

Extent of Use of Indigenous Technical Knowledge in Livestock Protection among the Maasai of Loita Ward of Narok County, Kenya

Josephat K. Kereto, Agnes Oywaya-Nkurumwa, James Obara

Abstract— Accumulated over time, the use of indigenous technical knowledge by the Maasai in protecting livestock against poor nutrition, improper breeding, pests or parasites, diseases as well as injuries emanating from accidental incidences caused by predation, lightning, raids and vehicles is on the decline. Knowledge on biodiversity used to conserve forests that ensure regular supply of water, availability of pastures and herbal plants for livestock treatment is unrecorded. The co-existence of the Maasai with wildlife albeit the danger they pose on livestock lives and the environmentally friendly techniques used to sustain the environment for future generations are diminishing. Oral channels used to transmit the Maasai indigenous technical knowledge by way of stories, riddles and proverbs from one generation to the other are also rare. Information on conservation agriculture practice, manure as well as stinging nettle uses by the Maasai is scarce as the extension service providers are largely absent. The purpose of the study was to determine the extent of use of ITK in livestock protection among the Maasai of Loita Ward compared to the use of modern scientific knowledge from extension service providers. The study employed a survey research design and was carried out in Loita Ward of Narok County, Kenya. The target population was the 30,130 pastoral Maasai households in Narok South Sub-county while the accessible population was 2,437 households in Loita Ward who applied indigenous livestock protection techniques. A sample of 120 respondents was selected through proportionate random sampling method. Qualitative data generated from Interview Schedule, Focus Group Discussions and Key Informants were studied and analyzed using Thematic Content Analysis in order to establish inherent facts and information about the extent of use of ITK in livestock protection. Statistical Package for Social Sciences was used for quantitative data analysis. The study revealed that Indigenous Technical Knowledge is the main knowledge disseminated by the Loita Maasai in the protection of their livestock though modern ideas have always found their way into the community through neighbours or demonstrations and shows seen elsewhere. Extension service providers (ESPs) understanding and disseminating both ITK and modern information, to improve synergy and lead to improved community livelihoods. This study recommends that the National Government and the County Government of Narok should safeguard the documented ITK of the pastoralists as it is a vital resource and knowledge from total loss and its

exploitation by other people at the expense of the owners, the Maasai.

Index Terms— Extent, Use, Indigenous Technical Knowledge, Livestock, Protection, Maasai, Loita Ward, Narok County, Kenya

I. INTRODUCTION

Four to seven hundred million indigenous peoples directly depend on pastoralism that over the years has evolved for the last ten thousand years since the domestication of animals [1]. The long association of pastoralists with livestock have enabled them to acquire enormous range of indigenous technical knowledge (ITK) that is critical for responding to livestock protection (LP) related risks at the pastoralists' level [1]; [2]; [3]. The ITK forms the basic component of any country's knowledge system applied for maintaining or improving people's livelihoods [4]. [The indigenous knowledge systems constitute the world largest reservoir of knowledge that utilizes indigenous livestock practices and techniques.

The modern knowledge has something that it could also learn from the pastoralist friendly coexistence with their environment. This makes the involvement of pastoralists by extension service providers (ESPs) in research and other technologies very important as this would only serve to up-scale such useful knowledge. Unfortunately, the development of ITK had to be slowed down by the changes that were taking place in the world history. The scramble for land by world powers subordinated the ITK systems to those of colonizing powers [5]. The colonialists made the locals to believe that ITK was primitive, irrelevant and out of tune in the society [6]. This colonial perception created a great difference between modern knowledge and the ITK systems [7]. The dominance of the modern knowledge system largely led to a prevailing situation in which ITK is ignored and neglected [8]. The continued weakening and erosion of ITK has made it hard for young people to acquire, use and blend it with modern knowledge thereby aggravating the problem further [9]. The extension service providers (ESPs) on their part only disseminated information recommended by the researchers to pastoralists but not ITK [10]. This situation affected the development and flow of ITK in livestock protection prompting many studies to begin.

In the 1990s, world scholarly studies were begun in an attempt to salvage ITK. One such study by [11] about using indigenous knowledge for agricultural development was successfully done. Another successful study was the one done

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in India in 1993 on a framework for incorporating indigenous knowledge systems into agricultural extension organizations for sustainable agricultural development [12]. Several studies then followed in Kenya like the one on ethnoveterinary diagnostic skills that concluded that the pastoralists' diagnostic skills appeared to be superior to those of agro-pastoralists but with the advent of modern veterinary medicine, the Maasai ethnoveterinary practice appeared to be on the decline [13]. In 2006, Warui, in his study, found out that the use of ethno-medicine was the preferred mode of treatment after investigating the use of traditional health remedies among the Maasai of Kuku Group Ranch of Southern Kajiado District, Kenya.

