Improving small ruminant productivity in pastoral systems of Kenya

Baseline household survey report 2021

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Baseline household survey report 2021

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Executive summary

The arid and semi-arid lands (ASALs) in Kenya have high levels of poverty exacerbated by poor accessibility and frequent droughts. Sheep and goats play an integral role in the lives of pastoral communities living in the ASALs. However, the sheep and goats reared in these regions are mainly indigenous breeds with low potential for meat and milk production. Since 2019, the International Livestock Research Institute (ILRI) in collaboration with the Ministry of Agriculture, Livestock and Fisheries and Irrigation (MALFI) in Kenya has been implementing activities to enhance livelihoods and resilience of pastoral communities in Turkana, Isiolo and Marsabit through herd management and community-based interventions for their sheep and goats. To determine the sheep and goats available and the production environment, a survey was carried out for randomly selected households in specific locations of Isiolo, Marsabit and Turkana counties.

This report presents information generated from the baseline as a guide for best-bet interventions for sustainable sheep and goat improvement in the pastoral flocks. In all the three counties, most households (73%) are headed by men. The level of education of the household heads differed across the counties with more men in Isiolo and Marsabit having a primary level of education than in Turkana County where 83% of them had no formal education. Land and water resources are communally owned across the three counties. Communities obtain water for their livestock from different sources and indicated that the key challenge in accessing water is the long distances to watering points. Both sheep and goats are grazed in mixed flocks. Though communities appeared to own large numbers of sheep and goats, it was interesting to find that specific numbers of the animals that were herded communally belonged to individual households, which owned an average of 4–10 animals, within the communal flocks. Households headed by men tended to own more animals than those headed by women. Mating of animals within the flocks was not controlled hence inbreeding could be quite high despite some limited efforts to identify specific males for breeding within the flocks. Male animals not identified for breeding are generally castrated when they are mature. The pastoralists desired to improve the mature size and body condition of their animals but did not indicate how they could achieve desired change. They were also knowledgeable of the disease conditions affecting their animals and used conventional veterinary medicines to treat their flocks. Availability and reach of animal health service providers to these communities was a challenge compounded by lack of infrastructure. Droughts adversely affect the different livestock reared. Following drought, the communities strived to rebuild their flock sizes mainly by purchasing animals where available. Training and capacity development for the pastoralists in these areas were requested in order to enable better animal husbandry practices, breeding management, fodder and animal health management. Additionally, the farmers expressed a desire to engage in groups which seek to improve the productivity of small ruminants within their areas. Groups provide a good platform for discussing and co-creating solutions and implementing community-based breeding programs.

1. Introduction

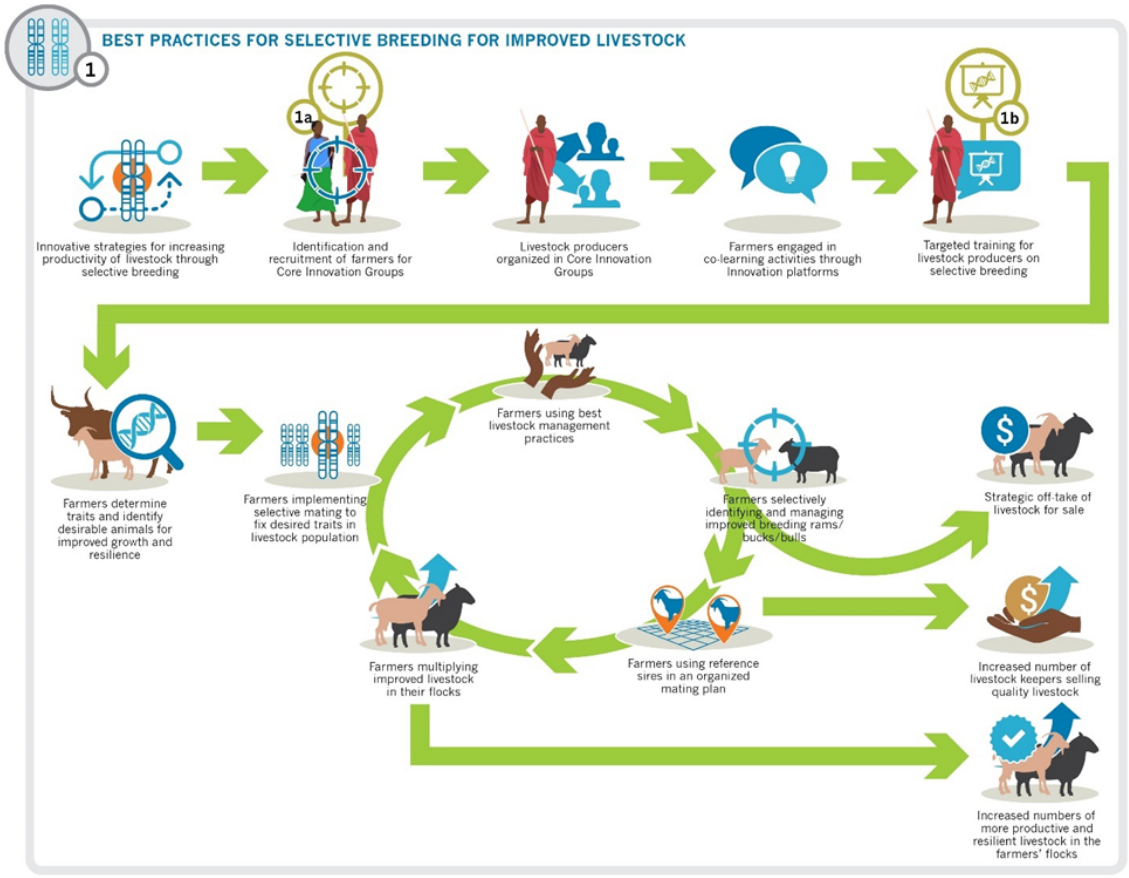
The arid and semi-arid lands (ASALs) comprise 60% of the Kenya's land mass and are estimated to host 70% of the country's livestock. The ASALs are predominantly used for pastoralism and extensive grazing. ASAL areas have the highest levels of poverty and gender inequality in the country, exacerbated by poor accessibility and frequent droughts. Sheep and goats play an integral role in the lives and livelihoods of pastoral communities in the ASALs through the sale of products such as milk, live animals and manure. They also complement other livestock species in the utilization of feed resources and are often owned and managed by women and children (Kosgey et al. 2004; Peacock 2005). Sheep and goats are important in ensuring food security as they provide households with both nutrition and disposable income (Ojango et al. 2016). Compared to cattle and camels, sheep and goats are easier to acquire and manage due to their low initial investment cost, short generation interval, low body mass and adaptive traits suitable for the ASALs. Their production within the pastoral communities tends to be low input–low output based on naturally available resources. Productivity levels fluctuate and output levels depend on the number of animals reared rather than the quality of the animals.

