milk, but usually more in the wet than dry season.

Table 2. *The relative importance of benefits that could be obtained from goats as indicated by Turkana pastoralists in Turkana South District (May–April 2007)*

Benefit	Division						
	Kerio	Loima	Turkwell	Kainuk	Katilu	Lokichar	Lokori
Food	28	23	36	39	41	30	38
Dowry	19	36	–	7	33	19	16
Environment use[a]	17	–	–	–	–	–	–
Money	14	16	14	25	6	19	16
Medicine	12	13	14	–	10	10	12
Skin for clothing	10	12	12	13	5	12	7
Exchange for other species	–	–	–	10	–	–	–
Manure	–	–	6	6	–	–	–
Cultural use	–	–	18	–	–	10	11

– Benefit not mentioned.
a. This is a direct translation from Turkana implying that goats helped in cleaning the compound by feeding on waste material, spilled grains, leaves and pods shed by trees that provided shades etc.

Goats could, in addition, be used to treat some of the diseases in humans, for example commonly high blood pressure and headache. To treat high blood pressure, a goat is walked in circles four times around a sick person and shortly afterwards, its heart is removed and used to pat the patient's thoracic wall as close to the location of the heart as possible. This is accompanied by traditional rituals, chanting and singing. For headache, a goat is slaughtered and omentum removed and used to cover the patient's head after being shaven. It was pointed out that healing effect follows a sensation that occurs underneath the omentum akin to movement of maggots. At this point, the omentum is removed. The participants also mentioned other cultural festivities where goats and sheep are slaughtered. For example, when a child is born, a kid or a lamb is slaughtered before a woman is allowed to step out of a *manyatta*[4] and when a person dies, a sheep is slaughtered and blood 'spilled' to 'chase away bad spirits'. In irrigation schemes, barren lands are treated by a goat being walked around it, then slaughtered and its skin used to wave away 'bad spirits'. Sacrifices to appease gods in severe droughts usually require slaughter of camels and goats.

4.2 Livestock diseases and interventions

4.2.1 Seasonal occurrence of diseases

The diseases enumerated by the participants as having affected goats in the last year slightly varied by division. The diseases that were commonly mentioned are *peste des petits ruminants* (PPR), contagious caprine pleuro-pneumonia (CCPP), mange, goat pox, worms, heartwater, foot rot and anaplasmosis.

PPR is a severe, fast spreading viral disease that had not been prioritized for this study but was identified as being economically important as it has high morbidity and mortality rates. It mainly affects small ruminants and it is characterized by sudden onset of depression, fever, discharges from eyes, nose, sores in the mouth, laboured breathing, coughing, foul-smelling diarrhoea and death. The disease was first reported in Oropoi Division, Turkana North District. Since the first incidence was reported, the disease has spread southwards towards Turkana South District. PPR outbreaks can be controlled through quarantine, combined with ring vaccination and immunization of high-risk populations. The available vaccine can be protective for a period of three years.

The use of participatory mapping to describe seasonal patterns in disease occurrence revealed that in dry season, *adakars* move out of their traditional grazing grounds to areas where pasture and water could be found. The participants indicated that many *adakars* congregate in such areas because of the limited number of dry season watering points. The participants said that livestock have a greater chance of coming in contact with game as they also seek available grazing and watering points during the dry season. CCPP, mange and tick borne infections were said to be prevalent in the dry season because of the congregation of animals. Tick infestation and tick borne diseases are associated with livestock coming in contact with game as most ticks that infest livestock in the dry season are considered to have dropped off from game. Such ticks were said to have a higher vectorial capacity than those encountered in the wet season. Plant poisoning leading to haematuria is also often encountered in the dry season.

4. Household.

The prevalence of CCPP and mange in wet season grazing areas was reported to be similar to that of dry season grazing areas. This is because *adakars* retreat to their traditional grounds at the onset of rains with animals infected in dry season grazing areas. These diseases are therefore disseminated across the two areas through animal movements. Haemorrhagic septicaemia is, however, known to occur in wet season in sheep.

4.2.2 Ranking diseases of camels by prevalence

In camels, the diseases that were often mentioned include camel pox, diarrhoea, pneumonia (camel cough), mange, anthrax, ticks and biting flies. Proportional piling was always used to rank diseases of camels. This was done in at least one *adakar* per division except in Kainuk Division where most *adakars* did not have camels. The results of this exercise are shown in Table 3.

Table 3. *Three diseases of camels ranked in order of prevalence in the last year in each division (vertically in columns) by the participants involved in the study (median scores are given in brackets)*

Rank	Turkana Central			Turkana South		
	Kerio	Loima	Turkwell	Katilu	Lokichar	Lokori
1	Pox (16)	Mange (32)	Mange (28)	Mange (32)	Diarrhoea (49)	Pox (38)
2	H.S. (14)	Anthrax (30)	Ticks (22)	Diarrhoea (30)	Mange (26)	Diarrhoea (38)
3	Trypanosomosis (12)	Pneumonia (20)	Pox (19)	Pox (16)	Pneumonia (11)	Pneumonia (15)

H.S. – Haemorrhagic septicaemia.
Diarrhoea – The participants called this syndrome camel cholera.
Pneumonia – This was referred to as camel cough.

The results show that over the last year, mange was the most prevalent disease in camels in Loima, Turkwell and Katilu Divisions. Diarrhoea and pneumonia were also highlighted as having been prevalent in that year. The participants described the diseases using the clinical signs manifested. For example, pneumonia was associated with dehydration, lung abscesses and high case fatality rates. Some of these cases could be treated with oxytetracyclines. Diarrhoea was associated with high case fatality rate and massive clots on blood vessels on post-mortem. Such cases could recover when promptly treated with oxytetracyclines. These two syndromes were always considered to be more important compared to mange. Cases of sudden death in camels with no premonitory signs were also reported in the area.

4.2.3 Relative incidence of caprine diseases

Relative incidence scoring of caprine diseases was conducted in two *adakars* per division except in Katilu Division where this exercise involved three out of four *adakars*. Six of these *adakars* are in Turkana Central while the rest are in Turkana South. The overall median proportion of goats that got sick in the last year was 69%. Turkana Central had a slightly higher median incidence (69.5%) than Turkana South (64%). These relative incidences were barely significantly different ($P = 0.06$). Participants attributed the high morbidity rates to outbreak of infectious diseases, specifically PPR and CCPP, which affected many animals in almost all areas, unavailability of the veterinary drugs and services, even in some of the *adakars* that had CAHWs, and drought.

Table 4 gives the median relative incidences of the diseases that were perceived to have affected goats over a period of one year. These incidences were also stratified by the presence/absence of a CAHW in an *adakar*. Generally, PPR, CCPP and mange were perceived to have been more prevalent than the other diseases. The presence of a CAHW did not affect perceptions of the levels of the diseases and when the participants were asked to state why the CAHWs were not effective, they pointed out that the CAHWs either lacked drugs or were overwhelmed with work and, therefore, could not manage all the cases presented to them. Of the 15 *adakars* involved in the relative incidence scoring, eight of them had CAHWs. These were Naipa, Kalemnyang, Puch, Lochorealomala, Lorengelup, Morulem, Kalemngorok and Lorokon. The participants also attributed high morbidity in goats to drought experienced over the past year, pointing out the fact that drought reduced the availability of pasture and resistance to diseases.