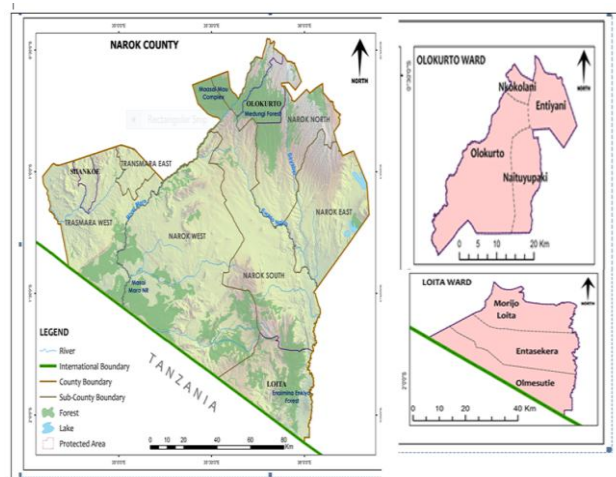
Value for livestock as an important asset, a wealth reserve and a sacrificial gift by the Maasai people is known. Indigenous technical knowledge (ITK) is applied to protect them though its flow and access through oral channels like stories, riddles and songs is on the decline. Consequently, incidences of pests, diseases, plant poisoning, poor nutrition, improper breeding and other accidental incidences like predation and theft are on the rise due to declining ITK in livestock protection (LP). The Maasai vast experiences in the preservation of biodiversity and co-existence with wildlife that increases competition for the already meagre pastures, mauling and cross transmission of pests and diseases to livestock are unrecorded. Unrecorded too, is the knowledge on environmental care given to forest resource that ensures availability of water, pastures, fodder and herbal medicine used for the control of pests and diseases. Livestock protection information from both ITK and extension service providers (ESPs) is in short supply among the Maasai of Loita Ward. There is need to document the available information within and without the community dependent on livestock in order to safeguard their livelihoods. In the absence of a profiled ITK in livestock protection and little integration with information from ESPs, the Maasai livelihoods would remain low hence the need for the study. The purpose of the study was to determine the extent of use of ITK in livestock protection among the Maasai of Loita Ward compared to the use of modern scientific knowledge from extension service providers.

The study assumed that respondents were sufficiently knowledgeable in livestock protection ITK and that all responses by the respondents were true and honest. Limitations of the study included lack of complete disclosure in the sensitive area of traditional medicine due to fear that the researcher was stealing the healing secrets. This resulted in the information being 'censored'. A number of data collection methods were used for triangulation purposes.

II. RESEARCH METHODOLOGY

A survey design was adopted for the study. The study area, Loita Ward is within a large protected park known as the Maasai Mara National Game Reserve famous for wild animals like lions, wild-dogs, hyenas, cheetahs, elephants, rhinos, giraffes, zebras, warthogs and buffaloes. Loita Ward is approximately 1,675.55 km² in size and is made up of Morijo Loita, Entasekera and Olorte locations. It is occupied by the Maasai community who practice a nomadic life-style

moving with their animals from one place to another in search of pastures, water and minerals lack of which could lead to infections by livestock nutritional deficiency diseases. Cattle, sheep and goats are the main livestock reared for milk, meat, blood and other products while other foods are gotten by trading with other people. Figure 1 shows where the study and pilot test was conducted.



Source: Map Preparation: solohkarani@live.com Service Layer Credits: ESRI, Virtual Kenya and DIVA GIS

Figure 1: Map showing the respective areas of study at Loita Ward and pilot test at Olokurto

The target population was the 30,130 pastoral Maasai households in Narok South Sub-county. The accessible population for the study was 2,437 pastoral Maasai households in Loita Ward [14].

The number of households in Loita Ward by location and sub-location is as shown in Table 1.

Table 1: The number of pastoralists' households by ward, location and sub-location

Ward	Location	Sub-location	No. of Households
Loita	Morijo Loita	Morijo	837
		Olorte	417
		Olorte	558
		Mausa	625
Total			2,437

Source: 2009 Kenya Population and Housing Census Volume 1A

Loita Ward in Narok County was purposively selected for the study. This was based on the past knowledge, practices and experiences the pastoralists in Loita Ward have in livestock protection ITK. The sample was drawn from the four sub-locations of Morijo, Olngarua, Olorte and Mausau respectively through proportionate stratified sampling method. A sample size of 120 respondents was selected for the study through proportionate random sampling method. The sampling unit was Maasai household heads who keep livestock in Loita Ward.