The sheep and goat breeds found in the pastoral communities in Kenya are mainly indigenous to the region with low potential for meat and milk production. Most livestock improvement programs in the country have resorted to cross breeding the local breeds with imported exotic breeds or directly replacing the indigenous breeds (Ojango et al. 2010; Kosgey et al. 2006). However, for sustainable improvement of livestock in the ASALs, the adaptive traits of the indigenous breeds are critical. Progressive selection and breeding within the indigenous breeds, though slow in attaining progress would result in long-term sustained genetic gains. For any livestock improvement program, livestock-keeping communities, notably pastoralists, must be involved and their needs taken into consideration. This enables clarity when defining the breeding objectives and creates a sense of ownership of the improvement envisaged by the community. Community involvement also facilitates adaptation and adoption of technologies for the targeted environment (Moll et al. 2007; Roessler et al. 2008).

From 2019, the International Livestock Research Institute (ILRI) in collaboration with the Ministry of Agriculture, Livestock and Fisheries and Irrigation (MALFI) in Kenya has been implementing activities to enhance the livelihoods and resilience of pastoral communities in Turkana, Isiolo and Marsabit through herd management and community-based breeding interventions for their sheep and goats. The activities are aimed towards adding value to engagements initiated in the communities through a United States Agency for International Development (USAID)-funded project; Accelerated Value Chain Development (AVCD), which was implemented by ILRI in partnerships with the local private sector actors and livestock keepers. The key objectives in continuing interventions initiated by AVCD are to enhance knowledge and develop capacity within the pastoralist communities on the potential of the existing genetic diversity in their livestock herds, to facilitate adoption of management practices to improve their productivity, and to promote behaviour change and practices for more commercial livestock production enterprises.

Working collaboratively with partners engaged in livestock development in the pastoral communities, a possible pathway to achieve impact in the pastoral communities using the sheep and goat value chain was developed (Figure 1).

Figure 1: Impact pathway of best practices for selective breeding and management to enable pastoral communities achieve enhanced returns from their livestock enterprises



To determine the nature of sheep and goats available in the counties and the nature of the production environment, a targeted survey was carried out for randomly selected households in specific locations of Isiolo, Marsabit and Turkana counties. This report presents information generated from the baseline as a guide to determining the best-bet options for sustainable sheep and goat improvement in the pastoral flocks.

2. Study area

The baseline study was conducted in Isiolo, Marsabit and Turkana counties identified for the Regional Pastoral Livelihoods Resilience Project (RPLRP) Kenya by MALFI (Figure 2). Within each county, sites for implementing activities were collaboratively determined with the county livestock departments using the following information:

County priorities for livestock development

Main markets for livestock in the county

The population densities of communities and their location around markets

Communities living within the Northern Rangeland Trust Conservancies (https://www.nrt-kenya.org/)

Activities of other development partners involved in livestock improvement in the county

Migration patterns of communities in the different areas of the county

Accessibility and communication, notably transport systems and mobile network coverage

Security within the communities for undertaking long-term activities

Figure 2: Map of Kenya indicating the location of the counties involved in the project

Isiolo County has three sub-counties, 10 wards, 22 locations and 43 sub-locations, with an estimated human population of 268,002 (KPHC 2019). The population comprises communities from different groups mainly, the Boran and Sakuye, Turkana, Samburu, Meru, Somali and communities from other parts of the country in smaller numbers. Most of the land (80%) is communally owned and is under the trustee of the county government. Communities practise nomadic pastoralism. Although livestock keeping is a key economic activity in the county, livestock are valued more as a social asset than as a source of income for households.

The Nakuprat-Gotu conservancy in Ngaremara Ward was selected as the site to implement the interventions on improving productivity of sheep and goats among the pastoral communities of Isiolo. Ngaremara Ward covers an area of 71,254 hectares and has an estimated human population of 5,520 (KNBS 2010).

Marsabit County covers an area of 70,961 km2 with an estimated population of 459,785 people (53% male and 47% female) (KPHC 2019). The county has four constituencies (Saku, North Horr, Laisamis and Moyale). Marsabit is one of the driest counties of Kenya, with temperatures ranging between 10.1°C during the cold months (June and July) and 30.2° C during the hot months (January–March and September–October). The county is populated by various ethnic communities including the Rendille, Gabbra and Borana, Samburu and Turkana.

The Songa Conservancy in Karare Ward was selected for interventions on improving productivity of sheep and goats. Karare Ward covers an area of 877.30 km2 with an estimated population of 16,100 people.

Turkana County covers an area of 77,000 km2 with an estimated population of 926,976 persons according to the Kenya Population and Housing Census 2019 (KPHC) results. The county is divided into six sub-counties namely, Turkana Central, Turkana East, Turkana North, Turkana West, Turkana South and Loima; 17 divisions and 56 locations that are further subdivided into 156 sub-locations. Land is communally owned and the Turkana people are the dominant community. The Turkana are nomadic pastoralists who mainly keep cattle, goats, sheep, camels and donkeys. The animals are their main source of food and wealth.