Table 4. *Median relative incidence scores of the diseases that affected goats over a period of one year preceding the study, first in all the sampled* adakars *and then by* adakars *with/without CAHWs (sample sizes are given in the parentheses)*

Disease	All *adakars*	*Adakars* with or without CAHWs		
		With CAHWs	Without CAHWs	$P > \|\chi^2\|$
PPR	18 (11)	21 (7)	13.5 (4)	0.06
CCPP	13 (15)	13 (9)	12.5 (6)	0.67
Mange	13 (13)	12 (7)	19.5 (6)	0.17
Heartwater	8 (11)	9.5 (6)	8 (5)	0.74
Ticks/lice	9 (3)	11 (1)	9 (2)	–
Worms	9 (5)	9 (3)	10.5 (2)	0.71
Anaplasmosis	7 (5)	8 (3)	6 (2)	0.13
Pox	6 (5)	4.5 (4)	7 (1)	–

– Median test not ran because of inadequate cell frequencies.

Table 5 gives diseases of goats ranked in descending order based on their median incidence, by division. CCPP was common across the divisions followed by mange. PPR had a higher relative incidence in central than Turkana South.

Table 5. *Three highly ranked caprine diseases by division and their estimated median incidence (in brackets) (the scores enclosed in brackets should be compared within Division, i.e. within columns)*

Rank	Turkana Central			Turkana South			
	Loima	Turkwell	Kerio	Kainuk	Katilu	Lokichar	Lokori
1	PPR (23)	PPR (23.5)	CCPP (41)	Mange (20)	Mange (20)	CCPP (18.5)	CCPP (17)
2	Mange (10.5)	CCPP (16.5)	Pox (15.5)	CCPP (14)	PPR (18)	Mange (16)	Ticks/lice (8.5)
3	CCPP (10)	Mange (13.5)	Heart water (11.5)	Heart water (14)	CCPP (8)	Heart water (13.5)	PPR (7.5)

4.2.4 Perceived impact of the diseases of goats

The benefits of keeping goats (Table 2) were used to evaluate perceived impact of a range of diseases identified as being important through either pair wise ranking or proportional piling. A maximum of six diseases and benefits were used at any one time. The results indicate that mange was perceived to have been the most important disease, even in areas where its incidence was low. This was a consistent finding in six out of eight areas where DIM was used regardless of the fact that the matrix was not standardized (Table 6). Most participants indicated that a goat

that had mange was difficult to treat (treatments are discussed below). They further said that affected goats lost value and could not be utilized for virtually most of the benefits considered. The participants were aware that the disease is zoonotic. Some in fact showed skin lesions which they thought were caused by mites transmitted from goats. Related information was collected from a team from the DVS that was vaccinating goats against PPR at Lorengippi, Loima Division. The team indicated that it had encountered many cases of scabies in children although they could not relate these cases to mange in goats (as the causative species had not been characterized by veterinary or health services in goats and humans). When asked to state where mange came from, most participants incriminated elephants because the skin of an affected goat got thickened like that of an elephant. The disease had therefore been given the name *lotome,* which is the local name of an elephant. Some of the participants believed that the prevalence of the disease had increased because the population of elephants was thought to have declined.

Table 6. *Three most important diseases of goats ranked in the descending order by division according to their perceived impact by Turkana pastoralists in Turkana South District (median scores are enclosed in brackets and are compared vertically)*

Rank	Loima	Turkwell		Kerio	Kainuk	Katilu	Lokichar	Lokori
		North	South					
1	Mange (38)	CCPP (25)	Mange (26)	CCPP (33)	Mange (30)	Mange (33)	Mange (51)	Mange (37)
2	PPR (26)	Mange (23)	PPR (17)	Mange (30)	Worms (24)	PPR (23)	CCPP (28)	Worms (29)
3	Pox (17)	PPR (23)	Worms (16)	Heart water (26)	Heart water (21)	CCPP (15)	Anaplasmosis (8)	Pox (9)

The importance of PPR was attributed to lack of treatment of the animals affected, and the high case fatality rate associated with the disease. The participants pointed out that they did not know how to manage the disease since it could not respond to tetracycline administered intramuscularly (typically used for treatment of CCPP). Unlike the case with mange, the skin salvaged from animals that died from PPR could be used for making dresses. The participants also said that PPR affected vital organs of an animal, i.e. mouth, eyes and nose, therefore limiting it from feeding/browsing.

In many areas, the participants said CCPP was no longer being regarded as a killer disease, unlike the previous two years, because most of them had learned how to treat it. Worm infestation was perceived to be important in Turkwell, Kainuk and Lokori Divisions. These divisions, including Katilu, had large irrigation schemes and animals were fed on crop residues.

4.2.5 Case fatality rates of diseases of goats

Case fatality rates for PPR, CCPP and mange were estimated using the data collected in eight *adakars* in Turkana South. The median case fatality rates were 73.2%, 66.7% and 62.5% for mange, PPR and CCPP, respectively. There was no significant variation in the case fatality rates when stratified by the availability of CAHW within an *adakar*. These results are shown in Table 7.

Table 7. *Estimated case fatality rates of the three diseases perceived to be important in goats in Turkana South (sample sizes are enclosed in the parentheses)*

Disease	Average level	Presence or absence of CAHWs in an *adakar*		
		Present	Absent	$P > \|\chi^2\|$
Mange	73.2 (6)	76.0 (1)	72.7 (5)	–
PPR	66.7 (5)	61.0 (2)	66.7 (3)	0.71
CCPP	62.5 (9)	62.5 (3)	56.4 (6)	0.64

– Median test not ran because of inadequate cell frequencies.

4.2.6 Service delivery and control measures

4.2.6.1 Veterinary service providers

Most participants indicated that they treated their animals on their own due to the unavailability of animal health personnel. This was commonly stated in *adakars* that did not have CAHWs. Even in areas where CAHWs were present, their roles had been reduced to that of distributing drugs as the majority of the livestock owners purchased drugs from them and proceeded to treat animals on their own. Moreover, a few herders observed that CAHWs were having challenges with regard to the management of mange and PPR. Herders also obtained drugs from veterinary drug outlets or vendors who hawked drugs throughout the district. CAHWs were often preferred when drugs were to be purchased on credit. Veterinary drug outlets, however, remained an important source of drugs because CAHWs were patchily distributed throughout the area and did not stock the frequently used drugs to the levels that would satisfy the demand. When asked about the services of the DVS, the participants said they were skilled and treated and vaccinated a large number of animals at any one time, but they were not always available. There were only three veterinarians and seven animal health assistants who were working in the DVS in the entire Turkana District.