Three instruments were developed by the researcher and

used to collect the data. The instruments developed include an Interview Schedules for household heads, Key Informants Interviews (KIIs) and Focused Group Discussions (FGDs). Key Informant Interviews (KII) was carried out with professionals (veterinary, livestock production practitioner (LPP), Kenya forest service (KFS), administration, NEMA and KWS) and cultural specialists (herbalists or traditional healers, herdsman, blacksmiths and seers). A total of sixteen elders and youth respondents purposely selected from Morijo Loita and Olorte locations held two separate male and female FGDs. Two or three group discussions with the same set of questions on any one topic is recommended [15]. This is because a point of saturation would be reached beyond which no anymore new responses are forth coming. Elders were chosen because they are the main custodians of ITK while the youth represented the relatively immediate recipients of learning experiences on ITK in livestock protection. For this study, elders were all men and women above 40 years while youth were those people 18 to 39 years old.

After the three instruments were designed as per the research objectives, thorough examination of the instruments was done to determine the content validity by peers, supervisors and experts at Egerton University's Faculty of Education and Community Studies. Their comments were used to adjust and improve the instruments thereby yielding valid data from which appropriate, meaningful and useful inferences were made [16,17]. Internal validity of the instrument was improved through triangulation of data sources as multiple people validated the data. In this case study, interactions and conversations with individuals and groups through interviews and discussions helped to triangulate the data [18].

A pilot study was carried out in Olokurto Ward of Narok County where the consistency of the Interview Schedule tool was pilot-tested with 25 respondents. Olokurto Sub-location was appropriate for pilot study because it shared similar livestock characteristics as the population studied. Pastoralists in this place rear similar livestock which suffer same challenges for their survival as those of Loita Ward. The reliability of the survey Interview Schedule tool was estimated to be 0.881 using Cronbach's Alpha Coefficient, which is a measure of internal consistency [19]. This was high enough to allow such a study be carried out.

Thematic Content Analysis; a systematic way of grouping information into categories or themes that helped make sense of FGD and KII data using an open coding process was employed on qualitative data. Statistical Package for Social Sciences (SPSS) was used in descriptive and inferential statistics analysis of the quantitative data. Descriptive statistics included percentages, frequencies, means and standard deviations. Inferential statistics analysis (Chi square and t-test) was employed in quantitative data analysis where the Null hypothesis was tested at 5% level of significance.

III. RESULTS AND DISCUSSIONS

Characteristic of respondents

The study participants were the Loita Maasai involved in livestock keeping. Six attributes of the respondents were considered: Gender of the respondents, land tenure system in

the area, ownership of livestock by the households, sources of livestock and uses of livestock and livestock manure by the respondents.

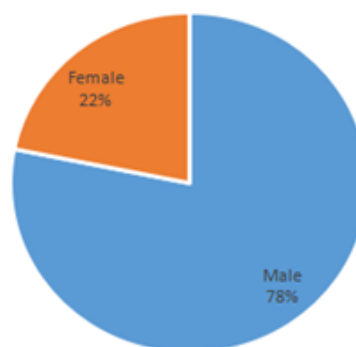


Figure 2: Gender of the respondents

Seventy eight percent of the respondents were male and only 22.0% were female – this implies that majority of the households are headed by men leading to gender inequality. All the respondents agreed that the land they live in Loita Ward is communally owned and pastoralists are granted the grazing rights.

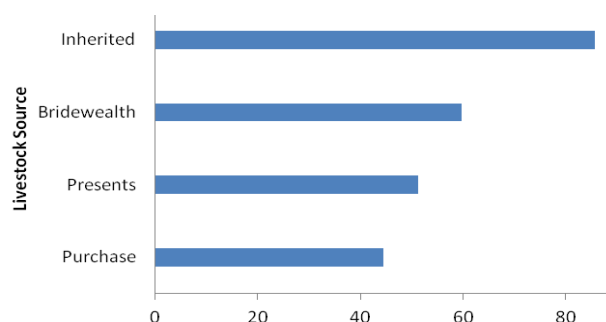
The mean number of cattle kept by the respondents was 48, while for sheep was 71 and goats 51. The numbers varied from as low as 5 to a maximum of 1,345. The more the number of sheep and goats (shoats) a pastoralist has the fewer or no sale or slaughter of cattle for small needs. The cattle, sheep and goats provide meat, milk and blood and other byproducts like livestock manure. Donkeys are kept as 'beasts of burden'.