Two sites, Napeikar and Kapua sub-locations in Turkwel and Kalokol wards, respectively, were selected for implementation of interventions for improving productivity of sheep and goats. Turkwel Ward covers an area of 3518 km2 with an estimated human population of 47,399, while Kalokol Ward covers an area of 1,135 km2 with an estimated human population of 19,477 people (KNBS 2009)

Forming core innovation groups

In each site identified in the counties, meetings were held with community members and each community nominated 30 participants representing different households to closely engage with the ILRI-RPLRP team in learning and adopting best practices within their flocks. The members identified formed a core innovation group (CIG). To ensure the benefits from project engagement within the wider community, each member within the CIG was mandated to teach at least 10 different households the new practices learned, and this knowledge was to be cascaded to additional members accordingly. Details on the methodology used for training and interacting with community members, identification of CIG members and their expected roles are outlined in Module 1-Best practices. In brief, the following criteria was used to select the CIG members:

- Members had to include representatives from all the villages and all language groups in the site, paying attention to ensure any disadvantaged groups were represented.
- At least 25% of the CIG members had to be of any given gender. This ensured participation of both men and women in the learning activities.
- Each CIG household represented was required to own some sheep and/or goats.
- CIG members were required to indicate their willingness to participate and contribute to the baseline survey, and to be willing to reach out and share knowledge gained with other members of the community.

3. Data collection and analyses

Data was collected using the Android-based Open Data Kit (ODK) mobile application (https://opendatakit.org/). This enabled real-time entry of information provided by each household into a central database, thus reducing secondary errors associated with paper-based data collection and entry. Information was collected in collaboration with local extension personnel from the Ministry of Livestock Development alongside enumerators engaged from the communities in each county by the project. Training on interacting with households and use of paperless data capture tools was provided to the teams within each county prior to implementation of the survey.

A total of 102 CIG members in the three counties participated in the survey (Isiolo 21, Marsabit, 28 and Turkana 53). The information collected sought to document the characteristics of the various livestock keepers and their household demographics, their sheep and goat flock structures, attributes considered important in the animals and requisite management practices adopted.

Qualitative and quantitative methods were used to analyse the data collated. Descriptive statistics on the communities and practices related to their sheep and goat populations were generated and tests for statistical significance on parameters carried out using either Chi-square (X^2) or t-tests. In instances where the respondents were requested to rank their choices, the equation adapted from Bett et al. (2009) was used to develop an index (I_i) and obtain an overall ranking.

$$I_i = \sum_{j=1}^{n} r_j X_{ji} \Big/ \left(\sum_i \sum_{j=1}^{n} r_j X_{ji} \right)$$

equation 1

Where X_{ji} is the number of respondents giving rank j, j = 1, 2, 3, 4, 5 to trait i, where i = trait (age, sex, size, body condition and breed). rj is the weight corresponding to rank j. The weight is given by r = 5, 4, 3, 2, 1. The weights given for each rank were based of the order of preference, with the highest rank having a higher weight and the lowest rank having a lower weight.

4. Results

4.1 Household characteristics

A majority of the households from all three counties were headed by men (Table 1). It was notable that in Turkana County, a significantly higher proportion of the households were headed by women compared to households in Isiolo and Marsabit ($P<0.05$, Table 1).

Table 1: Gender of the household head in project sites of Isiolo, Marsabit and Turkana counties

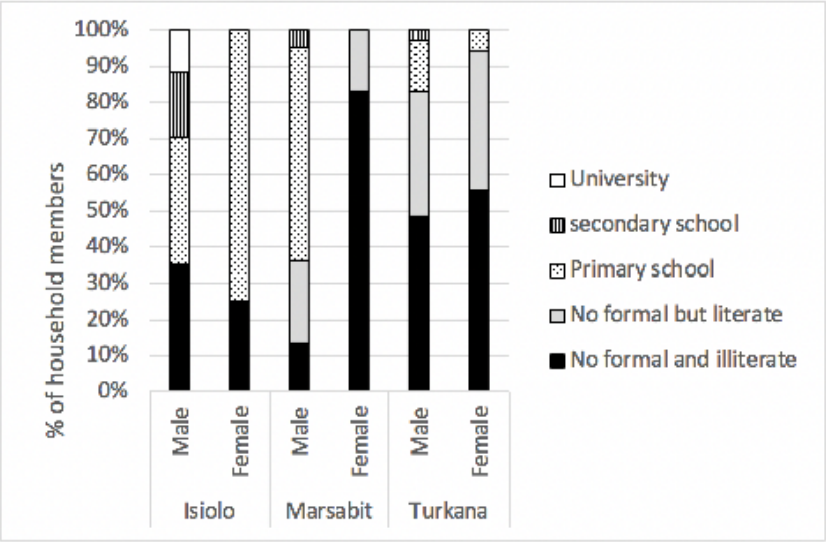
County	Number of households (N)	Proportion of households headed by different gender groups (%N)	
		Men	Women
Isiolo (Nakuprat-Gotu)	21	81%	19%
Marsabit (Songa-Karare)	28	79%	21%
Turkana	53	66%	34%
Total	102	73%	27%

The overall average age for those heading households was 45 years. Turkana County had more household heads above 45 years of age (76%) compared to Isiolo (45%) and Marsabit (46%). Differences in age depending on the gender of the household head were not significant. In all the three counties, a majority of the household heads indicated that they were agropastoralists, growing some crops in addition to keeping animals (85% in Isiolo, 95% in Marsabit and 53% in Turkana). Turkana was the only county in which a significant proportion of the household heads indicated they were also engaged in non-farm employment (26%) and 14% were full-time pastoralists not involved in any crop-based activities.

The level of education of those heading households differed depending on their gender as illustrated in Figure 3. In Isiolo, none of the women heading households had more than a primary level of education while in Marsabit none of the women heading households had any formal education. More men heading households in Isiolo had a secondary level of education compared to those in Marsabit and Turkana. In Turkana County, >50% of the household heads had no formal education.