4.2.6.2 Treatments made by herders

Most participants identified Alamycin® (oxytetracycline, Norbrook) as a frequently used drug in the treatment of a range of conditions in goats and camels including CCPP, heartwater, anaplasmosis, camel cough, diarrhoea etc. This drug was sold in formulations of varying concentrations ranging from 5 to 30%, which the majority of the participants indicated that they were not able to differentiate. They stated that they relied on information given by the salespersons for the choice of the drug formulation although some of them stated that they shook the bottle containing the drug in order to tell the concentration. Drugs with low concentration of the active ingredient were expected to foam while those with optimal concentrations were expected to form few bubbles. For treatment of CCPP, most herders said they would prefer a high concentration of Alamycin®, i.e. 20%, in order to achieve the desired response. A few herders said that they would administer different formulations until an effective one was identified. The amount of the drug used typically ranged between 3–5 ml for an adult goat, 2–3 ml for a weaner and 1–1.5 ml for a kid. Response to this regimen was reported to be good although a few of the cases required repeat treatment. It was stated that repeat treatments would involve the use of a lower amount of the drug than the principal dose. Injection sites varied, ranging from the neck, thigh, rib cage and directly into the pleural cavity. The standard regimes that guide the administration of tetracycline formulations vary with the concentration of the drug and the weight of an animal to be treated. When treating an adult goat of about 30 kg with a long acting formulation, a single dose of 1 ml (for a 30% formulation) or 1.5 ml (for a 20% formulation) would need to be administered deep intramuscularly. The other formulations of 5% and 10% would require

continued administration for at least three consecutive days with single doses of 3 ml and 6 ml, respectively.

Treatment of mange in both goats and camels varied by area. In Turkana Central, most cases were treated with acaricides, especially Triatix® (amitraz, Coopers), Steladone® (organophosphate, Ultravetis) or Diazol® (diazinon, Murphy). The latter is a pesticide used to control crop pests. Most of these acaricides were purchased from drug outlets in Lodwar or Kakuma at an approximate cost of KES 100 per 100 ml. Salt, grease and oil could also be applied on the affected areas as an additional treatment. The participants noted that these traditional treatments were not always effective. They also said that even the local herbs that were used to treat the disease in the past were no longer effective, they suggested that the disease had become resistant to traditional medicine. A few of the participants from Turkana Central were aware of the availability of ivomectin, a drug of choice, which was being used by a majority of herders in Turkana South. The participants that had used the drug before highlighted the high cost of purchasing it (stated to be about KES 1500 per 50 ml although they were aware that the cost was progressively declining) and the fact that they had to travel long distances to get it. Most of the respondents interviewed in Turkana South had treated mange with ivomectin at least once. Empty containers of Noromectin® (ivomectin, Norbrook) or Kelamectin® (ivomectin, Kela) were shown on request (Plate 1). The amount of drug used on adults ranged between 2–4 ml and young animals got about 1 ml.
The recommended dosages for ivomectin-based products vary with the type of preparation. An injectable preparation should be administered subcutaneously at 1 ml per 50 kg body weight while an oral drench should be given at a rate of 2.5 ml per 10 kg body weight. Frequently, the drug was given in conjunction with an acaricide spray. Some respondents reported repeating treatment more than twice. Two routes of administration were commonly used: subcutaneously on the neck fold and intramuscularly, on the sites described earlier under CCPP treatment. Most participants acknowledged that ivomectin was effective in the treatment of mange so long as the disease was not chronic. Chronic cases were said to require repeat injections. The drug was, however, reported to cause abortion in pregnant goats. Isolated reports of mixing veterinary drugs before injection were also given. One herder narrated how he mixed Triatix® (amitraz, Coopers) with Alamycin® (oxytetracycline, Norbrook) and Noromectin® (ivomectin, Norbrook). The concoction was said to have worked.

Plate 1. *Containers of products used by Turkana pastoralists to treat mange produced in different sessions of focused group discussions.*

Most of the treatments administered to camels involved the use of trypanocides and oxytetracycline to treat trypanosomosis and bacterial infections, respectively.

4.2.6.3 Services provided by CAHWs

A total of 17 CAHWs were interviewed, nine of them in Turkana Central and the rest in Turkana South (Appendix V). All of those interviewed in Turkana Central were recruited and trained in 2000/2001 under the support of VSF Belgium in collaboration with the DVS, while those interviewed in Turkana South were recruited and trained under the support of a number of NGOs and the DVS. Three of them were recruited in 2004/2005 under Red Cross, another three were recruited in 2002 under SNV and the last two were recruited in 1995 under the support of NORAD. Most of them had taken more than two refresher courses. These courses had been sponsored by a variety of NGOs including VSF Belgium, World Vision and Arid Lands, in collaboration with the DVS. Most of the CAHWs interviewed in Turkana South were young (with an age range of 27–47 years) and literate as nearly all of them had at least primary school education. Those interviewed in Turkana Central were elderly (most of them being over 50 years, with a few not able to state their ages) and had not had any formal education.

The range of equipment and drugs owned by the CAHWs was more or less similar except that those from Turkana South had additional equipments provided by the NGOs that trained them. Additional equipments included knapsack sprayers (although most of them were faulty) and burdizzos. Common equipments included syringes (plastic and automatic ones) and needles. Drugs that were commonly stocked included Alamycin® (Oxytetracycline, Norbrook), Novidium® (Homidium chloride, Merial), eye wound powder, Triatix® (Amitraz, Coopers), Triquin® (Quinapyramine prosalt, Ceva), Tremazole® (Albendazole, Twiga), Diseptoprim® (Sulfadiazine-Trimethoprim combination, Cosmos) and Tryzan® (Diminazene diaceturate, Coopers), among others. On inspection, most of the drugs were in good condition and only a very small number had surpassed their expiry dates. Most of the CAHWs in Turkana Central had exhausted their stocks and were hoping that VSF Belgium would replenish their dormant satellite drug stores, as was the case in the past. VSF Belgium had, however, reduced the frequency of supplying the satellite drugs stores with veterinary drugs in a bid to encourage development of a private drug delivery system. None had been initiated by the time of the study, probably because of the poor road network in the area. In Turkana South, there were a number of private veterinary drug outlets located along the Lodwar – Kainuk road. Two of them were owned by CAHWs. In these outlets, veterinary drugs were being sold in conjunction with other items, e.g. clothes. Despite the presence of the drug outlets in the area, most of the CAHWs from the south bought drugs at Lodwar, Kapenguria or Kitale, because local shops sold drugs at a price that would not allow them to make profits.

All the CAHWs could aptly describe the clinical signs of the diseases that were presented to them in the interview, including differentiating diseases that had more or less similar signs. For instance, when informed that a goat with CCPP would have nasal discharges just as PPR, most CAHWs would highlight coughing in CCPP as a differentiating clinical sign. For the treatment of CCPP, the CAHWs used 20% oxytetracycline with an adult goat getting 3 ml, a weaner 2 ml and a kid 1 ml. CAHWs could also differentiate the formulations of oxytetracycline. They were therefore likely to treat the disease more appropriately than the herders. The dosages used did not vary across

areas, i.e. Turkana Central and Turkana South. Management of mange, however, varied by area. In Turkana Central most CAHWs said they treated mange with acaricides, mostly Triatix® (Amitraz, Coopers). Four CAHWs indicated that they could use ivomectin if it was supplied by VSF Belgium. In the south, all the CAHWs interviewed said they treated mange with Noromectin® (Ivomectin, Norbrook) at a dose of 1 ml per goat. They further said that the need for a repeat treatment would depend on the capability of the client to pay for the drug. When questioned whether they had the drug, some of them answered in affirmative whereas a few said they would ask the herder to buy the drug but would assist in its administration. In camels, CAHWs had at one time or another treated trypanosomosis with Triquin® (quinapyramine prosalt, Ceva). An adult camel was given 10 ml, weaner 7.8 ml and a calf 5 ml, all intramuscularly in the neck.

