Small ruminant husbandry practices amongst Kajiado and Marsabit pastoralists and their effects on *Peste des petits ruminants* control strategies

P N Gitonga[1], C K Gachene[1], E Njoroge[2] and S M Thumbi[3,4]

[1] Department of Land Resource Management and Agricultural Technology, University of Nairobi,
P.O. Box 29053-00625 Nairobi Kenya
paula.n.gitonga@gmail.com
[2] Program Management Specialist, Office of Economic Growth, USAID Kenya and East Africa
P.O. Box 629-00621 Nairobi Kenya
[3] Wangari Maathai Institute for Peace and Environmental Studies, University of Nairobi
P.O. Box 29053-00625 Nairobi Kenya
[4] Paul G. Allen School for Global Animal Health, Washington State University, Pullman, WA 99164, USA

Abstract

The contribution of sheep and goats to pastoralist livelihood is limited by the frequent occurrence of trade sensitive diseases such as *Peste des Petits Ruminants* (PPR). A descriptive risk based cross-sectional survey was undertaken to characterise small ruminant disease control and husbandry practices in two pastoral regions of Kenya. The overall aim of the survey was to characterise pastoralist small ruminant husbandry practices so as to enable a more focused PPR control strategy in pastoral areas of Kenya. A total of 63 small ruminant owners were surveyed of which 55% (35) were in Kajiado and 45% (28) in Marsabit.

The study revealed that all 35 sampled sites in Kajiado were permanent settlements compared to 18 of the 28 sites surveyed in Marsabit. Sedentarization was also accompanied by diversification of livelihoods particularly in Kajiado where only 57% of livestock owners relied entirely on livestock keeping compared to 75% in Marsabit. In addition, Kajiado livestock owners practiced a more individualistic small ruminant management evidenced by investments in animal health and breeding programmes. All livestock owners interviewed regularly used anthelmintic drugs, while 57% sourced for preventive vaccines for their sheep and goat herds. The overall conclusion of the survey was that small ruminant husbandry practices were heterogeneous and were determined by access to veterinary services, animal

health inputs and markets. The study recommends that PPR disease control programmes in pastoral systems of Kenya be tailored to specific geographical areas based on the type of livestock disease prevalent while taking into account the social and economic setting of the pastoralists' communities.

Key words: *animal health input, descriptive analysis, herd management, heterogeneous*

Introduction

Pastoralism is a way of life characterised by raising livestock species mainly small ruminants, cattle and camels on extensive natural rangelands (Fratkin and Roth 2005). Pastoralists have developed management systems based on strategic mobility that is driven by factors such as seasonal availability of grazing and water resources, avoidance of areas with known livestock disease outbreaks as well as availability of markets (Notenbaert et al 2012). Although pastoralism is a traditional way of life, it is highly adaptive to trends that allow new economic opportunities such as livestock insurance (Chantarat et al 2013) or better access to livestock market price information using mobile phone communication technology (Food and Agriculture Organisation of the United Nations (FAO-UN) 2013a; Mwanyumba et al 2015). Sheep and goats represent a significant composition of pastoralist livestock herds. Their small body size, rapid rate of reproduction and low market price makes them easy to sell and buy when compared to larger ruminants such as cattle and camels (Kosgey et al 2008). In addition, income from their sale is able to cater for 60% of household needs for grain food, medical and education expenses (Behnke and Muthama 2011). The FAO-UN Statistical department projections indicate that between the years 2000 to 2030, global consumption of mutton will increase to 7 million tonnes per year. With mutton production in Sub-Saharan Africa which is mostly under pastoral production systems expected to reach 1.8 million tonnes (FAO-UN/OIE 2015). However, the endemic presence of small ruminant diseases such as PPR will not only affect productivity of small ruminants but will hinder pastoralists from accessing lucrative international markets to meet the increasing global demand for mutton and chevon (FAO-UN/OIE 2015). PPR, is a highly contagious viral disease of sheep and goats. Once the PPR virus is introduced into a susceptible herd, it results in clinical disease in 90 percent (%) of animals and death in 30 to 70% of infected animals (Barret et al 2006; World organization for animal health (OIE) 2013). PPR virus is not a zoonotic disease but it causes significant livelihood disruption of livestock keepers in Africa, the Middle East and Asia with global estimates indicating that direct annual losses due to PPR outbreaks are between United States Dollar (USD) 1.2 and 1.7 billion (FAO-UN/OIE 2015). In Kenya, the first recorded PPR outbreak occurred in 2006 in Turkana County which is located in the extreme Northern part of Kenya (Nyamweya et al 2010). By the year 2008, the disease had spread to all Northern located arid counties in Kenya as well as in semi-arid counties located in the former Rift Valley Province. The spread of PPR virus in Kenya has continued despite government efforts to control it through vaccination targeting all small stock herds in arid and semi-arid counties of

Kenya (Government of Kenya (GoK) 2008). The Kenya government incurs an annual cost of 1 billion Kenya shillings due to expenditure spent on PPR vaccination activities and revenue foregone during trade bans (GoK 2008).

The underlying factors causing PPR outbreaks in Kenya are not well understood, but they have been linked to husbandry practices, uncontrolled livestock movement and mixing of herds during communal herding as pastoralist track pasture and water resources (Gitao et al 2014; Kihu et al 2015). A risk based cross-sectional questionnaire survey was therefore undertaken to characterise small ruminant husbandry practices in two pastoral systems of Kenya. The study hypothesized that heterogeneous husbandry practices related to disease control may increase the susceptibility of small ruminant herds to PPR infections. This concept of heterogeneity emphasizes that although pastoral communities experience similar socioeconomic disruption due to drought or livestock diseases. They have differing vulnerabilities due to differences in application of coping and adaptive strategies (Fratkin 2001). This may imply that livestock disease control programmes in pastoral systems of Kenya should not apply blanket interventions but should consider the heterogeneous social, ecological and economic settings (Kihu et al 2015).