Table 2: Number of livestock owned by Respondents (n=120)

Livestock type	Mean	Median	Mode	Std. Dev.	Min.	Max.
Cattle	47.9	40	30	33.93	5	200
Sheep	71.4	50	50	66.95	5	400
Goats	50.5	30	50	85.67	0	876
Total	171	131	100	152.06	20	1,345

The study confirmed that most of livestock types reared by the Maasai in Loita Ward were cattle, sheep and goats and although donkeys are reared, they are never eaten nor their milk taken except for the rare treatment of common colds in children.

Livestock owned by the respondents of Loita Ward come from different sources as indicated by the results given in Figure 3.



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Figure 3: Sources of livestock owned by the respondents in Loita ward

The study found out that majority (85.7 percent) of the respondents' livestock originated from inheritance from parents and other relatives. Others came from bride wealth (59.7 percent) in the case of the Maasai community who normally practice a patriarchal system where brides are married off to the bridegroom and presents (51.3 percent) and 44.5 percent were purchased.

The entire life of a Maasai in Loita is nearly all centred around livestock. The study found out that 99.2 percent of the foods (milk, meat, blood) the respondent consume come from livestock.

Table 3: Uses of livestock by Loita Ward Maasai (n=120)

Uses of Livestock	Frequency	Percent
Foods (milk, meat, blood)	118	99.2
Cultural purposes	77	64.7
Prestige	62	52.1
Sale	61	51.3
Educate children	59	49.6

Most Maasai also derive their pride or prestige (52.1 percent) from livestock which are also used to support their other numerous cultural activities (64.7 percent). Sale (51.3) of livestock is not given a priority and comes as a last resort. Sheep and goats are the ones sold for meeting needs at home including education of children (49.6 percent) or slaughtered in order to spare cattle for other big ceremonial occasions.

The uses of livestock manure cannot be underrated as given by the respondents in Table 4.

Table 4: Uses of livestock manure (n=120)

Manure is used to	Frequency	Percent
Smear or plaster houses for occupation by the community members	53	44.5
Support conservation agriculture, stinging nettle and fodder crops	33	27.7
Attract income	1	0.8
Smear injured tree parts	34	28.6

The respondents use the dung to smear or plaster (44.5 percent) their houses (inkajijik in Maasai language) and 28.6 percent use it to smear on injured parts of plant where herbal medicine has been drawn from while 27.7 percent use it to support conservation agriculture and support the naturally growing plants such as the stinging nettle that livestock feed on during drought.

Manure as a livestock by-product that allows the natural growth of stinging nettle fed upon by livestock during drought also favours conservation agriculture practice where

fodder and other crops grow. This mutual relationship is vital, as livestock manure improves soil fertility that supports the growth of pastures, fodder and other crops that in turn are fed upon by livestock to produce milk, meat and blood for the survival of pastoralists.

4.5 Extent of use of ITK and Extension Scientific Knowledge among the Maasai of Loita

4.5.1 Knowledge system most preferred by the Respondents

The respondents were asked to state the knowledge system they most used in livestock protection. The summary of responses statistics is given in Table 5.

Table 5: Type of knowledge most used to protect livestock by the Loita Maasai (n=120)

Knowledge type as used in livestock protection	Frequency	Percent
Indigenous technical knowledge (ITK)	72	60.5
Extension service (ES)	40	33.6
Both (ITK and ES)	7	5.8

The study established that, in livestock protection, 60.5 percent of the residents applied ITK, 33.6 percent applied extension service (ES) while 5.8 percent applied both ITK and extension knowledge systems.

The indigenous technical knowledge is regarded as being as old as the human race itself [20]. This early primary knowledge that every child learns as it grows up, is possessed by every member of the community on behalf of the community [21]. Coupled with its values, understandings and methods, the integration of ITK with ES in livestock protection might enrich and modify the course of development dominated by modern technologies [22,23]. The study observed that the appropriate practices of ITK by pastoralists has ordinarily ensured livestock stayed healthy and produced a reliable supply of milk and meat that meets the demands of pastoral households [24]. The ITK also thrives in many areas such as: education through knowledge transfer for generations; farming practices like conservation agriculture; soil conservation and farm rotation and food technology by applying fermentation techniques and preservation.