CAHWs got paid based on drugs they administered because clients were not paying for diagnostic service provided. A CAHW would be paid KES 20 and KES 6 for treatments of mange using Noromectin® (ivomectin, Norbrook) and CCPP using Alamycin® (oxytetracycline, Norbrook), respectively. CAHWs frequently sold whole drugs thus giving their clients an option of treating cases themselves. In some cases, CAHWs were requested to assist in drug administration. This was mainly influenced by the distance as clients who were far removed from CAHWs treated their animals on their own. Some CAHWs said that a proportion of clients offered goats in exchange for drugs since much of the purchases made in remote areas involved barter trade. A goat for instance would be exchanged for 500 ml 5% Alamycin® (oxytetracycline, Norbrook), three bottles of 100 ml 10% Alamycin® (oxytetracycline, Norbrook) or 100 ml 20% Alamycin® (oxytetracycline, Norbrook). CAHWs preferred being paid in cash than with goats because clients often used animals of lower value compared to that of the drugs purchased. Under such circumstances, a CAHW would replenish his stocks by selling a more mature goat in his flock as he waited for the one offered to mature.

When asked 'what advice would you give your client after treatment', many of the CAHWs in Turkana Central said they would inform their clients about withdrawal periods that should be observed before consuming meat or milk from treated animals. The withdrawal periods given varied with the respondent. For milk consumption, the range given was between 3–14 days while that of meat was 14–28 days. This advice, according to them, was more likely to be ignored by their clients. None of the CAHWs from Turkana South remembered to highlight any recommendations related to withdrawal periods following treatment. They mostly indicated that they would ask their client to observe treated animals just in case they required additional treatment.

Although the CAHWs interviewed acknowledged that they had been trained on how to make records on treatments made and diseases reported by clients, none of them kept records of their activities. They also stated that they were not receiving periodic counselling and supervision from the DVS or the NGOs that trained them. They said that the linkage they had with the DVS was limited to their involvement in vaccination campaigns. One such campaign was being undertaken at the time of the survey against PPR (Plate 2). The CAHWs in Turkana South said they had a working relationship with a private veterinarian based in Kapenguria. This collaboration allowed the CAHWs to obtain drugs from an agro-veterinary shop owned by the vet, with the CAHWs providing reports to the vet on treatments made. Such reports would be sent to the DVO, Turkana Central. When a CAHW encountered disease outbreaks or cases that were difficult to treat, he/she reported them to the *adakar* chief, who would in turn report to the DVO.

Plate 2. *Involvement of CAHWs by the Department of Veterinary Services in drenching and vaccination of goats and sheep against PPR in Turkana South District (March–April 2007).*

When asked to enumerate the constraints that they face in provision of veterinary services, CAHWs mentioned emergence of diseases, particularly PPR, that were not responding to treatment, distances involved in visiting clients, clients refusing to pay for services, competition from drug vendors and insecurity. A number of those interviewed in Turkana Central were aware of a scheme introduced by VSF Belgium where they were expected to contribute KES 2000 for buying bicycles. Most of them had not contributed saying that they had not acquired enough capital to give the required contributions. They also acknowledged the fact that they had been trained on how to deal with defaulters to avoid running into debts in the course of duty. Some blamed NGOs that gave free drugs to their clients as this was thought would cause dependency syndrome. With regard to drug vendors, some CAHWs indicated that they always declined to assist the clients who purchased substandard drugs. This, they hoped, would make them realize the difference between the drugs the CAHWs sold versus those purchased from the vendors.

4.2.6.4 Perceived coverage and impact of previous vaccination campaign against CCPP

Twelve out of the 32 *adakars* studied acknowledged receiving vaccination against CCPP in goats between July and October 2005. The number was equally distributed between the two areas. These *adakars* could differentiate this campaign from that carried out in July 2006—where mass drenching and treatment of mange was done—by describing the colour of the drugs/vaccines used and whether or not cold chain was used in each campaign. Mass treatment against mange was said to have been very effective. Many of the participants said they came to know of the treatment of mange (i.e. ivomec) from that campaign.

The estimated overall median proportion of goats vaccinated against CCPP (2005) was 32.5%. This proportion is significantly lower than the median proportion (67.5%) of goats that was not vaccinated ($P = 0.004$). The proportion does not vary with area since 32.5% was perceived to have been vaccinated in Turkana Central compared to 36% in Turkana South ($P = 0.34$). This analysis did not include *adakars* where vaccination was never done. When asked to give reasons why the campaign had a low coverage, the participants said:

a. The exercise was conducted in the dry season when some of the animals had been driven to the hills where pastures could be found. In addition, the majority of herders believed that vaccinating animals over the dry season would cause abortions,

b. The time allocated for the campaign was short and the vaccines that were brought were inadequate as a number of animals were left unvaccinated,

c. The elderly men who could have given permission for presentation of animals were not around at the time of the vaccination,

d. The vaccination was being carried out in conjunction with mass drenching that had to be paid for. The element of payment, it was said, could have discouraged some people from presenting their goats for vaccination,

e. In areas bordering West Pokot, e.g. Lorengippi, there was a threat of invasion by cattle rustlers prior to the campaign. A dead camel calf had in fact been dumped at the watering point a day before vaccination,

f. Relief food was being distributed at more or less the same time as the vaccination, therefore, many people had gone to get food,

g. The DVS did not mobilize the herders as there was no prior information about vaccination,

h. There was usually a herd of animals that was always hidden in the thickets so that people with evil spirits and intensions would not see it. Such animal are never brought to the *manyatta*.

The participants perceived the CCPP vaccination to have had a substantial impact. Of those vaccinated, the median proportion of goats that got sick (with any disease) within a period of six months after vaccination was estimated to be 32.1%. This is significantly ($P = 0.00$) lower than the median proportion (72.5%) of the goats that got sick in the unvaccinated group. The perceived impact of the campaign was, however, higher in Turkana South than in Turkana Central (Figure 2). This is related to the results presented above which showed that in the past year, Turkana Central had higher incidence of diseases of goats than Turkana South.

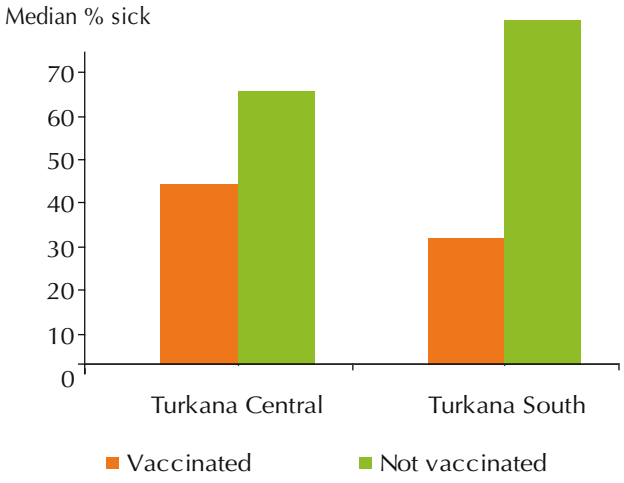

Figure 2. *Perceived impact of a vaccination campaign against CCPP carried out in July 2005 in Turkana Central and Turkana South on the incidence of diseases in goats.*

When asked to gauge the impact of the vaccination on the incidence of CCPP over a period of six months that followed the campaign, the participants estimated that 3.5% of goats got CCPP in the vaccinated group while 26.2% got the disease in the unvaccinated group. These proportions were significantly different ($P = 0.02$). The perceived impact of the campaign on CCPP incidence similarly varied by area with a significant impact being recorded in Turkana South than in Turkana Central. The median incidences of CCPP in the vaccinated groups were 14.2 and 0% in Turkana Central and Turkana South whereas in the respective the median incidences in the unvaccinated group were 21.2 and 40.8%.