Methods

Study area

The study areas were purposively selected based on the following criteria. The area (i) is classified as a PPR endemic or high risk zone (GoK 2015) (ii) inhabitants practice pastoralism and have a significant population of small ruminant herds (Kenya National Bureau of Statistics (KNBS) 2009) (iii) is an important small ruminant transhumance and trade stock route to neighbouring countries (Muthee 2006). In addition to the mentioned criteria, the prevailing security situation was also considered. The study areas selected and meeting the criteria above were Kajiado and Marsabit counties in Kenya. Kajiado County is classified as a semi-arid county located in the South Western part of Kenya. The county has an international border with the Republic of Tanzania in the South and lies between longitudes 36º 5’ and 37º 5’ East and Latitudes 1º 0’ and 3º 0’ South (Kajiado County Integrated Development Plan (Kajiado- CIDP) 2013). Kajiado is predominantly inhabited by the Maasai community, who are the second biggest pastoralist community in Kenya after the Somali community (Bekure et al 1991). The population density in Kajiado is estimated to be 31 persons per square kilometre (KNBS 2009). Kajiado is classified as a high risk PPR zone (GoK 2015). The first PPR outbreak in Kajiado was reported in 2010 in Namanga, which is an area located close to the Kenya-Tanzania border (GoK 2015). Marsabit is classified as an arid county that is located in the upper Eastern region of Northern Kenya. It the second largest County in Kenya after Turkana. Marsabit shares an international border with the Republic of Ethiopia in the North and lies between longitudes 37° 57’and 39°21’ East and latitudes 02°45’ and 04° 27’ North (Marsabit-CIDP 2013). The County is vast with an average population

density of 4 persons per square Kilometres. Marsabit inhabitants comprise of a diverse mix of pastoral, agro-pastoral and fishing communities. The pastoral communities include the Borana, Gabra, Samburu/Ariaal, Rendille, Somali, Turkana and Dassanech. The agro pastoralists include the Burji while the fishing community are the El Molo (Marsabit-CIDP 2013). Marsabit is classified as a PPR endemic zone with reports indicating that the first outbreak occurred in March 2008 in Laisamis Sub-county (GoK 2008).

Survey design

The type of questions included in the questionnaire were informed by literature findings as well as risk factors associated with PPR from previous studies conducted in similar pastoral settings (Muse et al 2012; Gitao et al 2014; Kihu et al 2015). A pilot baseline survey to pre-test the questionnaire was carried out in Mashuru, Kajiado County in December 2013. This pilot survey allowed the determination of the length of time it would take to complete the questionnaire as well as to clarify ambiguous or difficult questions. A cross-sectional survey was then carried out in Kajiado and Marsabit counties between January 2014 and February 2015. The sampling unit was the homestead also known in the local dialect as *'manyatta*' for Marsabit communities and '*boma/enkang'* for Kajiado communities. A *boma* or *manyatta*, is a cluster of households composed of related families who herd their livestock together and pursue similar socioeconomic activities. (Bekure et al 1991; Fratkin and Roth 2005; Kihu et al 2012). Homesteads to be visited were selected using the 'snowball' sampling technique (Biernacki and Waldorf 1981; Muse et al 2012; Gitao et al 2014). This technique involved initial contact with either the county veterinary officer, chief or community disease reporter who then introduced the researcher to the first homestead-head (HH) (Gitao et al 2014). The HH in turn, introduced the research team to the next HH. In total 63 HH were interviewed from 35 sites in Kajiado and 28 sites in Marsabit.

Data collection

The ethical clearance for the study was obtained from the University of Nairobi, Faculty of Veterinary Medicine, Biosafety, Animal use and Ethics Committee. In addition, homestead-head (HH) gave a verbal and signed consent to participate in the survey. In the case where the HH was illiterate he gave an affirmative verbal consent and authorised either the local disease reporter or another literate family member to sign on his behalf. A geographical positioning system (GPS) was used to record the coordinates of homestead samples using a Garmin unit model eTrex® 30. The interviews took between 30 and 45 minutes and were all conducted by the researcher in Swahili language. Where the respondent was not conversant with Swahili, interviews were conducted in the local language with the help of an interpreter who in all cases was the community disease reporter.

Data collected included demographic characteristics of homesteads, small ruminant husbandry practices including size of herds kept, breeds kept, disease control practices and animal health inputs used. Information was also

collected on the type of small ruminant diseases prevalent in the area as well as the HH perception on factors hindering small ruminant disease control and possible policy interventions. To triangulate the data collected using the questionnaires, the researcher observed and validated HH responses before recording. This was critical for demographic questions such as number of wives, number of children and their school attendance. This was also important for husbandry questions such as types of breeds kept and herd size. The researcher also conducted informal key informants (KIs) group discussions with local area disease reporters, veterinary officers and animal health technicians. The KIs discussions allowed the researchers to validate HH responses on type of government vaccine interventions carried out in the area as well as validate which small ruminant diseases were prevalent in the area.

Data entry and analysis

The responses to the questionnaires were entered, coded and analysed using the Statistical Package for Social Sciences (SPSS) version 22 and analysed for descriptive statistics that is frequencies and means. The map was developed using ArcMap GIS version 10.1 for desk top use (ESRI Corp., USA).

Results and Discussion

Socio-economic characteristics

A total of 63 homestead were surveyed (Figure below), of this, 55% were in Kajiado and 45% were in Marsabit. All 35 sites in Kajiado were permanent settlements compared to 18 of the 28 surveyed in Marsabit. In both study areas, permanent settlements were located around trading centres, schools and permanent watering areas. All Kajiado settlements were located in individually owned parcels of land. The homestead households were composed mainly of individual nuclear family members that is the husband, wives, young or unmarried children and immediate extended paternal family members in most cases the elderly mother and father. However, this was in contrast to what was observed in Marsabit, where both the permanent and satellite homesteads were located in clan based communal land holdings.