As if that is not enough, the study also found out that ITK in livestock protection is rich in herbal medicine know-how. This could bring about development in areas such as healing in livestock troublesome diseases. For example, to treat ECF, the Loita Maasai people commonly use herbs such as Oleparmunyo (*Toddalia asiatica*) and Osokonoi or East African green wood (*Warburgia salutaris*) to treat bloat among other conditions (Appendix D). This same knowledge sometimes enables a traditional livestock expert to successfully remedy a traverse foetus and fix broken bones [24]. This shows that the pastoralists are endowed with a lot of traditional knowledge in the treatment of most pests and diseases inflicting livestock using herbal medicine.

However, in both female and male FGDs, the study was made to understand that the low use of extension service (ES)

was due its limit in availability at Loita Ward. Also, in a situational analysis done by [25], he established that there is limited extension of animal health services among the pastoralists. The FGDs thought that, if ES in areas such as deworming, multi-vitamins and vaccinations was available in Loita Ward to provide services alongside ITK, chances are that more pastoralists' livestock would survive from most preventable livestock ailments. In most of these areas, services are centred in towns and do not reach the rural farmers [25]. Therefore, blending the two knowledge systems in relevant areas would result in improved integrated knowledge beneficial to the community.

4.5.2 Reasons for use of ITK technologies by the respondents

The respondents' reasons for using ITK in livestock protection technologies as indicated in Table 6.

Table 6: Reasons for use of ITK technologies by the Loita Maasai (n=120)

ITK technologies are:	Frequency	Percent
Affordable	47	39.2
Available	53	44.1
Easy to administer	19	16.0
Others (cheap, accessible)	1	.83
Total	120	100.0

The Loita Ward pastoralists gave a number of reasons as to why they preferred using ITK technologies to modern technologies. The respondents described ITK technologies as being available (44.1 percent), affordable (39.2 percent) and easy to administer (16.0 percent) among others (0.83 percent) like they are cheap and accessible.

The study was able to establish that, indigenous technical knowledge (ITK) meets entirely every aspect of the lives of the Loita pastoralists. No wonder, [30], referred ITK to as the social capital and asset that pastoralists invest in the struggle for survival and subsistence. This is because it is the same ITK that has helped the pastoralists get shelter and achieve control of their own lives through utilization of livestock products. That is why this knowledge in the heads of the practitioners is seen as easy to administer by the community thus regarded as available. That may further explain why the community is ready to share it with other interested people if only to enhance it for improved livelihoods [21].

The study is convinced that ITK still remains the backbone of collective existence of the pastoralists and in its documented form brings it into the mainstream thereby becoming a valuable complement to modern medical scientific knowledge and pharmaceutical production [24]. The two blended knowledge systems would only serve to strengthen areas such as environmental conservation (land and biodiversity) and bringing about positive effects on the environment. Unfortunately, the Maasai are losing grazing land as a result of crop farmers from other areas encroaching upon their land [9].

The integrated knowledge is more likely to make the ITK of the Maasai community be respected and the exploitation of their natural resources without any benefits going to them stopped. The disappearing of ITK, its misuse and constant copying by others with very little economic benefits going back to the community would stop. The documented ITK would be helpful to the Maasai child and other interested people who would have some reference to use for future generations to come [26].

4.5.3 Frequency of ITK use by the Loita pastoralists

The respondents gave responses on how frequent they used ITK to protect livestock and their responses are as indicated in Table 7.

Table 7: Use frequency of ITK in protecting livestock in Loita Ward (n=120)

ITK use	Frequency	Percent	Cum. Percent
Regularly	62	51.7	51.7
Frequently	38	31.7	31.7
Rarely	18	15.0	15.0
Never	2	1.7	1.6
Total	120	100.0	100.0

The study shows that almost all (98.4 percent) of the respondents used ITK in different rates to protect livestock. Only 1.6 percent of the respondents never used ITK at all. The ITK technologies used by the Loita pastoral community in protecting livestock were developed over decades of adjusting pastoral systems to local climatic and social conditions. In some circumstances, for example, local knowledge consists of knowing how to keep conditions of productivity at some level over the long run, rather than maximizing productivity in years of optimal conditions [27].

The study found out that the frequency of doing certain activities or practices meant to improve the livestock went on throughout the year while others took place as and when necessary. For example, livestock pasturing is a daily activity. In pasturing animals, livestock are taken out for grazing irrespective of whether it's a rainy season or during drought if at all livestock were to provide milk, meat and blood all the time. Other activities are done depending on their frequency of occurrences and urgency, for example, control of pests and diseases drive the use of herbs [27;28]. Breeding and selection, on the hand, is done when conditions are favourable. Otherwise, reaction to an attack by predators is immediate and abrupt. The joint performance of these practices using both knowledge systems would obviously improve the lives of livestock and livelihoods of the community.