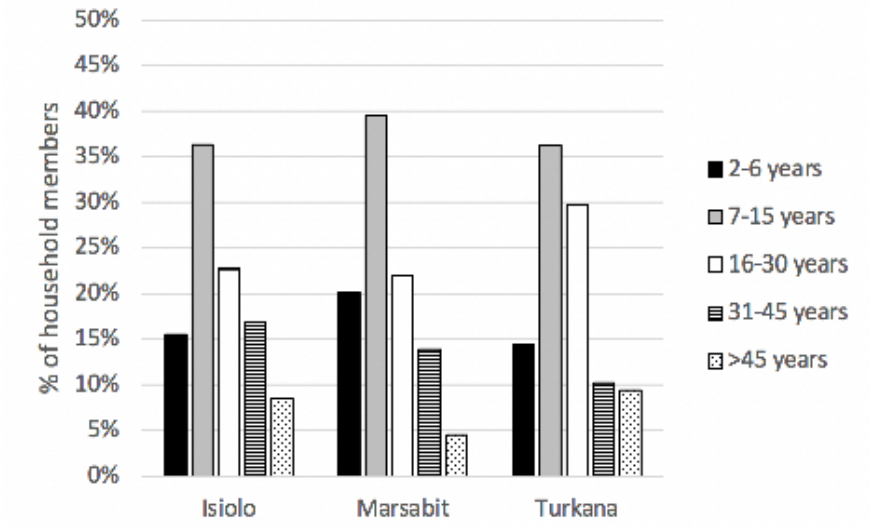
Understanding the level of education and literacy in communities is important in planning interventions that require capacity development. Where literacy levels are low, tools and methods need to be adapted to enable participation and learning at all levels. The low literacy levels in the ASALs also highlight the need for additional efforts by the national government to avail adult learning interventions in pastoral communities.

Figure 3: Education level of household heads by gender in the three counties



The average number of members in a household in all the counties was 8 ± 3 persons. Differences in household composition by gender across the counties were not significant. The general composition of households by age groups within the three counties is illustrated in Figure 4. There was a higher proportion of children within the school going age group (7–15 years, >36%) in all households across the counties. Generally, youth and young adults (16–30 years) comprised 25 % of the household members while the middle age adults (31–45 years) comprised 13% of household members. Marsabit County had a higher proportion of children below six years (20%) compared to Isiolo (16%) and Turkana (14%) (Figure 4).

Figure 4: Proportion of household members of different age groups in the three counties



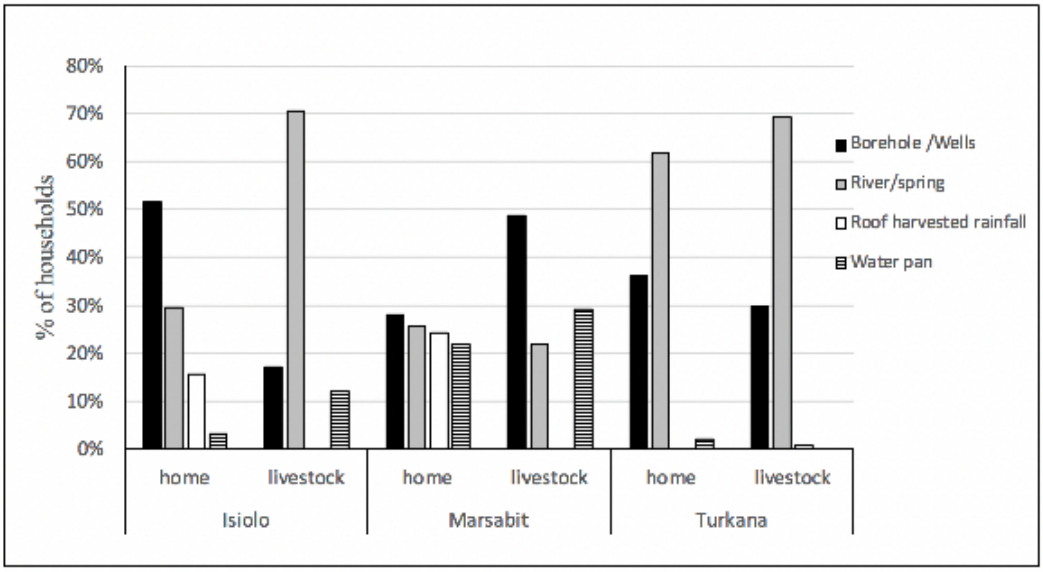
4.2 Resource endowment

Water sources and use

In all the three counties, the land and water resources were communally owned. The main sources of water in Isiolo and Turkana were rivers and springs, while in Marsabit the main source of water was boreholes or wells (Figure 5). It was notable that except for communities in Turkana, households accessed water from different sources depending on whether the water was for their livestock, or for domestic purposes. In Isiolo, water from borehole/wells was mainly used for domestic purposes, while water for livestock was mainly sourced from rivers and springs. Water for domestic

use in Marsabit was obtained from all the different sources, but water for livestock was mainly from boreholes/wells (Figure 5). The respondents indicated that water used for domestic purposes was mainly carried from the source by adult females within the household.

Figure 5: Sources of water used for domestic purposes and livestock production in the three counties



In the ASALs, water tends to be one of the most limiting factors for livestock production and is often a source of conflict between communities. Pastoral livestock keepers migrate their flocks in search of water and pastures. Over time, community settlements with large herds of animals that form around key water points have resulted in degradation of the environment.

Constraints identified in the access to water by the communities are presented in Table 2. In all three counties, long distance to watering points was noted as a critical constraint by a higher proportion of households, followed by seasonality in the supply of water. In Marsabit County, insecurity was noted to be the second most important constraint to water access (Table 2).