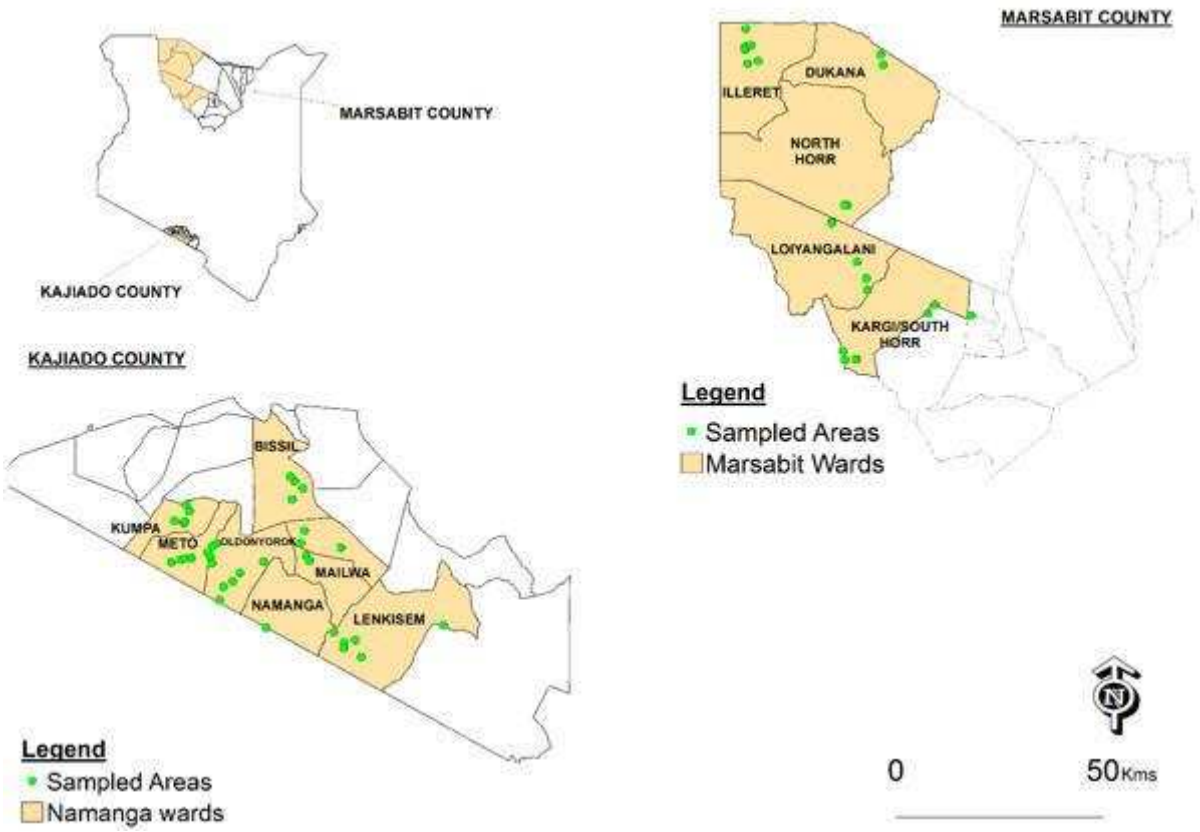

Figure 1: Sheep and goat herds sample sites in Marsabit and Kajiado Counties of Kenya

In addition, households in Marsabit homesteads were composed of extended family members. That is, the husband, wives, young children, married sons and their children, married brothers and their children and elderly parents. Kajiado is located near Kenya's capital city, Nairobi and has experienced an influx of local immigrants resulting in a rapid change of land ownership due to fear of land grabbing by outsiders. The once expansive group ranches have now been subdivided into individually owned parcels of lands (Boone et al 2007; Morara et al 2014). This may explain why in this study, surveyed Kajiado livestock owners had a more individual nuclear family settlement when compared to Marsabit's clan based or extended family settlements on communally owned land. Sedentary lifestyle as seen in this study also meant diversification of livelihoods this trend is similar to other studies carried out in Kenya (Fratkin and Roth 2005). In the current study, livestock keeping was the main livelihood strategy for 57.1% of Kajiado and 75% of Marsabit livestock owners. In Kajiado, 3 supplementary livelihood strategies were the most common these were, taking up salaried employment (25.7%), crop farming (8.6%) and setting up commercial ventures (8.6%) such as cow milk sale points, butcheries and grocery shops. In Marsabit, supplementary livelihood strategies were based on the geographical location of the community sampled as this determined the soil type, terrain and water resource availability (Schwartz et al 1991). Samburu and Rendille livestock owners interviewed, engaged in irrigated crop agriculture as they resided in South Horr, a lush and green valley between Ol Donyo Mara and Mt. Ngyiro

mountain ranges. The other livelihood diversification strategy was fishing amongst the Dassanech community residing at the Northern edge of Lake Turkana.

Demographic characteristics

The study surveyed 5 pastoral communities the Maasai in Kajiado and the Samburu, Rendille, Dassanech and Gabra in Marsabit. As per the custom of most pastoralist communities the heads of the family interact first with visitors and are assumed to have more exposure and knowledge about social and livestock husbandry practices and this is why the study purposively targeted them (Fratkin 2001). The demographic characteristics of respondents are summarized in Table 1. The survey revealed that 71.4% of HH in Kajiado and 85.7% in Marsabit had no formal education training. This finding is in agreement with most social settings of pastoralist which directs youth-life to learning indigenous pastoral knowledge (Fratkin 2001; Mwanyumba et al 2015). Current studies indicate that some pastoral communities are changing and have adopted modern way of life which gives more consideration to formal education (Fratkin and Roth 2005; Ng'asike 2011). This was the case in Kajiado where 60% of HH interviewed indicated that children in their homesteads attended formal schooling compared to Marsabit where only 42.9% of children who had attained school going age attended school. On further probing, Marsabit HH explained that children still played a significant role in providing labour for herding, this was especially so for small ruminants (Fratkin and Roth 2005).In addition, settlements located away from trading centres (which in most cases had schools), were disadvantaged as available schools were located too far away and since they had no boarding facilities, the daily commute by children was impossible to make (Marsabit-CIDP). However, it should also be noted that the universal understanding of education ignores the nomadic culture which has high levels of undocumented environmental and livestock husbandry knowledge and specialisation (Fratkin 2001; Kaufmann 2012). In addition, most pastoralist perceive formal education training as one of the factors that is causing cultural erosion in their societies (Ng'asike 2011). This perception of social erosion was confirmed in this study by one HH from the Dassanech community who remarked that formal schooling was only for children who could not herd, thus could not be trusted with livestock assets. Formal schooling was therefore a second chance that would allow the children contribute to the household economy through formal employment. On average, the family size of sampled homesteads consisted of 2 wives in both Kajiado (± 0.7; Range 1 -3) and Marsabit (± 0.9; Range 1 – 4) and an average of 5 children (± 1.8; Range 2 -8) in Kajiado and 8 children (± 2.9; Range 1 - 14) in Marsabit. These findings are in agreement with the 2009 National household census report that indicated that pastoral households had on average more children than the average national fertility of 4.6 children per woman. This is mainly because, child-bearing for pastoral women starts at an earlier average age of 16 years or less when compared to urban or rural women in non-pastoral communities who start child bearing after formal education training which on average is after 18 years (Ferrè 2009).