4.3 Effect of nomadic pastoralism on disease persistence and transmission

Participatory mapping was used to identify seasonal migratory pathways and grazing patterns of the various *adakars*. In the dry season, animals were moved towards major rivers, Kerio and Turkwell, and Lake Turkana where water and pasture could be obtained. These wet lands were usually shared by most of the *adakars,* although immigrants were usually taxed by the inhabitants before being allowed to settle. Some of the *adakars* in Loima Division occasionally crossed over to the Karamoja area in eastern Uganda.

From the focus group discussions, at least three interrelated ways in which nomadic pastoralism might have contribute to disease transmission and persistence were identified. These include:

a Promotion of contact between infectious and susceptible animals

When asked to state reasons why CCPP was prevalent in the district, the participants incriminated sharing of watering points, grazing areas and shade as the most important factor that promoted the spread of the disease. Mites were also more likely to be transmitted in shade because camels were often seen scratching themselves in turns on trees while resting. The participants further said that some herders were not keen on treating their animals; their herds served as reservoirs that could not be easily isolated. While migrating, the participants said they often rested in vacated homesteads and kraals which could serve as contact nodes especially for parasites like mites. In the dry season, the participants said they are forced to drive their animals towards game reserves where they were likely to come in contact with wild animals.

b Dissemination of disease pathogens through time and space

No clear seasonal variation in the occurrence of diseases of goats was recorded because the participants always said that the diseases contracted at dry season grazing areas were disseminated to wet season grazing areas. This phenomenon was expected to enhance spatial spread of diseases. Similar events were expected to occur when sick animals are exchanged locally with friends as gifts or dowry, or purchased from markets. Some participants talked of instances when they purchased animals from the local markets that ended up infecting their flocks with CCPP. It was said that clean animals were usually used for dowry but those purchased in the markets were not always healthy.

c Reduced access to veterinary services

Migrations often removed herders from CAHWs, although if herders were to congregate at a common point access to animal health services could be enhanced provided CAHWs moved with the herders.

Even then, supply of veterinary drugs could be curtailed depending on areas where herders prefer to settle. The common reason given for the low coverage of vaccination program against CCPP described above was the fact that most herders had moved to the hills.

4.4 Impacts of conflicts on livestock husbandry and disease occurrence and persistence

Information on the frequency of occurrence of armed conflicts and communities involved was sought in specific *adakars* where cattle rustling was known to be the main constraint to livestock production. These *adakars* were: Lorengippi, Kaemanik, Naipa, Lokiriama, Morulem, Kaesamalit and Lopeduru. Conflicts involving Turkana pastoralists were classified as being either internal or external. An example of an internal conflict was reported by participants interviewed in Kaesamalit where they said they had been raided by fellow Turkanas from Naipa in December 2006. External conflicts involved communities bordering Turkana within and outside the country. These communities were: Pokots living in West Pokot District, Kenya; Karamoja, Tepes and Jie in Uganda; and Toposa and Dongiro in Sudan. Conflicts involving the Pokots were more frequent than those involving the other communities. The participants indicated that hardly two months passed before they were attacked by the Pokots. In such raids most of the livestock got stolen. For instance, a raid launched by the Pokots in December 2006 was reported to have resulted in the theft of 7000 camels, 2500 goats and 120 donkeys at Lorengippi *adakar*. Undetermined number of people were also killed in the raid. The participants said that animals stolen in such raids were never recovered and compensations have never been provided to mitigate the effects of conflicts. The effects of conflicts on livestock husbandry are summarized in Figure 3.

Key informant interviews revealed that previous raids instigated by Turkana pastoralists against pastoral communities in Sudan led to the acquisition of infectious diseases, particularly PPR, as infected animals were brought into the District. CCPP, lumpy skin disease and CBPP were also said to have been acquired from Uganda through animals stolen in cattle rustling. It is therefore expected that if PPR was not contained within Turkana District, the disease would spread to the entire North Rift through the same process. Conflicts involving communities within Kenya, i.e. the Pokots, were not been associated with the spread of infectious diseases. It was however said that coping strategies like congregating in large families in a bid to firm up security, avoiding insecure but resourceful areas (in terms of pasture and water) and reducing grazing time reduced the productivity of livestock in the area. Delivery of veterinary services had also been affected. Some CAHWs reported that some of the goats that had been bartered with drugs had been stolen from the CAHWs.

Efforts to resolve conflicts were being implemented by a number of NGOs and the Catholic Church. The Catholic Church was organizing seminars involving elders from *adakars* where conflicts were prevalent. An NGO called Riam Riam had also started using CAHWs from warring communities to channel conflict resolution messages. The participants interviewed in the study said that conflict resolution efforts often failed because the people involved, i.e. old men, were usually not the ones who instigate conflicts.