Table 2: Key constraints to water access in the different counties

	Proportion of respondents in each county (% N)		
Constraint	Isiolo N=21	Marsabit N=28	Turkana N=53
High cost	6%	2%	1%
Insecurity	0%	36%	0%
Long distance to water point	47%	47%	34%
Poor water quality	18%	0%	28%
Seasonality in supply	29%	16%	37%

Goat resources

The communities appeared to own large numbers of goats, which are herded extensively. It was, however, interesting that though the animals are herded communally in large groups, individual households owned specific numbers of animals in the flocks. The average number of goats owned by the individual households in Isiolo (10.7 ± 26.7) was significantly larger ($P<0.05$) than that in Marsabit (4.6 ± 4.3) and Turkana (6.4 ± 5.8). The main breeds of goats found in the three counties were Galla, Small East African (SEA) and crosses between the Galla and SEA. The average number of SEA goats kept in Turkana was significantly higher than in Marsabit ($p<0.05$). Ownership of the different goat breeds in the community flocks by male- and female-headed households is illustrated in Table 3.

Goats at a market in Isiolo County (photo credit: ILRI/Julie Ojango).

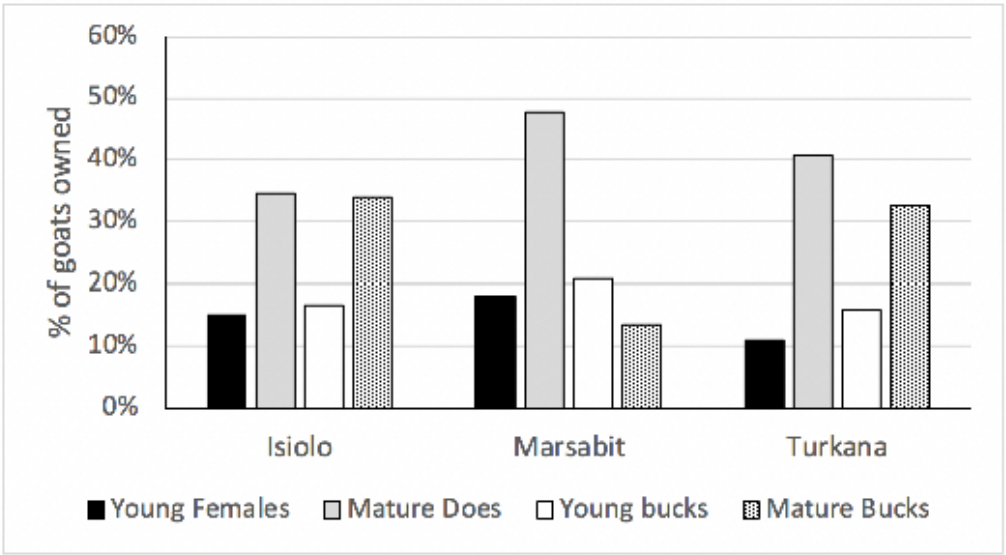
Table 3: Average number of goats of each breed owned by households headed (HH) by men and women in the three counties

	Average number of goats owned (±SD) by each household					
	Isiolo		Marsabit		Turkana	
	Women HH (N=4)	Men HH (N=16)	Women HH (N=6)	Men HH (N=23)	Women HH (N=15)	Men HH (N=38)
Breed						
Galla	6.7 ± 6.4	3.8 ± 1.9	--	10.0	5.0	9.4 ± 4.4
Small East African (SEA)	--	--	3.3 ± 2.4	4.7 ± 4.6	6.7 ± 5.5	6.1 ± 6.0
Galla x SEA	3.0 ± 2.0	12.8 ± 30.8	--	--	--	--

In Isiolo, households headed by women owned more purebred Gala goats than those headed by men, while male-headed households tended to own more of the Galla and SEA crosses. In Marsabit, households headed by men tended to own more goats than those headed by women, while in Turkana, differences in the average number of goats owned between female- and male-headed households were not significant.

Across all counties, mature female goats comprised a larger proportion of the flock than animals of other categories (Figure 6). Households in Isiolo and Turkana counties also retained a large proportion of mature bucks in their flocks, while those in Marsabit had a higher proportion of young males compared to mature males.

Figure 6: Relative proportion of different categories of goats owned by the households in the three counties



Sheep resources

All the pastoralists kept sheep alongside their goats. The average number of sheep owned by each household in the different counties was 7.5 ±14.1, 2.6 ± 2.1 and 3.6 ± 2.5 animals in Isiolo, Marsabit and Turkana, respectively. Notably, the average number of sheep owned by households in the three counties was lower than the average number of goats. The dominant sheep breed owned in the three counties was the Blackhead Persian (BHP) followed by its cross with the Red Maasai (RM). The number of sheep owned differed significantly ($P<0.05$) depending on the breed type and the gender of the household head in Isiolo County, with high numbers of the BHP owned by male-headed households (Table 4).

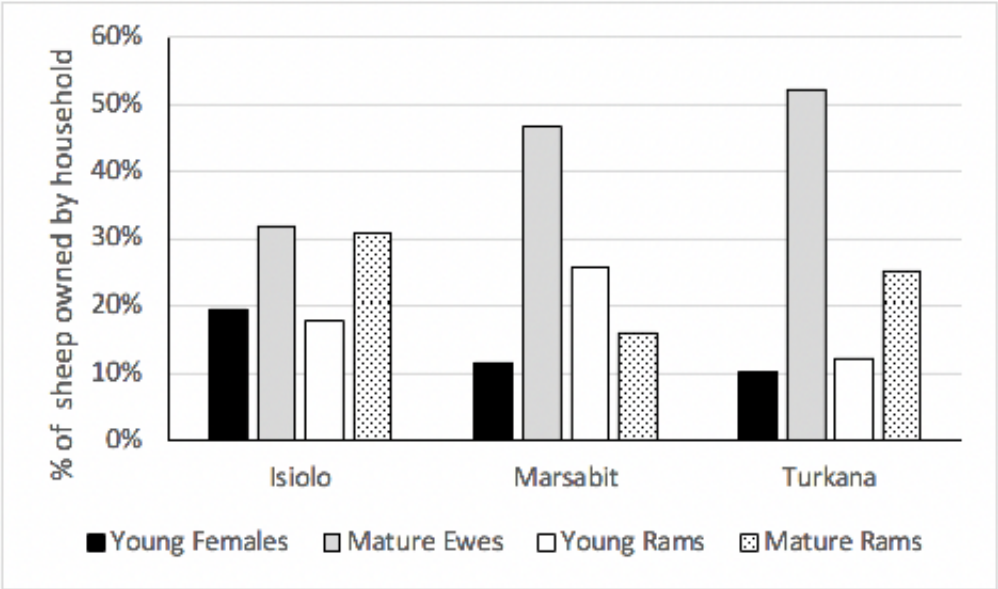
Table 4: Average number of sheep of each breed owned by households headed (HH) by men and women in the three counties