Table 1: Homestead head (HH) responses within each demographic characteristic trait surveyed in Kajiado and Marsabit counties, Kenya

Parameter	Kajiado (n=35)		Marsabit (n=28)	
	No. HH Respondents	%	No. HH Respondents	%
Gender				
Male	34	97.1	26	92.9
Female	1	2.9	2	7.1
Age Group				
<20-35 years	13	37.1	2	7.1
36-50 years	15	42.9	14	50.0
>51 years	7	20.0	12	42.9
Level of Education				
No formal education	25	71.4	24	85.7
Lower primary	3	8.6	4	14.3
Upper primary	2	5.7	0	0.0
Secondary	2	5.7	0	0.0
Tertiary	3	8.6	0	0.0
Children attend formal school				
Yes	21	60.0	10	35.7
No	1	2.9	5	17.9
Too young	6	17.9	1	3.6
Not all	7	20.0	12	42.9
Livelihood strategy				
Livestock keeping only	20	57.1	21	75.0
Livestock and crop farming	3	8.6	3	10.7
Livestock and Salaried employment	9	25.7	1	3.6
Livestock and Business	3	8.3	0	0.0
Livestock and Fishing	0	0.0	3	10.7

Small ruminant husbandry practices

All pastoral communities in the survey kept more than three species of livestock at a time (Table 2). However the Maasai in Kajiado and Dassanech in Marsabit did not keep camels. Breeds of small ruminants reared differed between the surveyed Counties. Pastoralists own a wide range of indigenous livestock species and breeds that are selected on the basis of adaptive traits, such as resistance to diseases and droughts as well as productive traits, such as increased growth and carcass weight (Kosgey 2008; König et al 2015). In addition, keeping more than one livestock specie means pastoralists can generate a wider variety of livestock products and make better use of the available natural grazing resources during the different seasons of the year (Notenbaert et al 2012). More than half (68.6%) of Kajiado communities predominantly kept Red Maasai crossed with Dorper sheep breeds and crosses of Small East African Goat (SEAG) and Galla (74.3%) goat breeds. In Marsabit, the sheep breed of choice was the Black Head Persian (50%) that was mainly kept by the Gabra, Samburu and Rendille communities. The Dassanech also reared the Black Head Persian breed but they crossed it with the Horro sheep breed that originates from Ethiopia. The predominant goat breed reared in Marsabit was the Small East African Goat (71.4%) followed by the SEAG crossed with Galla goat breed (10.7%) kept by the Samburu, Rendille and Dassanech and the pure breed Galla goat (17.9%) mainly kept by the Gabra community (Table 2). The findings suggest that Kajiado pastoralists are transforming to a more commercial form

of small ruminant production system so as to be able to meet the growing demands of the urban human population within and outside the County (König et al 2015). However, Marsabit communities were observed to be producing for subsistence consumption due to lack of market access (Muthee 2006; Rutto et al 2013).

Table 2: Homestead head (HH) responses within each small ruminant husbandry practice surveyed in Kajiado and Marsabit counties, Kenya

Parameter	Kajiado (n=35)		Marsabit (n=28)	
	No. HH Respondent	%	No. HH Respondent	%
Number of Livestock Specie kept				
1 to 4 Species (Cattle and Shoats, donkey)	25	71.4	8	28.6
1 to 4 Species (Camel and Shoats)	0	0.0	20	71.4
>5 Species (Cattle, Shoats , donkey, chicken)	10	28.6	0	0.0
>5 Species (Camel, Shoats , donkey, chicken)	0	0.0	0	0.0
Type of Market Access				
Local Market	29	82.9	11	39.3
External Market	6	17.1	0	0.0
No Market	0	0.0	17	60.7
Current Market Price				
Goat Price (Kenya Shilling (Ksh.)				
Ksh. 2,000 – 3,000	0	0.0	22	78.6
KSh. 4,000-5,000	29	82.9	0	0.0
Ksh. >6,000	6	17.1	0	0.0
Don't know	0	0.0	6	0.0
Sheep Price (Kenya Shilling (Ksh.)				
Ksh. 2,000	0	0.0	0	0.0
Ksh.3,000	35	100	0	0.0
Don't know	0	0.0	0	0.0
Sheep herd size				
<50 (small herd)	20	57.1	6	21.4
51-100 (medium herd)	8	22.9	6	21.4
>100 (large herd)	7	20.0	16	57.2
Goat herd size				
<50 (small herd)	11	31.4	2	7.1
51-100 (medium herd)	10	28.6	5	17.9
>100 (large herd)	14	40.0	21	75.0
Sheep breeds kept				
Red Maasai	11	31.4	0	0.0
Dorper X Red Maasai	20	57.1	0	0.0
Black Head Persian	0	0.0	14	50.0
Black Head Persian X Horro	0	0.0	8	28.6
Black Head Persian X Red Maasai	4	11.4	6	21.4
Goat Breeds kept				
Small East African Goat	9	25.7	20	71.4
Galla X Small East African Goat	26	74.3	5	10.7
Galla	0	0.0	3	17.9

This is supported by the current survey findings indicating that 82.9% of Kajiado HH sold or bought sheep and goats from the local market, with the current market prices for goats reported as being favourable as it was immediately after the December 2013 rain and festive seasons. In Marsabit, market linkage for small ruminants was largely lacking based on 60.7% of livestock owners responses. Furthermore, Marsabit HH interviewed only sold

goats to local butchers or middle men when in financial distress, they also indicated that the purchase price was always low. All HH also indicated there was no market for sheep who were mainly kept to meet household milk, fat and meat demands.