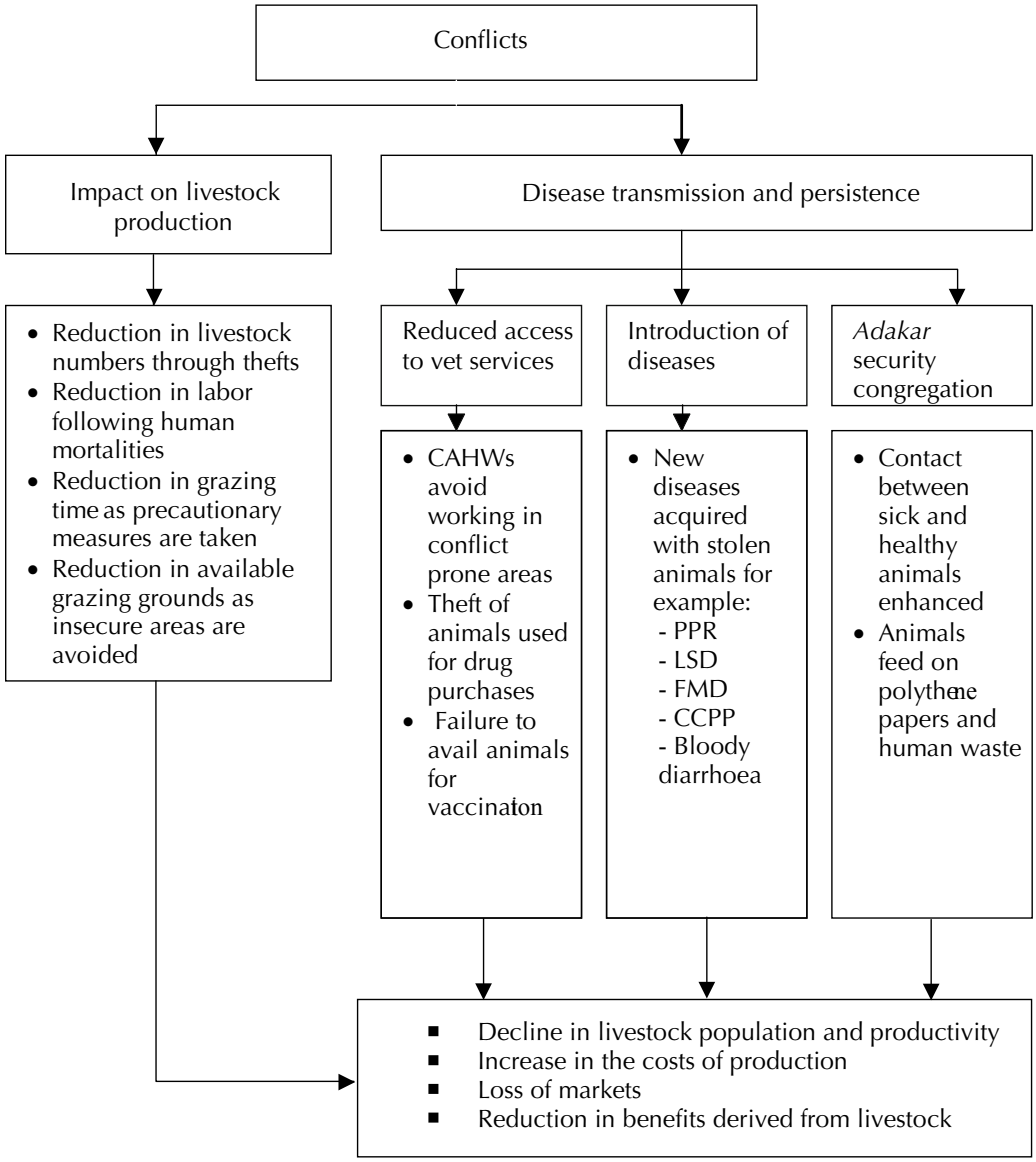

Figure 3. *Synthesis of the effects of conflicts on livestock husbandry obtained from focused group discussions held with Turkana pastoralists in Turkana South District.*

5 Synthesis and recommendations

5.1 Livestock species and disease priorities

- Turkana pastoralists keep multiple livestock species including goats, sheep, camels, cattle and donkeys. A small number of free ranging chickens are also kept, but this has not gained wide acceptance in the community. Dogs are usually kept for security and hunting. Goats and camels are the most important species for family's survival. Intervention measures targeted at these species are therefore likely to substantially improve the livelihoods of the local pastoralists. Such interventions include disease control, improvement of the local breed types, and formulation of efficient ways of feeding them—particularly in irrigation schemes where crop residues are available.
- The diseases that are perceived to be important in goats include mange, PPR and CCPP, while in camels the diseases are mange, pneumonia and diarrhoea. In areas adjacent to irrigation schemes, helminthosis is regarded as an important disease of small ruminants. PPR in goats and pneumonia in camels are considered by the herders as important diseases. TLDP II is already working with stakeholders like the DVS, NGOs (World Vision, OXFAM, FAO) and the local community towards controlling PPR in goats by providing vaccines and drugs for countercurrent infections.

5.2 Disease control

- Although emergency veterinary interventions are sometimes warranted, efforts need to be made to incorporate emergency funding opportunities into longer-term disease control strategies for infectious diseases such as CCPP and PPR. For effective control of disease, sound intervention programs should be developed through timely, targeted epidemiologic studies that characterize the diseases and their transmission dynamics so that appropriate combined strategies and targets (e.g. the number of animals and size of the areas that need to be treated and the frequency of interventions) are formulated. Such studies would also formulate ways of circumventing constraints associated with pastoralism. These types of studies have been carried out for related disease of cattle (rinderpest and contagious bovine pleuropneumonia) leading to more rational eradication and control programs (Mariner et al. 2005; Mariner et al. 2006a; Mariner et al. 2006b). The tools and methods of analysis developed in these studies could be adapted to small ruminant disease.
- Study participants reported that the current PPR outbreak started in Oropoi Division, Turkana North District in 2005, but no interventions were put in place until heavy mortalities were reported. The DVS officially recognized the disease recently, and VSF Belgium together with FAO/DVS/World Vision have been immunizing small ruminants as one way of tackling the spread of the disease. Sustained control can be achieved by taking into consideration the factors that reduced the coverage of previous vaccination campaigns. It should be born in mind that the short generation time of small ruminants increases the difficulty of controlling disease in these species when compared to cattle or camels. Active surveillance methods such as participatory disease surveillance (PDS) should be in place to detect disease outbreaks in a timely fashion, paired with rapid response actions based on known epidemiology. This may involve: a) upon PDS alert

sending out a team trained in participatory epidemiology as a joint NGO/DVO activity to rapidly confirm and identify transmission patters of the disease, b) adapting existing rinderpest models to PRR in goats for the analysis of data and estimation of program targets, c) engaging CAHWs in affected areas in disseminating information to communities on symptoms and prevention measures of the disease upon first report, d) quickly mounting mandatory ring vaccination in a small zone around an affected area, and e) implementing widespread prevention measures based on DVO supervised CAHW cost recovery strategies, rather than DVO led central campaigns. This has the effect of stabilizing the services provided by CAHWs while at the same time improving the coverage of the interventions as CAHWs are able to access areas of rough terrain.

- CCPP has been endemic in Turkana District for a long time. A study conducted by Wafula (2006) showed that the prevalence of the disease is high in areas bordering Uganda and Sudan. The disease is perceived to be important in Kerio and Lokori Divisions, where mange and PPR are not common. Herders and CAHWs reported that they are capable of managing the disease by treating clinical cases using oxytetracycline. Given that treatment of clinical CCPP cases is being employed more frequently by the Turkana to manage CCPP compared to other methods of control e.g. vaccination, movement control etc. research is required to document the efficacy of practical and reasonable treatment regimes and the methods in which the various interventions can be integrated. A similar observation has been made by Mariner et al. (2006) with respect to the management of CBPP. In the case of CBPP, periodic treatment of clinically ill animals combined with vaccination of the remainder of the herd was the most efficacious control option.
- It appears that Turkana herders are not familiar with how livestock acquire and transmit mange. Some of the key informants, however, indicated that the restocking program that was being carried out under DRP in 2006 allowed for the dissemination of the disease because affected goats were used in the program. The areas where the disease is prevalent are Kainuk and Katilu. The disease is perceived as being important in goats even in geographic areas where it is not perceived as being prevalent. Most of the CAHWs and participants in Turkana South have experience with treating mange using ivomectin and acaricides, but most of those from Turkana Central commonly use acaricides and other substances including used engine oil, salt etc. There is an issue with the high cost of ivomectin. However, the cost can be expected to continue to decline as generic forms become available. It is recommended that CAHWs be trained on how to use ivomectin and acaricides in continuing education programs. The species of mange parasites should be better characterized so that adequate information that could inform the development of intervention strategies is generated.