	Average number of sheep owned (±SD) by each household					
	Isiolo		Marsabit		Turkana	
	Women HH (N=3)	Men HH (N=10)	Women HH (N=4)	Men HH (N=18)	Women HH (N=12)	Men HH (N=31)
Breed						
Blackhead Persian (BHP)	3.7 ± 2.8	12.5 ± 21	1.5 ± 0.9	2.9 ± 2.3	3.0 ± 2.0	3.4 ± 2.2
BHP x Dorper	--	3.9 ± 3.5	--	--	3.7 ± 2.1	8.0 ± 2.8
Red Maasai	--	--	--	--	--	5.5 ± 1.9
Red Maasai x BHP	2.6 ± 0.6	5.5 ± 3.1	2	2	8	7.6 ± 4.5

Blackhead Persian sheep in Isiolo (photo credit: ILRI/Julie Ojango).

The relative proportion of different categories of sheep owned by the households is illustrated in Figure 7. Across the three counties, there were more mature female sheep (ewes) than sheep of other categories. It was notable that the households in Isiolo and Turkana also reared a large number of mature male sheep.

Figure 7: Relative proportion of different categories of sheep owned by the households in the three counties



The composition of the sheep and goat flocks reflects the potential for multiplication. The higher proportion of mature female animals available present an opportunity for selection in line with the traits desired by the communities. However, retaining the high proportion of mature males is undesirable. The reasons why communities retain many mature males need to be understood, and the livestock keepers educated on alternative ways of managing reproduction to improve returns from their sheep and goat resources

4.3 Management practices adopted for sheep and goats

Breeding management practices

In all the three counties, the pastoralists indicated that they practiced some form of selection for the male animals they preferred for mating in their flocks. Males not earmarked for use in breeding were generally castrated when mature using traditional methods and fattened for sale. Within the flocks, the breeding males were left to mate at random. The respondents indicated that they sometimes sourced males for mating from other livestock keepers though the larger number of male animals used for breeding were from their own flocks (Table 5).

In Marsabit County more than 40% of the households indicated that they used breeding rams on loan from other livestock keepers. Through this practice, a ram would be introduced from a different flock for mating, then returned to its original owner at the end of the mating season. Information on which animals were used to breed in specific animal flocks was based on recall as there is no written documentation on the animals within the communities. In all the counties, respondents indicated that kidding and lambing occurred in the months of April, October and November.

Table 5: Main sources of rams and bucks used for breeding in the communities

	Proportion of respondents sourcing male animals for breeding					
	Goats (bucks)			Sheep (rams)		
Source of breeding males	Isiolo (N=19)	Marsabit (N=29)	Turkana (N=52)	Isiolo (N=15)	Marsabit (N=19)	Turkana (N=36)
Bought from another farmer	11%	24%	0%	7%	11%	6%
Own bred	89%	62%	100%	93%	47%	94%
On loan from other farmers	0%	14%	0%	0%	42%	0%

Traits of importance in sheep and goats

When buying or selling animals, the main traits considered important by the pastoralists were the sex and age, breed, body conformation and body condition. Each respondent was requested to rank the traits they considered important in order of preference on a scale from 1 (most important) to 5 (least important). The score given by the household heads for each trait were grouped and a relative rank determined from the index calculated based on the weighted scores using equation 1. The ranks determined for different traits for both sheep and goats in the different counties are presented in Table 6.

Table 6: The relative importance of different traits in both sheep and goats for pastoral livestock keepers

	Isiolo			Marsabit			Turkana		
Trait	weighted score	Index	Relative rank	weighted score	Index	Relative rank	weighted score	Index	Relative rank
Age	52	0.20	3	101	0.30	1	38	0.09	4
Breed	51	0.19	2	13	0.04	5	13	0.03	5
Conformation	50	0.19	3	46	0.14	4	149	0.34	1
Body condition	40	0.15	5	86	0.26	3	140	0.32	2
Sex	72	0.27	1	90	0.27	2	92	0.21	3