Studies in pastoral communities in Somalia and Ethiopia have demonstrated that even with limited investment in animal health inputs, milk off-take in goats reared under pastoral systems can increase by 550%. However, pastoralists still resist in the investment of animal health inputs for their small ruminant herds when compared to investment done for large ruminants ((FAO-UN 2013 b). This is mainly because, sheep and goats have a higher reproductive rate when compared to large ruminants. This translates to larger herd sizes that are costly to maintain especially when the market purchase prices are too low to meet the cost incurred when investing in animal health inputs (FAO-UN/OIE 2015). Table 3 summarises small ruminant health management practices in the surveyed homesteads. All (100%) livestock owners in Kajiado regularly used anthelmintic, antibiotic and tick control products, while only 57% of those interviewed invested in the purchase of preventive vaccines for their sheep and goat herds. In contrast, all Marsabit (100%) livestock owners did not invest in the purchase of tick control products or preventive vaccines. However, when available, 42.9% of Marsabit livestock owners indicated that they occasionally purchased anthelmintic products while only 28.6% purchased antibiotic drugs for use in their small ruminant herds. With regard to access to veterinary services, 57.1% of Kajiado livestock owners indicated that they had access to veterinary services, this was in contrast with what was reported in Marsabit where 78.6% of livestock owners indicated that they had no access to veterinary services. Veterinary services was defined by the livestock owners interviewed in both Kajiado and Marsabit counties as the provision of free vaccination services, extension services and rapid response during disease outbreaks. Furthermore, 40% of Kajiado HH indicated that they did not report to veterinary authorities or local authorities like the chief or disease reporter disease incidences in their small ruminant herds. However, in Marsabit and despite not having access to veterinary services, 53.6% of HH indicated that they always reported incidences of small ruminant diseases to the chief or local disease reporter (Table 3).

These findings are largely in agreement with previous studies carried out in pastoral systems of Kenya (Njanja et al 2003; Onono et al 2013), these studies have reported that due to the historical marginalisation of pastoral areas by both the colonial and post-independent governments, pastoralist communities have learned to rely on their indigenous knowledge and ethno-veterinary practices to control diseases in their livestock herds (Catley et al 2011; Onono et al 2013). In addition, as observed in Kajiado the access to animal health inputs meant that Kajiado livestock keepers could treat their own animals without informing the veterinary authorities (Onono et al 2013). It can then be hypothesised that in Marsabit, lack of access to animal health input may have been the reason that drove reporting of diseases to chiefs or community disease reporters, as they are often the first people veterinary authorities get in

touch with when they want to pass information to the communities (Catley et al 2011).

Table 3: Homestead head (HH) responses within each small ruminant health management practice studied in Kajiado and Marsabit Counties

Parameter	Kajiado (n=35)		Marsabit (n=28)	
	No. HH Respondent	%	No. HH Respondent	%
Anthelmintic use				
Yes Albendazole	23	65.7	12	42.9
Yes Levamisole	5	14.3	0	0.0
Yes both oral and Ivermectin Injection	7	20.0	0	0.0
None	0	0.0	16	57.1
Antibiotic use				
Yes – 1 product Tetracycline	3	8.6	8	28.6
Yes – > 2 products (Tetracycline, Penicillin/Amoxycillin , Tylosin)	32	91.4	0	0.0
None	0	0.0	20	71.4
Tick/flea control product				
Yes – 1 product Synthetic pyrethrin	26	74.2	0	0.0
Yes – > 2 products (Synthetic pyrethrin and Organochlorine)	8	22.9	0	0.0
None	1	2.9	28	100
Preventive Vaccine use				
Yes (CCPP, Enterotoxaemia, and SGP)	20	57.1	0	0.0
None	15	42.9	28	100
Do you have access to Vet services?				
Yes always	20	57.1	0	0.0
Yes but it is limited	7	20.0	6	21.4
No treat own animals	8	22.9	22	78.6
Do you report disease outbreak and to Who?				
Yes, Chief or Community disease reporter	11	31.4	15	53.6
Yes to Vet or Animal health technician	10	28.6	0	0.0
No	14	40.0	13	46.4

PPR knowledge and control strategies

PPR is still a new disease phenomenon amongst pastoralist communities in Kenya, it therefore has no local name and is often referred by the presenting clinical signs (Kihu et al 2012). Pastoralist refer to it as a disease that is unresponsive to treatment and has clinical manifestation of tearing, nasal discharge, emaciation, diarrhoea, mouth lesions and death. (Nyamweya et al 2010; Kihu et al 2012; Gitao et al 2014). In Kajiado county, PPR was referred to as 'Ngoroti' or 'Oludua' which means persistent diarrhoea. While in the Southern parts of Marsabit county, PPR was referred to as 'Lookiyooi' which is a Samburu and Rendille local name describing PPR clinical signs of bilateral nasal and ocular discharge with concurrent diarrhoea. However, in most instances in Kajiado and in Northern parts of Marsabit, PPR was confused with other diseases such as Contagious Caprine Pleuropneumoniae (CCPP), helminthiasis and tick borne disease such as babesiosis as noted by other researchers such as Nyamweya and colleagues (2010).

Knowledge of PPR clinical signs was higher (71.4%) amongst Marsabit HH surveyed when compared to Kajiado HH (51.4%). However, for both Kajiado

and Marsabit, small ruminant owners interviewed indicated that the greatest risk for PPR introduction into herds was from mixing herds at watering areas (Table 4). More than half of HH interviewed in both study areas indicated that they had not accessed PPR vaccine for their sheep and goats herds (Table 4). In addition, 62.9% of Kajiado livestock owners indicated that the main challenge seen in PPR vaccination campaigns was the lack of allocation of enough vaccines and activity days so as to ensure coverage of all animals in the herd. While in Marsabit, the most common challenge was the lack of access to PPR vaccines for herds located in satellite settlements (Table 4).