5.3 Access and utilization of veterinary inputs

- Sustainable access to veterinary drugs and diffusion of information on their correct application remains a key challenge to improving animal health in Turkana. The community has been active in seeking remedies for the diseases observed in their livestock. There is growing trend towards uptake of veterinary drugs, unlike in the past. Drug use practices described by the participants, however, suggest application methods could be greatly

strengthened and optimized regimens recommended for management of specific diseases. Some of the methods used in drug administration are unlikely to benefit herders. There is a need to sensitize herders on using medicines in ways that specifically address the local disease problems that are encountered by the community and the risks associated with misuse of veterinary drugs. This could involve training of a few herders, community leaders and CAHWs who can in turn act as resource persons in their communities. These training could be conducted in farmer field schools, some of which have been established in Turkana Central. The farmer field schools, once adapted to the needs and expectations of the local communities, should be initiated in other areas, including Turkana South. CAHWs should be given some of the responsibilities of coordinating and running the training sessions so as to consolidate their acceptance in the community.

- Policies governing the utilization of veterinary medicines in Kenya presume that these products are always used by professionals who can identify the different concentrations and packages that are available in the market. Animal health systems in remote, pastoral areas are increasingly relying on community-based approaches to service delivery and drug use. Veterinary drugs, therefore, are often used by herders who may not be able to differentiate the different concentrations of specific products that are commonly used to treat endemic diseases, e.g. oxytetracyclines, dewormers etc. The herders should therefore be sensitized on appropriate methods of using veterinary drugs, including the risks that accompany misuse of these products. This should be done through the farmer field schools.
- Access to veterinary inputs are sustained in the long-term through strengthening sustainable community-based and privatized delivery systems that promote cost-recovery on the interventions provided rather than the centralized, DVS-led programs that are often administered as mass emergency interventions. Cost recovery limits dependency and consolidates coping strategies against disease shocks. In southern Sudan, CAHWs charge for all vaccinations and treatments, return money to supervisors, and are paid 20% for work (Jones et al. 1998). Cost recovery systems, however, vary by area. A similar approach should be tried in Turkana but the main challenge will be in convincing herders to pay for services when the risk of an epidemic is not apparent.

5.4 Community animal health workers

- Most herders opt to treat their own animals due to limited access to animal health services. The distribution of CAHWs is poor while some of them are no longer active. The active ones, however, are very skilled in disease diagnosis and drug administration. Their impact as measured by case fatality rates is low because they basically distribute drugs, particularly to herders that are far removed from them. There is also minimal incentive for them to actively engage in clinical services, because most of the time herders prefer to purchase whole drugs from them rather than pay for their services. Undoubtedly, there is a need to identify and train more CAHWs, but methods should be worked out on how to address some of the constraints they face. TLDP is already considering a scheme that will aid them in acquiring bicycles. They should also be offered more refresher courses with content on pharmaceutical access, cost recovery, and mobilizing herders to increase demand for the more reliable services provided by CAHWs. Unlike general merchants that distribute drugs, CAHWs are able to provide appropriate advice on drug use.

- The study describes two contrasting drug delivery and reporting systems involving CAHWs in Turkana Central and Turkana South. The system in Turkana South is likely to be more sustainable than that in Turkana Central because the CAHWs in the area have been attached to a private veterinarian based in Kapenguria, West Pokot. A similar system should be established in central, although this might be more challenging given the fact that there has not been a private veterinarian practicing in the area. The road network in the area is also not well developed compared to that existing in the south. The project could identify and provide initial capital as credit to a private veterinarians or AHAs to establish a drug outlet that could be used by the CAHWs in Turkana Central. The CAHWs could then be linked to private AHAs and veterinarians through several possible mechanisms, including 1) the private veterinarian in West Pokot can be engaged in dialogue to identify mechanisms to profitably link CAHWs throughout Turkana South and Turkana Central districts to him; 2) as in Sudan, opportunities can be created for AHA to establish private pharmacies in central districts to which local CAHWs are linked for re-supply and continuing education; and 3) AHAs in Turkana Central can be linked to veterinarians in West Pokot to ensure quality control in service provision, surveillance and CE. The CAHWs should also be linked to livestock marketing association as this might help them to secure better markets for the goats they receive in exchange for drugs.
- All CAHWs should also be linked to and supervised by the DVS directly or indirectly through a private veterinarian or AHA. There have been reports that CAHWs collaborate with the DVS, especially in vaccination campaigns etc. This system was found to be wanting because the factors that promote the collaboration are unrelated to the need to sustainably promote the services of CAHWs. The department, usually, is understaffed and would prefer to work with the CAHWs to gain access to the community. The CAHWs are motivated by the allowances that they get by participating in such campaigns, though some of the CAHWs who participated in the PPR vaccination campaigns are actually no longer actively involved in provision of veterinary services. Although this approach helps the community to recognize the role of CAHWs, a more beneficial relationship between CAHW and the DVS should be developed. In this relationship, the DVS obtains reports directly or indirectly from the CAHWs on the local problems encountered, and the CAHW is guided and provided with a referral system when difficult cases are encountered. The DVS, CAHWs and herders should benefit from the surveillance system in order for it to be sustainable. Mariner et al. (2002) point out that this could be achieved if the system allows the professional and sub-professional staff in the DVS to receive timely feedback reports and the CAHWs are given refresher courses tailored towards disease surveillance in addition to courses on disease diagnostics and treatment. CAHWs in Turkana would also benefit from being trained on entrepreneurship skills given that herders pay for drugs provided by the CAHWs and not services.

5.5 Pastoralism and transboundary disease

- Seasonal migratory patterns allow high contact rates in the dry season grazing areas where herds from many areas congregate. Some diseases are disseminated to wet season grazing areas when herds move at the onset of rains. These migratory patterns are not limited by international boundaries. The congregation of herds at dry season grazing areas provides an opportunity to access and treat a large population of animals at any one time compared to the levels that might be achieved in wet season when herds are dispersed, and stand the best

chance of breaking the chain of transmission. Vaccinations conducted late in the dry season are unlikely to achieve a desirable level of coverage because many herders believe that side effects associated with vaccination, e.g. abortions etc., occur commonly when the campaign is conducted in the dry rather than the wet season.

5.6 Conflict and animal health care

- There are isolated efforts by the government, NGOs and churches aimed at resolving conflicts in the entire Turkana district, but the problem is endemic, particularly along the Turkana-Pokot border. The problem has been regarded by many as a way of life of the warring communities. The bodies involved in conflict resolution should merge their efforts and advise the government on the best ways to approach the problem, given that these bodies have a wealth of knowledge on socio-economic issues that promote cattle rustling. Livestock branding and tracking, as promoted by the GOK, with and without conflicts, could aid in making predictions on disease transmission patterns. Such predictions could assist the development of appropriate intervention measures, including the sensitization of communities on the diseases that they ought to look out for and report to CAHWs/DVS.