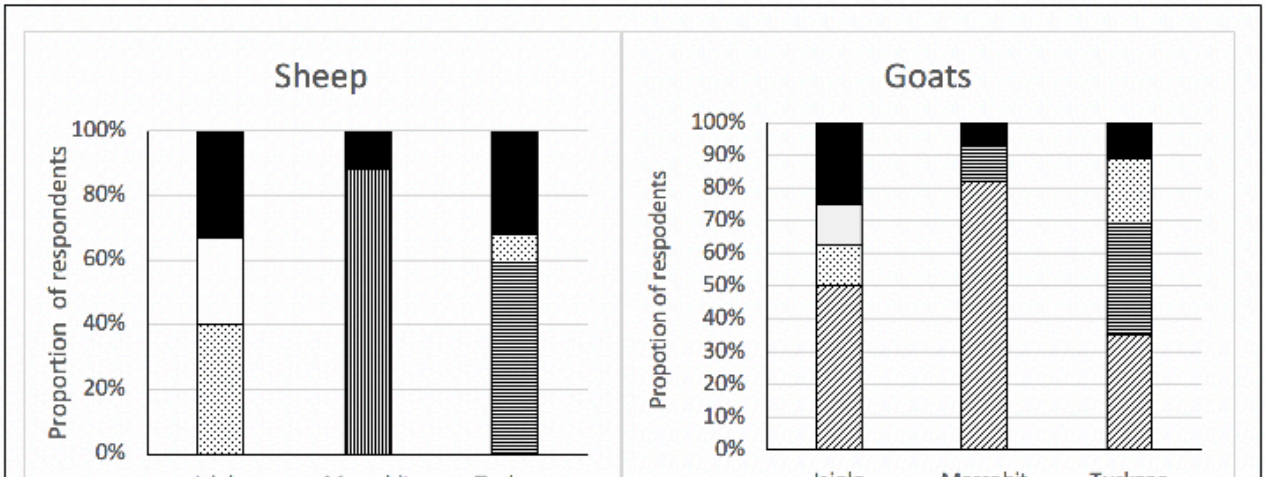
Index = Weighted score as a proportion of the total sum of scores traits

The ranks for traits differed across the counties. In Isiolo County, sex and breed of the animal were most important. This is reflected in the specific breed-types of sheep and goats reared in the county. In Marsabit, the age of the animals and their sex were most important, while in Turkana conformation and body condition ranked highest. In both Marsabit and Turkana counties, the breed of the animal was the least important trait.

Animal health management practices

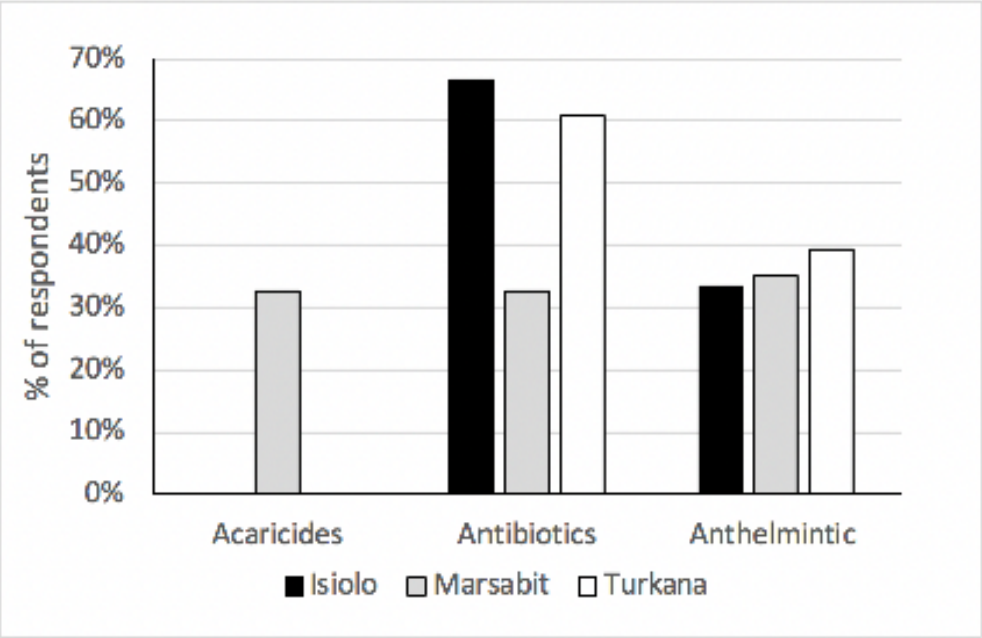
The pastoralists were aware of the importance of rearing healthy animals for optimal production and indicated that various diseases threaten the well-being of their sheep and goats. The proportionate responses in relation to the key diseases affecting animals across the three counties are presented in Figure 8.

Figure 8: Per cent of households that reported specific disease challenges that affect their sheep and goat flocks



The most frequent disease indicated to affect the sheep was enterotoxemia in Marsabit County and helminths in Turkana County. Contagious caprine pleuropneumonia (CCPP) was reported most frequently as a challenge for goats in the three counties. When asked what treatment measures they adopted for different conditions, the livestock keepers indicated that they mainly used acaricides to control ticks, and antibiotics and anthelmintics as illustrated in Figure 9.

Figure 9: Common veterinary drugs used for sheep and goats by the pastoralists



Not all the households in the three counties provided feedback on the availability of animal health services. The main factors identified to be limiting the services, and the proportion of all the respondents who provided this information across all counties are presented in Table 7.

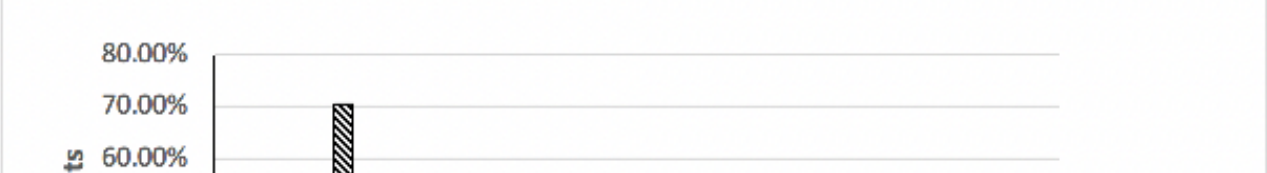
Table 7: Key factors indicated to affect the delivery of animal health services

Factor identified to limit service		Per cent of all respondents
Desired drugs	Unavailability of desired drugs	18%
	High cost of drugs	24%
Infrastructure	Poor road to access	18%
	Long distance to agrovet shop	7%
	Vastness of the area	3%
Service providers	Government vet not easily accessible	8%
	Scarcity of animal health providers	17%
	Untrained community disease reporters	5%

4.4 Managing animals through drought

The ASALs experience frequent droughts. Community members interviewed noted that the drought in 2018 was the most severe relative to the other years. In 2018, many households lost their livestock to effects of drought. They were asked to indicate the effect and severity of droughts on the different livestock species reared (Figure 10).