However, the sustainable use of any knowledge system depends on its access. For example, due to the growing demands by the conventional medicine, herbal medicine has taken a new level where scientific analysis is being introduced to improve the healing capacities of these plant medicines [28]. Being dynamic, integrating ITK with ES would improve their availability as well as accessibility in

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Loita Ward thereby helping to better the livelihoods of the pastoralists.

While this indigenous knowledge has assisted the Maasai all this time to survive, Kenya does not have a policy to protect this cultural knowledge yet. The one said to be in the process of being developed entitled 2018 Proposed Amendment to the Protection of Traditional Knowledge and Cultural Expressions Act is not ready. This is despite Article 11 of Kenya's Constitution recognizing culture as the foundation of the nation and cumulative civilization of the Kenyan people. Therefore, there is need for the government to provide national legislation to give full effect to this Article [31].

4.5.4 Extent of ITK use in Loita Ward

This was defined as the degree or the limit of use put to the different ITK practices by the Loita Maasai. The extent of use was operationalized as an index involving 12 main traditional practices related to the protection of livestock by the Maasai pastoralists living in Loita. These included: a) livestock manure use, b) pasture use and management, c) feeding of livestock during drought, d) treatment of animal diseases, e) pest control, f) using traditional techniques to control animal breeding, g) livestock traits selection, h) coexistence of Maasai livestock with wildlife - compensation, i) protection of livestock from other causes of accidents - raids, j) weapons used to protect livestock, k) lightning protection measures and l) protection of livestock from other causes of accidents and the way they are minimized. The 12 main traditional ITK practices had indicators related to them which formed the basics of rating the practice. The degree with which the twelve practices were used in protecting livestock was rated accordingly. The degree of use of the activity was rated on a scale ranging from 0 (no use) to 5 (maximum use). The scores were then added and averaged for each indicator within the 12 main practices and the final grand score formed the index of degree of ITK use. Table 32 gives the mean scale of each practice and by referring to Appendix F; details of the specific indicators of each practice are indicated and accordingly interpreted. For example, on Table 32, the mean use of livestock manure is 1.47 and is rated as the practice given minimum use based on its indicators of smearing floors and walls of houses (2.00), smearing injured parts of the plants parts where medicine has been extracted (1.30) and supporting conservation agriculture (1.22) by the respondents (Appendix F). The Loita people are yet to intensify on the use of livestock manure.

The ITK that was mostly practiced by the pastoralists was the one on pasture management which had a mean use of 2.96. This is paramount because livestock cannot survive without feeding. Constant source of information is needed by the pastoralists on the availability of pastures for their livestock from among themselves and neighbours (community 3.21) and ESPs. Treatment of animal diseases was rated with a mean use of 2.66 and is important for livestock health. Whenever livestock health was threatened, traditional healers and herbalists came together to offer their services as the mean 2.70 and administering of herbs (2.66) mainly obtained from forests (3.40) show. Thus, all practices are very important for the complete protection of livestock with others frequently applied while others are implemented with rise in

demand. The ITK practices that are done at appropriate times as they occurred include controlling animal breeding using traditional techniques (mean 0.557) where livestock are allowed to mate just before the rainy season so as for calving, lambing and kidding to take place just when there are sufficient pastures for livestock which in turn provide milk, meat and blood as appropriate. Protecting livestock, on the other hand, from accidents (mean 1.09) and predation is normally prompt and immediate as they occur.

The reliability of the resulting index was determined using Cronbach's alpha, a measure of internal consistency of a multi-item indicator. The mean score for each indicator and the main practice undertaken are summarized in Appendix F. The grand mean score for the index, Cronbach's alpha and the mean scores for the 12 main practices are shown in Table 7.

Table 7: Extent of use of ITK practices by Loita Maasai

The ITK practices in livestock protection as used by Loita Maasai	Extent of use		
	Mean	SD	Range
Livestock manure use	1.47	1.09	3.75
Pastures use and management	2.96	1.27	5.00
Feeding of livestock during drought	2.38	0.76	3.60
Treatment of animal diseases	2.66	1.36	5.00
Pest control	2.09	1.65	5.00
Using traditional techniques to control animal breeding	0.577	0.18	0.75
Livestock traits selection	2.53	0.77	3.83
Protection of livestock from other causes of accidents - compensation	2.73	1.60	5.00
Weapons used to protect livestock	2.41	0.88	4.00
protection of livestock from other causes of accidents and minimizing them	1.09	1.25	4.50
Coexistence of Maasai livestock with wildlife	4.21	0.76	4.00
Lightning protection measures	2.04	0.65	3.83
Index of extent of use for ITK index	29.01	3.98	21
Mean Extent of use index	2.23	0.306	1.64
Cronbach's alpha	0.798		

The overall mean of the extent of ITK use by Loita Maasai was found to be 2.23 on a scale of 0 to 5. The Cronbach's alpha for the index was 0.798, which was deemed to be satisfactory based on the number of indicator items involved.

i). Categories of the extent of ITK practices

The scale of the index was then categorized as follows to determine the extent of use: 0 no use, 1.1 to 2 low use, 2.1 to 3

medium use, 3.1 to 4 high use and 4.1 to 5 very high use of the ITK practice as shown in Table 33.