Table 4: Homestead head (HH) knowledge on PPR and control strategies

Parameter	Kajiado (n=35)		Marsabit (n=28)	
	No. HH Respondents	%	No. HH Respondents	%
List PPR Clinical signs				
Correctly listed signs	18	51.4	20	71.4
Confused clinical signs	10	28.6	3	10.7
Don't know signs	7	20.0	5	17.9
Given the listed signs has PPR occurred in your herd?				
Yes	8	22.9	17	60.7
No	27	77.1	11	39.3
How do animals get infected with PPR?				
Introduction of new stock into	11	31.4	5	17.9
Mixing of animals at watering areas	24	68.6	23	82.1
Don't know	0	0.0	0	0.0
How do you control PPR?				
Vaccination during outbreaks	30	85.7	11	39.3
Avoid infected areas	5	14.3	17	60.7
Don't know	0	0.0	0	0.0
Have you vaccinated your animals against PPR ?				
Yes	16	45.7	11	39.3
No	19	54.3	17	60.7
What are the Challenges facing small ruminant PPR vaccination activities?				
Lack of access especially for satellite/*Fora* herds	10	28.6	17	60.8
Too few vaccines/days given the large small ruminant herds	22	62.9	2	7.1
Financial constraints to pay for the whole herd	3	8.5	9	32.1

PPR vaccine has been shown to be highly effective in eliciting protective antibodies against all 4 lineages of the PPR virus. Furthermore, PPR vaccination or natural infection confers lifelong immunity to vaccinated animals (Barret et al 2006; FAO-UN/OIE 2015). All respondents in Kajiado and Marsabit elucidated these two facts. The small ruminant owners indicated that PPR vaccination was effective in stopping morbidity and mortality rates in herds even if administered during outbreaks and they also elucidated to the fact that once herds were vaccinated or infected, adult animals did not succumb to future outbreaks.

Small ruminant production Constraints and Preferred policy interventions

Table 5 summarises HH multiple set responses regarding prevalent diseases affecting sheep and goat herds as well as constraints and suggestions on disease control strategies. Surprisingly, PPR was not ranked first when surveyed livestock owners were asked to name in order of importance goat diseases that caused them the highest small ruminant losses in terms of morbidity or mortality. In Marsabit, PPR was ranked second to CCPP in goats while in Kajiado it was ranked third, the first being CCPP and second helminthiasis. The finding supports the view of the global PPR strategy that recommends that PPR control programmes should incorporate control of other important small ruminant diseases such as CCPP and helminthiasis. This would give livestock keepers more incentives to invest in preventive vaccination of their small ruminant herds (Wolf 2005; FAO-UN/OIE 2015).

Small ruminant production constraints

Sixty percent of small ruminant owners in Kajiado indicated that lack of quality drugs especially anthelmintics was the main problem hindering their livestock disease control efforts. The also identified lack of regular veterinary health and extension services (31.4%) and lack of early warning of disease outbreaks (8.6%) as among the 3 important constraints. In Marsabit, the main constraint was lack of veterinary animal health services (52.4%) specifically vaccines and extension services, the second constraint was lack of outlets to buy drugs like anthelmintics (35.7%) and the third challenge was the lack of inclusion when disease control decisions were being made with 7.1% of respondents remarking that they wanted to be included in the decision of when and what type of vaccine should be given to their herds (Table 5). The survey findings indicate that pastoralists are aware of the main drivers of diseases in their production systems and their views are largely similar with those of research findings. Drivers of disease burden include climatic variability that is changing the transmission dynamics of vector borne pathogens such as Rift valley fever virus (Perry et al 2013), land tenure systems have also resulted in movement restriction (Boone et al 2007) hence limiting the pastoralist traditional practice of avoidance. Pastoralist sedentarization that also increases pathogen contamination load in the environment resulting in increased incidences of disease outbreaks (Perry et al 2013).

Table 5: Multiple Response set of homestead head (HH) on prevalent diseases, constraints hindering disease control and preferred policy interventions

Parameter	Kajiado (n=105)		Marsabit (n=84)	
	No. Responses	%	No. Responses	%
Prevalent Sheep diseases				
Helminthiasis/diarrhoea in young	35	33.4	26	31.0
Enterotoxaemia	18	17.1	17	20.2
Pneumonia	25	23.8	21	25.0
Sheep and Goat Pox (SGP)	27	25.7	20	23.8
Prevalent Goat diseases				

CCPP	40	38.1		32.1
PPR	10	9.5	14	19.0
Helminthiasis/diarrhoea in young	37	35.2	8	9.5
Tick borne infections (Babesiosis and Heart water)	7	6.7	12	14.3
Contagious ecthyma (Orf)	11	10.5	2	2.4
Sheep and Goat Pox (SGP)	0	0.0	6	7.1
Constraints in disease control				
Lack of quality drugs (anthelmintics)	63	60	30	35.7
Lack of veterinary services (Vaccination and Extension services)	33	31.4	44	52.4
Lack of early warning of outbreaks so as to allow avoidance of areas or vaccinate herds	9	8.6	0	0.0
High prevalence of diseases when compared to the past	0	0.0	4	4.8
Lack of inclusion when designing disease control activities	0	0.0	6	7.1
Preferred small ruminant disease control policy interventions				
Provision of regular and timely veterinary services(vaccination, extension, response to outbreaks)	85	90.5	71	84.5
Set up drug outlets (at local market centres) and ensure they stock quality drugs (anthelmintics)	10	9.5	10	11.9
Improve market, communication and transport infrastructure	10	9.5	3	3.6

Preferred policy interventions for disease control

Livestock owners were asked to mention policy interventions that could be implemented to complement their small ruminant disease control practices (Table 5). Multiple set responses indicated that 90% of Kajiado HH wanted provision of regular veterinary services such as extension and vaccination services. In addition, 9.5% of HH indicated that ensuring drug outlets sold quality drugs especially anthelmintics as well as improving mobile phone connectivity would enhance their disease control strategies. In Marsabit 84.5% of small ruminant owners indicted that better access to veterinary services was key in supporting their disease control efforts. In addition, 11.9% of HH felt that setting up veterinary drug sale outlets would also support small ruminant disease control efforts. The policy suggestions suggest that small ruminant owners know what disease control policies can support them. It is therefore important that any livestock disease control strategy engages them especially with regard to ensuring regular provision of extension and animal health services. Additionally, public-private sector initiatives can improve access to animal health inputs as well as enable setting up of marketing, communication and transport infrastructure (Muthee 2006).