Figure 10: Relative impact of drought on different livestock species reared in the counties



The pastoralists reported that camels reared in Turkana and Isiolo counties were least affected by the drought, while the sheep and cattle were the most affected in Marsabit. In Turkana and Isiolo counties, both goats and sheep were reported to be affected by the drought though in Turkana the pastoralists reported that the effects on the goats were more moderate than on the sheep.

Mortality of animals during drought was also high. More than 50% of the goats and sheep that died were mature animals. Livestock keepers in Turkana lost a higher proportion of goats (44%) compared to Isiolo (36%) and Marsabit (20%), while those in Isiolo lost a higher proportion of sheep (67%) compared to Turkana (20%) and Marsabit (13%).

The pastoralists indicated that they adjusted their management practices following the drought as they needed to restock their flocks. The general practices adopted prior to and after the drought in the different counties are presented in Table 8.

Table 8: Proportion of respondents practicing different drought management practices

	Management practice	Per cent of households adopting practice		
		Isiolo	Marsabit	Turkana
Before drought	Controlled mating	--	--	12%
	Destocking (selling animals)	63%	18%	31%
	Deworming	--	--	8%
	Migrating (in search of pasture)	21%	25%	4%
	Preservation/purchase of fodder	16%	57%	45%
After drought	Deworming and vaccination	--	--	40%
	Migrating (return to home base)	25%	25%	--
	Restocking (purchase new animals)	75%	75%	60%

Regular deworming of animals was only regularly practiced in Turkana County irrespective of the prevailing environmental challenge. All the communities strived to build up their herds following drought periods. It would be important to understand what factors influence the number of new animals purchased within each community.

5. General discussion

Pastoralist livestock production faces many challenges that make it fail to realize its potential contribution to the national economy. Interventions planned for improvement of these systems need to take into consideration demographic differences, the rights to the different animal resources and the levels of literacy within communities as these greatly influence adoption and use of new practices and technologies. The households within the three counties involved in this study were mainly headed by men who also made decisions on the management of their livestock. The education and literacy levels for those heading households varied across the counties and depending on the gender of the household head with very few women heading households having a basic education. All the households had a high number of young children below 16 years of age and youth. This presents a potential challenge in the availability of labour for herding livestock within the communities as the CIG members indicated that herding of sheep and goats was generally undertaken by the children. The impact of this on the children's formal education needs to be given consideration when implementing interventions that need continuous engagement of the community.

Water and land resources were communally owned within all counties. Sources for water varied from rivers and springs to wells and boreholes. Water harvesting using water pans was practiced mainly in Marsabit County. However, the long drought periods have negatively impacted water harvesting and the livestock keepers there migrate in search of water for their animals. The water access challenge in Marsabit was noted to be a source of increased incidences of insecurity in the county.

The sheep and goat flocks owned by households across the counties differed in size, breed types reared and the composition in terms of age categories. Animals in flocks were characterized based on physical appraisal without any direct measurements of different attributes. The flock structures across all counties where such that a larger proportion of mature female animals were reared. However, in Isiolo and Turkana counties, the flocks had a larger proportion of mature male animals. There was some indication that males not earmarked for breeding within the flocks were castrated, however, animals are generally castrated when they are already mature. With the random and uncontrolled mating in many large flocks, the large number of males greatly impacts efforts in breed selection for improvement. It was only in Marsabit County where some livestock keepers indicated that they do not rear their own breeding male animals but source breeding males to run with their female animals from other livestock keepers. There are, however, no records on the relationships among animals mated and there are no direct efforts to avoid inbreeding.

Households in Isiolo owned more goats than sheep, and also owned a higher proportion of Galla goats and their crosses with the Small East African breeds than in the other counties. In Marsabit and Turkana counties, the predominant breed of goat breed reared is the Small East African. The predominant sheep breed across the counties was the Blackhead Persian. Crosses between Red Maasai Sheep and Blackhead Persian sheep are also kept by a number of households. For the various breeds reared, the livestock keepers in different counties had different traits that they considered important when purchasing animals for their flocks. Reasons for ranking specific traits were not clarified through the questionnaire but would be important in developing breeding objectives for improving productivity. The differences in community expectations and environmental conditions for rearing animals reflect a need to identify and introduce context-specific breed types for each county.

Several disease conditions were noted to affect the sheep and goats in the project areas. Of greatest concern across all counties was CCPP in goats. Adoption of vaccination practices was not common. Expanding pastoralists knowledge on disease prevention and control rather than treatment is a critical intervention measure to be adopted alongside efforts to improve livestock productivity. Availability and reach of animal health service providers to the communities was a challenge compounded by lack of infrastructure in the areas. Through community engagements and capacity development that encourage cooperation, it is anticipated that opportunities will be created for members to present issues of concern to different development partners.

6. Recommendations

The large land and animal resources in pastoral areas of Kenya have great potential to improve productivity of small ruminants which are a key contributor to community livelihoods. Limitations to productivity need to be quantified and targeted interventions introduced in line with community goals.

Training and capacity development for the pastoralists in these areas are required to enable better animal husbandry practices, breeding management, and fodder and animal health management. Capacity development programs should be packaged to target the youths who form the bulk of the population. The training needs to have a high focus on practical applications of knowledge and skills.

Stakeholders and service providers including animal health service providers, marketing agents and financial service providers in the small ruminant value chain should be involved in the planned intervention activities. Animals recording and monitoring systems should be put in place for traceability, decision-making and management of the animals.

Additionally, farmers need to be organized in groups which are objectively created for the purpose of improving the productivity of small ruminants within the areas. The groups can provide a platform for discussing, co-creating solutions and implementing a community-based breeding program. Using information from the baseline survey and other sources, breeding objectives can be developed that will guide the breeding program.

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