Table 8: Categories of the extent of ITK practices

Extent of use of ITK practices			
Categories	Description	Frequency	Percent
0	No use	0	0
1.1 - 2.0	Low use	0	0
2.1- 3.0	Medium	99	83.2
3.1- 4.0	High	21	16.8
4.1 - 5.0	Very high	0	0
Total		120	100

From the study, 83 percent of the respondents living in Loita Ward had a medium level of use while 16.8 percent had high level of use of the ITK practices used in protecting livestock. The medium use of ITK practices implied that most of Loita people averagely used ITK practices and other sources of knowledge especially modern knowledge which they share among themselves and their neighbours. Minority (16.8 percent) of the respondents mainly use the ITK practices and very little of others if any.

The results illustrate that the ITK practices are not used at the same rate among the Loita Maasai, as it is obvious that some practices were more used than others. This could be attributed to the fact that some of the ITK skills and knowledge was being lost from among the community with the passing on of the old generation of elders who are the custodians of this knowledge [9, 26]. The excelling of any community in the performance of any activity depends on the frequency the activity is repeated with certain motives of success. This implies that, though a certain ITK practice in livestock protection may be common to a particular group of people, it may not be equally distributed amongst all people in the same way in a particular setting. People's facility with ITK depends on the centrality of their participation in an activity. Therefore, the sustainability of ITK practices would depend on the interest of a large proportion of the community to acquire it [26].

Chi-square test

The chi-square test was performed on the index of ITK practices to determine the significant differences in the frequencies of the different categories and the chi-square value, the significance level and the degrees of freedom are shown in Table 9.

a). Table 9: Chi-square test

Categories	Observed/Expected		Residual	Statistics
	N	N		
1.1 - 2 Medium	99	59.5	39.5	$\chi^2= 200.27$
3.1 - 4 High	21	59.5	-39.5	df 4
Total	120			p < .001

b). Medium category of ITK use by the Loita Maasai was found to be significantly ($\chi^2= 200.27$, df 4, p < .001) higher than the other categories. This means that the availability of ITK to majority of the Maasai pastoralists of Loita Ward who medially use it may be diminishing by day due to the disappearance of those who have it. Thus, those who have less of this knowledge like the youth would certainly more likely adopt to any other knowledge available to them and this in most cases was the modern extension service though it is not readily available due to lack of ESPs. Therefore, the usage of any knowledge depends on its availability and access when the user needs it in order to ultimately improve the pastoralists' livelihoods.

ii). Extent of scientific knowledge use

The extent of scientific knowledge use was operationalized as an index involving 9 main scientific practices related to the protection of livestock by the pastoralists living in Loita, these included: a) livestock manure use b) Pasture use and management, c) livestock breeding management, d) treatment of animal diseases, (e) pest control, f) protection from lightning, g) reducing animal accidents, h) protection of livestock from other causes of accidents and i) coexistence of Maasai livestock with wildlife. The 9 main scientific practices had indicators related to them which formed the basis of the rating of the practice. The mean values for the main index and its indicators are given in Table 35.

Table 10: Extent of use of extension service knowledge (ESK) practices by Loita Maasai

Extension Service Knowledge Practices	Extent of use		
	Mean	SD	Range
Livestock manure use	0.05	.09	1.21
Pasture use and management	1.89	1.14	4.00
Using traditional techniques to control animal breeding	2.57	1.91	5.00
Treatment of animal diseases	1.66	1.36	5.00
Pest control	2.47	1.28	4.50
Lightning arresters	0	0	0
Protection of livestock from other causes of accidents and minimizing them	1.09	1.25	4.50
Protection of livestock from other causes of accidents – raids	1.52	1.88	5.00
Coexistence of Maasai livestock with wildlife	1.20	0.63	2.75
Extent of use for ESK index	7.37	2.55	10.9
Mean Extent of use index	1.22	0.42	1.82
Cronbach's alpha	0.899		

The use of scientific knowledge by Loita Maasai was found to be low (mean of 1.22) compared to that of ITK which was found to be 2.23. The reason for this is the fact ITK has been the knowledge source of choice for ages. Availability of

Extent of Use of Indigenous Technical Knowledge in Livestock Protection among the Maasai of Loita Ward of Narok County, Kenya

extension service has not been sufficient in Loita Ward and even in the surrounding areas leading to its low use generally.