Conclusion and Recommendations

Based on the survey findings, the study can conclude that sheep and goat production is still an important livelihood strategy for Kajiado and Marsabit pastoralist communities. However, there exists differences in small ruminant disease control practices amongst Kajiado and Marsabit communities that are driven by the level of access to veterinary services, animal health inputs and livestock markets. The study recommends that small ruminant disease control programmes be tailored to specific geographical areas based on the areas social and economic settings. In addition, with regard to PPR control, Kajiado

communities would be willing to pay for vaccines when compared to Marsabit communities as they are able to recover the input expense after sale of their animals. While in Marsabit PPR vaccination programmes should continue to be offered as free public good services as the small ruminant production systems in Marsabit are still driven by subsistence consumption. In addition, PPR vaccination campaigns should target small ruminant herds that are in satellite or mobile settlements as they usually have a higher number of animals when compared to permanent settlement herds. Policy makers in both Kajiado and Marsabit should include CCPP vaccination as recommended in the PPR global strategy. Further, during PPR vaccination campaigns the anthelmintic product selected should first be tested for efficacy this will be especially important for Kajiado county small ruminant herds.

Future research areas

Future research areas should determine the efficacy and resistance of anthelmintic drugs especially in Kajiado County, Kenya.

Acknowledgements

The authors would like to thank USAID Feed the Future Innovation Lab for Adapting Livestock Systems to Climate Change, Colorado State University, USA and National Drought Monitoring Authority Kenya for funding the field research. The research would not have been possible without the support of the County veterinary officials in Kajiado and Marsabit as well as the small ruminant owners who agreed to participate in the study. Sincere gratitude also goes to Dr. Stephen Kimondiu of Vétérinaires Sans Frontier –Germany for logistical support while in Marsabit.

References

Catley A, Alders R G and Wood J L N 2011. Participatory epidemiology: Approaches, methods, experiences. The Veterinary Journal. DOI: 10.1016/j.tvjl.2011.03.010. Retrieved on October 16 2015 from http://origem.info/FIC/pdf/catley_participatory_epidemiology_Vet_J_2011.pdf

Chantarat S, Mude A G, Barret C B and Carter M R 2010. Designing index based livestock insurance for managing asset risk in Northern Kenya. Journal of Risk and Insurance 80(1): 2015-237.

Barret T, Paul-Pierre P and Taylor W P 2006. Rinderpest and *Peste des Petits Ruminants*: Viral plagues of large and small ruminants. Elsevier Limited, Oxford UK. ISBN-13: 978-0-12-088385-1.Pp 68-85.

Behnke R and Muthama D 2011. The Contribution of Livestock to the Kenyan Economy. Intergovernmental Authority on Development (IGAD)/ Livestock Policy Initiative (LPI). Working Paper No. 03-11. Pp 20-21, 36-40. Retrieved on October 16 2015 from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.386.3966&rep=rep1&type=pdf

Bekure S, Leeuw P N, Grandin B E and Neate P J H 1991. Maasai Herding: An Analysis of the Livestock Production System of the Maasai Pastoralists in Eastern Kajiado District,

Kenya. Addis Ababa, Ethiopia: ILCA.Pp1- 154. Retrieved on October 16 2015 from http://www.ilri.org/InfoServ/Webpub/fulldocs/X5552e/X5552E00.HTM

Biernacki P and Waldorf D 1981. Snowball sampling: Problem and Techniques of chain referral sampling. Sociological Methods and Research. 10: 141-163.

Boone R B, Lackett J M, Galvin K A, Ojima D S and Compton J T 2007. Links and broken chains: evidence of human-caused changes in land cover in remotely sensed images. Environmental Science and Policy 10: 135-149.

Ferrè C 2009. Age at first child Does education delay fertility timing? World Bank Policy Research Working paper Number 4833. Pp 47. Retrieved on October 16 2015 from https://openknowledge.worldbank.org/bitstream/handle/10986/4029/WPS4833.pdf?sequence=1

Food and Agriculture Organisation of the United Nations (FAO-UN) 2013 a. Cell phones revolutionizing Kenya's livestock sector. Retrieved on October 16 2015 from http://www.fao.org/news/story/en/item/170807/icode/

F**ood and Agriculture Organisation of the United Nations (FAO-UN) 2013 b**. Supporting livelihoods and building resilience through *Peste des Petits Ruminants* (PPR) and small ruminant diseases control. Animal Production and Health Position Paper. Rome. Pp 16. Retrieved on October 16 2015 from http://www.fao.org/docrep/017/aq236e/aq236e.pdf

Food and Agriculture Organisation of the United Nations (FAO-UN)/ World Organisation for Animal Health (OIE) 2015. Global Strategy for the control and eradication of PPR. OIE ISBN 978-92-9044-989-8 and FAO ISBN 978-92-5-108733-6.P. Pp13-16. Retrieved on October 16 2015 from http://www.fao.org/3/a-i4460e.pdf

Fratkin E 2001. East African Pastoralism in Transition: Maasai, Boran and Rendille Cases. African Studies Review. 44(3):1-25. Retrieved on October 16 2015 from http://www.smith.edu/anthro/documents/FratkinASRr-2-.pdf

Fratkin E and Roth E A 2005. As Pastoralists Settle: Social, Health, and Economic Consequences of Pastoral Sedentarization in Marsabit District, Kenya. Kluwer Academic/Plenum Publishers New York. Pp 29-52, 105-136.

Gitao C G, Ithinji D G, Gitari R and Ireri R G 2014. The confirmation of Peste des petit ruminants (PPR) in Kenya and perception of the disease in West Pokot. Research Opinions in Animal and Veterinary Sciences. 4(6): 312-317. Retrieved on October 16 2015 from http://www.roavs.com/pdf-files/Issue-6-2014/312-317.pdf

Government of Kenya (GoK) 2008. Situation analysis and Concept note for the Emergency project for the control of *Peste des petits ruminants* in Kenya. As of June 2008. Pp 1-19.

Government of Kenya (GoK) 2015. Draft national strategy for the progressive control of Peste des Petits Ruminants in Kenya. Zero Draft as of February 2015. Pp 1-65.