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Appendix I List of Community Animal Health Workers interviewed in the study

Name		*Adakar*
Turkana Central		
1	Paul Emase Ngichilia	Kangirisae
2	Joseph Epuu	Lorengelup
3	John Orot	Lorematet
4	Aurien Nakole	Lochorealomala
5	Peter Apiot Ekoriey	Lokiriama
6	Itukon Chopir Lolucho	Puch
7	Ikai Lokorekeju	Kalemnyang
8	Iwelete Erupe	Naipa
9	Hannah Akiru	Lokamichura
Turkana South		
10	Rebecca Eloto	Lorokon
11	Benjamin L. Lomu	Loyapat
12	Dorcas Epusie	Kainuk
13	Peter Peto Lobuin	Kalemngorok
14	Joseph Loriken	Katilu
15	Lomeiyo Akopirot	Morulem
16	Jacob Loote Lodit	Lotubae
17	Julius Lokapel	Lopeduru

Appendix II List of people who assisted in the mobilization of the herders in the selected *adakars*

Name	*Adakar(s)*	Occupation
Turkana Central		
Peter Akure	Kangirisae	Assistant Chief
Jonathan Epakan	Nakurio, Lomuria	Assistant Chief
Leonard Eporon	Lorengelup	Chief
Julius Tukei	Lochorealomala	Assistant Chief
James Achuman	Lokiriama	Assistant Chief
Andrew Lengole Lemkol	Puch	Assistant Chief
John Epuu Lororoo	Lochorekuyen	Assistant Chief
Barnabas Nyanga	Lorengippi	Assistant Chief
Patrick Koele	Kaemanik	Assistant Chief
Albert Ngikadelio	Naipa	Assistant Chief
Albert Ngikadelio	Lokamichura	Assistant Chief
David Lokol	Kalemnyang	Elder
Obonyo Mr.	Turkwell	Farmer
Research team†	Lomil	–
Gregory Longelesh Lodwat	Napeililim	CAHW
Turkana South		
Akales Kiyok	Juluk	Elder
Loyanae Samal	Nakwamoru	Elder
Ebekan Longolol	Lorokon	Elder
Peter Ematte	Loyapat	Assistant Chief
Henry Etabo Ekitella	Kalemngorok	Chief
Epukon Aleri	Namakat	Elder
Ezekiel Ejore	Angaraabat	Assistant Chief
Allan Aleper	Katilu	Chief
Yohana E. Ekitella	Lochwaangimatak	Chief
Lowoth Edukan	Kaekorisogol	Elder
Josphine Ekal	Kamarese	Assistant Chief
Lobokan Ekutan	Morulem	Elder
Lucas Lokolonyoi	Lotubae	Assistant Chief
John L. Lengiro	Lokori	Assistant Chief
Gideon Ikaal	Kaesamalit, Lopeduru	Assistant Chief

† The research team was forced to mobilize the community due to unavailability of the area chief despite having been notified of the meeting in advance.

Appendix III Sampling frame

A sampling frame made up of a list of *adakars* stratified by division. Against each *adakar*, the number of CAHWs is enclosed by the brackets. *Adakars* selected for the study are marked by the symbol, √

Turkana Central					
Loima Division		Turkwell Division		Kerio Division	
Loima (2)		Turkwell (0)	√	Ngimuriae (0)	
Namoruputh (1)		Lorugum (1)		Kerio (1)	√
Puch (2)	√	Kalemunyang (2)	√	Nadoto (1)	
Lochorekuyen (0)	√	Lobei (1)		Nakurio (2)	√
Urum		Kangalita (1)		Lokoyo	
Lokiriama (2)	√	Lomil (0)	√	Kangirisae (1)	√
Lochoralomala (0)	√	Napeililim (1)	√	Nakopet (1)	
Atalokamusio (0)		Kaapus (2)		Kaatir (1)	
Lorengippi (1)	√	Nachuro (?)		Lorengelup (2)	√
Nadwat (0)		Neremit (1)		Nakwaperit (1)	
Kaemanik (0)	√	Naipa (2)	√	Kaakimat (1)	
		Kotaruk (2)			
		Lokamichura (0)	√		
		Nameyana			

Turkana South							
Kainuk Division		Katilu Division		Lokichar Division		Lokori	
Kainuk		Kalemngorok	√	Kamarese	√	Lokwamusing	
Loyapat	√	Nabeeye		Lokichar		Lokori	√
Kakongu		Namakat	√	Lokabuuru		Morulem	√
Lorokon	√	Simailele		Kaasuroi		Lokwii	
Kaaputir		Lopur		Kaekorisogol	√	Lotubae	√
Nakwamoru	√	Nangaraabat	√	Napusimoru		Katilia	
Kapelibok		Katilu	√	Lochwaangikamatak	√	Lokorokor	
Lomerimudang		Lokapel		Locheromoit		Lopeduru	√
Juluk	√	Kogitankori		Loperot			
		Kanaodon		Kangakipur			
		Nakabosan		Nakaalei			
				Kaesamalit	√		
				Nakukulas			

Appendix IV Checklist used to guide focus group discussions and key informant interviews

a Herders

- Livestock production
    - Herd composition
        - What are the common livestock species kept in the community?
        - Rank livestock species by:
            - Numbers
            - Importance to family's survival
- Livestock diseases
    - List the common diseases that affected goats/camels in the last year
    - Determine the relative incidence and case fatality rates of the listed diseases
    - Disease Impact Matrix for the highly ranked livestock species
        - List and rank benefits of keeping the selected livestock species
        - Design and fill the matrix based on the perceived relative effects of the diseases – benefits on y axis and diseases on x axis
- Treatments and vaccines given in the last year (work well with individuals)
    - In the last year, who treated your animals? What were the conditions treated? What were the treatments? How much did it cost for each? What was the effectiveness of these treatments?
- Evaluate emergency interventions conducted in the last 2 years
    - What are the interventions carried out by the DVS in the last two years?
    - Determine proportion of animals vaccinated for CCPP versus not vaccinated in an intervention carried out in 2005. Further divide these groups into two: those that remained healthy/sick after vaccination
    - Proceed to identify diseases incriminated and divide the sick category into those that got CCPP versus other diseases.
    - Determine the relative case fatalities
- Watering, grazing
    - Combine mapping and verbal time lines to identify grazing patterns and the location of water sources, saltlicks, source of drugs, with respect to *adakars*
    - Identify the diseases encountered within the different grazing grounds?
- Conflicts
    - Frequencies and general impacts
    - Identify the times when conflicts occurred in the last one year

- Determine the impact of these conflicts on livestock husbandry and coping strategies adopted by the affected *adakars*
- Describe how each conflict was resolved

- Linkages between conflict and disease occurrence
  - Use the calendar drawn above on conflicts to determine the incidence of livestock diseases
  - Determine if the occurrence of the diseases is associated with conflicts

b Community Animal Health Workers

Part I: Personal characteristics

Date: _____ Area: _____

Name: _____ Age: _____

Gender: _____

Highest level of education: _____

What are your main sources of income? Which is more important?

Part II: Knowledge and skills

- How long have you been working as CAHW? How many trainings have you had? When and for how long?
- How many cases do you handle per week? Any records made? Ask to be shown
- What are the common equipments you commonly use?
- List five diseases for each of the livestock species kept in the area
- What are the signs for the each of the disease?
- How do you treat these diseases? How do you estimate the amount of drug required? What is the cost for each treatment?
- How are drugs obtained? Are these sources reliable?
- Which drugs do you commonly use?
- What advice do you give after treatment? What withdrawal periods are practiced? (ask this if it doesn't come out from the preceding question)
- How do you store the drugs you use?
- Are there conditions that are difficult to treat? What do you do with them? How often do you visit/work with vet department?
- Are there any zoonotic diseases in the area?

Part III: Cost recovery and working with the community

- How do you get paid for services?
- What are the main challenges faced in the course of duty?
- Are there instances when payments have delayed? Not offered? How did you deal with these incidences?