Though, the pastoralists of Loita to a large extent rely on ITK for the protection of livestock, they also share information among themselves and from neighbours whose original source might have been from ESPs through agricultural demonstrations or shows. Such knowledge could be like that on livestock manure applied in conservation agriculture, coexistence of Maasai livestock with wildlife where KWS compensates pastoralists whose livestock or relatives might have been attacked and killed by wildlife, and the administration who assist to normalize live in areas where livestock raids are prevalent and advice pastoralists on how to minimize accidents on roads. They also occasionally benefit from ESPs when they visit Loita Ward for the vaccination of livestock against notifiable diseases like F&MD among others. The Maasai livestock have improved over time as a result of breeding and selection to fit to the environment and for resistance against pests and diseases but the pastoralists appear ready to adopt AI if the service would be availed to them. Lightning strikes are not frequent in the area though pastoralists are receptive and ready to adapt to any practice that may help avoid any calamities that accompany the strikes.

iii). Comparison of the extent of use of scientific and indigenous technical knowledge

Paired sample t test was used to compare the existing significant differences between the extent of use of scientific knowledge (SK) and ITK practices undertaken by the Loita Maasai. The results are as presented in Table 11.

Table 11: Paired t-test for comparing the ITK and modern science

	Mean	Paired Differences			df	P
		Mean Difference	Std. Dev.	Std. Error t		
Scientific knowledge	1.22					
ITK practices	2.23	-1.00293	.48913	0.04484	22.36	118.000

The results show that the mean of the ITK (2.23) was higher than the mean of the scientific knowledge (1.22) indicating that the use ITK among the Loita Maasai was higher than the scientific one. The means were compared and ITK was found to be significantly higher (t 22.36, df 118) than the scientific knowledge. The reason for this difference may be due to cost, availability and access of the knowledge system.

Throughout history, the Loita Maasai have been responsible for the development of many technologies and have substantially contributed to knowledge and by extension modern knowledge. It is the basis for local level decision making in food security, human and animal health. It is based on empirical experiences and is embedded in both biophysical and social contexts and cannot easily be removed from them [29]. This indigenous knowledge is important as it can provide important insights into the processes of observation, adaptation and mitigation of climate change consequences.

The ITK is rich in time tested approaches that foster sustainability and environmental integrity. Although SK is dominant in Kenya, and officially sanctioned science, it has been implicated in the world's ecological disasters like pesticide contamination, introduced species, dams and water diversions thus reliance on western science alone can be seen as increasingly problematic and even counterproductive [29]. ITK is full of wisdom and holistic values that raise opportunities to consider the long-term costs and benefits of actions that may affect the environment. Not surprisingly, instances of ITK can be found embedded in numerous existing knowledge categories: Indigenous knowledge (IK), traditional environmental knowledge (TEK), and traditional ecological knowledge and wisdom (TEKW). The working together of the two knowledge systems is very necessary as this provides great potential for enhancing the ability to integrate the two knowledge systems recognized by the pastoralists [29].

IV. CONCLUSION AND RECOMMENDATION

This study concludes that Indigenous Technical Knowledge is the main knowledge disseminated by the Loita Maasai in the protection of their livestock though modern ideas have always found their way into the community through neighbours or demonstrations and shows seen elsewhere. Therefore, by extension service providers (ESPs) understanding and disseminating both ITK and modern information, this would serve to improve synergy and lead to improved community livelihoods.

This study recommends that the National Government and the County Government of Narok should safeguard the documented ITK of the pastoralists as it is a vital resource and knowledge from total loss and its exploitation by other people at the expense of the owners, the Maasai. The extension service providers need to collaborate with the relevant cultural ex-perts to have livestock products like milk, meat, blood among others added value as this would create employment in the different segments of the platform right from input suppliers, producers, transporters, processors, wholesalers and retailers and consumers. The ESPs should help pastoralists in embracing new and best methods of livestock production that protect the environment as well as capacity build them in areas such as book keeping, business skills or entrepreneurship to advance their skills and earn profits that would benefit them much. This way, the pastoralists would be able to monitor the performance of their farm business and make appropriate decisions making framework to determine the specific cost of each resource or to help minimize the aggregate cost of production.

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