Kajiado County Integrated Development Plan (Kajiado-CIDP) 2013-2017. Retrieved on October 16 2015 from https://www.kajiado.go.ke/?mdocs-file=9312&mdocs-url=9311

Kenya National Bureau of Statistics (KNBS) 2009. National census report. Retrieved on October 16 2015 from https://www.opendata.go.ke/Agriculture/Census-Vol-II-Q-11-Livestock-population-by-type-an/qbvv-8bjk

Kihu S M, Njagi L M, Njogu G N, Kamande J N and Gitao C G 2012. Peste des petits ruminants in Kenya; Pastoralist knowledge of the disease in goats in Samburu and Baringo Counties. Research Opinions in Animal and Veterinary Sciences.2 (11): 544-553. Retrieved on October 16 2015 from http://www.roavs.com/pdf-files/Issue_11_2012/544-553.pdf

Kihu S M, Gachohi M, Ndungu E K, Gitao C G, Bebora L C , Njenga J M, Wairire GG, Maingi N, Wahome R G and Ireri R 2015. Sero-epidemiology of Peste des petits ruminants virus infection in Turkana County, Kenya. BMC Veterinary Research. 11:87. Retrieved on October 16 2015 from http://www.biomedcentral.com/content/pdf/s12917-015-0401-1.pdf

König Z E, Mirkena T, Strandberg E, Audho J, Ojango J, Malmfors B, Okeyo A W and Philipson J 2015. Participatory definitions of breeding objectives for sheep breeds under pastoral systems- the case of Red Maasai and Dorper sheep in Kenya. Tropical animal health and Production. Retrieved on October 16 2015 from http://link.springer.com/article/10.1007%2Fs11250-015-0911-7

Kosgey I S, Rowlands G J, Van Arendonk J A M and Baker R L 2008. Small ruminant production in small holder and pastoral/extensive farming systems in Kenya. Small Ruminant Research 77:11-24.

Marsabit County Integrated Development Plan (Marsabit-CIDP) 2013-2017. Retrieved on October 16 2015 from http://marsabit.go.ke/wp-content/uploads/2015/04/County-Integrated-Development-Plan.pdf

Morara M K, MacOpiyo L and Kogi-Makau W 2014. Land Use, land cover cjange in urban pastoral interface. A case of Kajiado County, Kenya. Journal of Georgraphy and Regional Planning. 7(9): 192-202. Retrieved on October 16 2015 from http://www.academicjournals.org/journal/JGRP/article-full-text-pdf/0EAE70C48265

Muse E.A, Karimuribo E D, Gitao C G, Misinzo G, Mellau L S B, Msoffe P L M, Swai E S and Albano M O 2012. Epidemiological investigation into the introduction and factors for spread of Peste des Petits Ruminants, Southern Tanzania. Onderstepoort Journal of Veterinary Research. (79): 457.Pp 1-6. Retrieved on October 16 2015 from http://www.ojvr.org/index.php/ojvr/article/viewFile/457/524

Muthee A 2006. Kenya Livestock Sector Study: an Analysis of Pastoralist Livestock Products Market Value Chains and Potential External Markets for Live Animals and Meat. Deloitte Consulting Limited, African Union- InterAfrican Bureau for Animal Resources (AU-IBAR). Retrieved on October 16 2015 from http://www.bdsknowledge.org/dyn/bds/docs/552/KenyaLivestockValueChainReport.pdf

Mwanyumba P M, Wahome R G, MacOpiyo L and Kanyari P 2015. Pastoralist livelihoods, resources and strategies in Garissa County, Kenya. Livestock Research for Rural Development 27(10). Article number 202, retrieved on October 16 2015 from http://www.lrrd.org/lrrd27/10/mwan27202.html

Ng'asike J T 2011. Turkana children's rights to education and indigenous knowledge in science teaching in Kenya. New Zealand Journal of Teachers' work 8(1): 55-67. Retrieved on October 16 2015 from http://www.teacherswork.ac.nz/journal/volume8_issue1/ngasike.pdf

Njanja J C, Gathuma J M, Gitau G K, Njeruh F M and Kinuthia R N 2003. Pastoralists' perception of livestock production systems and opportunities for improvement in South-western Marsabit, Kenya. Livestock Research for Rural Development 15(7). Retrieved on 15th November 2015 from http://www.lrrd.org/lrrd15/7/njan157.htm

Notenbaert M O, Davies J, De Leeuw J, Said M , Herrero M , Manzano P , Waithaka M, Aboud A and Omondi S 2012 . Policies in support of pastoralism and biodiversity in the heterogenous dry lands of East Africa. Pastoralism: Research, Policy and Practice. 2:14. Retrieved on October 16 2015 from http://www.pastoralismjournal.com/content/2/1/14

Nyamweya M , Ounga T, Regassa G and Maloo S 2010. Technical brief on Peste des petits ruminants ELMT (Enhanced Livelihood in the Mandera Triangle) Livestock services technical working group. Pp1-5. Retrieved on October 16 2015 from http://www.elmt-relpa.org/FCKeditor/UserFiles/File/elmt/200912/PPRTechncial%20Brief%20Nov09[1].pdf

Onono O J, Wieland B and Rushton J 2013. Factors influencing choice of veterinary service provider by pastoralist in Kenya. Tropical Animal Health and Production 45:1439-1445.

Perry B D, Delia G and Sones K 2013. Current drivers and future directions of global livestock disease dynamics. Proceedings of the National Academy of Sciences of the United States of America. 110 (52): 20871- 20877. DOI: 10.1073/pnas.1012953108. Retrieved on October 16 2015 from http://www.pnas.org/content/110/52/20871.full

Rutto J K, Odhiambo M O, Njuguna E M and Murithi F M 2013. Determinants of market participation decisions in small ruminants' market by livestock keepers in Isiolo and Marsabit Districts, Kenya. Livestock Research for Rural Development 25:3. Article number 42, retrieved on October 16 2015 from http://www.lrrd.org/lrrd25/3/rutt25042.htm

Schwartz H J, Shabaani S and Walther D 1991. Marsabit District Range Management Handbook of Kenya Volume II. Ministry of Livestock Development, Nairobi, Kenya. Pp 164.

Wolf C 2005. Producer Livestock Disease Management Incentives and Decisions. International Food and Agribusiness Management Review. 8(1): Pp 46-61. Retrieved on October 16 2015 from http://ageconsearch.umn.edu/bitstream/8179/1/0801wo01.pdf

World organization for animal health (OIE) 2013. Peste Des Petits Ruminants. Chapter 2.7.11:Pp1–14. Retrieved on October 16 2015 from http://www.oie.int/fileadmin/Home/fr/Health_standards/tahm/2.07.11_PPR.pdf

Received 20 October 2015; Accepted 4 January 2016; Published 1 February 2016

Go to top