to Lokiru Kidong,
the communities and healers of Karamoja
and our Creator…

Adding My Stick into the Fire

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JEANNE TERESE GRADÉ

ETHNOVETERINARY KNOWLEDGE IN PASTORAL KARAMOJA, NORTHERN UGANDA

Thesis submitted in fulfillment of the requirements
For the degree of Doctor (Ph.D.) in Applied Biological Sciences:
(Agricultural Science)

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Etnoveterinaire kennis in Karamoja, een traditioneel veeteeltgebied in Noord-Oeganda

Photograph front cover: Karamojong cattle and donkeys grazing during rainy season in Dodoth.

Photograph back cover: Pian traditional healers preparing and treating goat with local medicines, Bokora sheep sleeping inside manyatta and Lorengendwat goats rushing out to graze

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Executive Summary

The present study presents the cataloguing and documenting of indigenous veterinary knowledge of Karamojong pastoralists as a component to an ongoing non-governmental organisation-managed community animal health and development program. The region of Karamoja, 28,000 km^2, is located in northeastern Uganda, in the Great Lakes Region of East Africa.

The following problem statements justify this research. Karamoja has a *fragile indigenous knowledge data base*, prone to fragmentation. It is primarily oral history with very little written data. The growing number of *locally endangered medicinal plants* presents another and related problem. The area has high (small arms) insecurity and deforestation indices. Since the Karamojong people are semi-nomadic pastoralists with limited agriculture experience, they have little familiarity with agroforestry, plant propagation, resource conservation and protection. Karamojong people have a *marginalised lifestyle*. Their region has poor infrastructure with high mortality and morbidity rates. The area is prone to recurrent drought and famine. *Government relationships* are poor, adding to the external/environmental pressure that Karamojong knowledge faces. Finally, *Karamojong culture and lifestyle* is focused on cattle, yet they have the poorest veterinary services available in Uganda. Karamojong indigenous knowledge (IK) has proven remarkably resilient in the face of inhospitable environments, less so regarding the social pressures mentioned above. The ecological *environment* has become harsher and grazing areas more limited during the lifetime of the elders. As a result of these environmental changes, we see increasing reliance on external support and foreign elements entering the system, thereby diluting their indigenous coping mechanisms.

Cataloguing the indigenous veterinary treatments began ten years ago, with the overall objective of integrating the most confidently used treatments into regional development livestock trainings. The next phase of research and development (R&D) entailed selecting a few of these plant treatments to promote in agroforestry and in scientific validation field trials. During this field trial phase, goats were observed to self-medicate. As very little is

known about animal self-medication, we set up another study to better understand livestock zoopharmacognosy. Continued research activities revealed the depth and breadth of Karamojong IK. Meanwhile, external shareholders got another glimpse into IK's potential for community and community animal health worker (CAHW) local capacity building. The research blended endogenous with exogenous ideas and R&D networks. Endogenous approaches mingled both science and tradition, thereby adding value to both. This phase included ways to 're-discover', re-invent and make Karamoja's ethnoveterinary knowledge (EVK) systematically available for community use. The final phase investigated how well this blended EVK diffused into the community.

The pastoralists of south and central Karamoja have a lot of indigenous knowledge and a variety of plants to choose from to satisfy their subsistence requirements and to cater to their livestock healthcare needs. This study recorded EVK information on 209 plant species, distributed over 116 genera and 54 families. There were 130 separate EVK uses listed. The most common indication was against anaplasmosis, for which 29 species were reported. Many of the plants in this inventory were never documented for animals before at all and/or for the specific uses recorded here (CHAPTER III).

Due to its local importance, a field trial case study is illustrated, testing a traditional dewormer medicine, *Albizia anthelmintica*, under field conditions. The EVK treatment proved to be effective at levels that are consistent with the veterinary pharmaceutical standards for a novel treatment. Therefore, Karamojong EVK holds potential for developing sustainable local resource-based and integrated livestock management plans not only in the study area, but also in other developing countries (CHAPTER IV, V).

The thesis assessed not only the pastoralists' wisdom, but also the livestock's 'intuition', where the hypothesis that animals self-medicate was investigated, by using a combination of veterinary, ethnobotanical and indigenous research techniques. We showed that livestock evidently self-medicate. There is reason to suggest, that in Karamoja, some ethnomedicine knowledge has originated from careful animal observation. To our knowledge, this was the first time the techniques we used were combined in

zoopharmacognosy, and one of the few studies ever to investigate livestock self-medication (CHAPTER IV, VI).

Results of ethnographic action research show that with growth of a viable EVK network in Karamoja, local interest for nature conservation has increased. Encouraging EVK and increasing medicinal plant availability benefits not just livestock, but also the people who depend on them. The sharing has stimulated dialogue between antagonistic groups, within families, clans and tribes and even across borders. Strengthening local institutions that address EVK and natural resource management creates a context for peace as a by-product (CHAPTER VIII).

Ethnoveterinary knowledge is more commonly known and used where healers have actively shared it with one another. The latter would indicate that registered healers have shared their EVK effectively and have encouraged its diffusion in the areas studied. These results support the working hypothesis that knowledge will not disappear if it is used and communicated (orally, practically and written) through all available networks - indigenous, endogenous and exogenous. This may enable a smoother transition into the next cultural identity era in which Karamoja reaches a sustainable independent way of living in relation to the modern context (CHAPTER VIII).

This written body of research presents Karamoja's ethnoveterinary knowledge and also validates the pastoralists' ethnobotany knowledge through systematic scientific research. It has both substantiated and strengthened this knowledge and has opened more avenues for further validation, a sound foundation for development initiatives.

Given livestock's central role in Karamoja, we recommend that community development programs have an initial EVK survey as an integral part of their core methodology, dynamics and approach. The work in this thesis contributes significantly to the understanding that EVK is at the heart of Karamojong culture. Efforts to preserve, promote and protect it will benefit the entire culture.

This ethnoveterinary study, in a previously unstudied area and with a poorly documented population still living in a traditional way, has helped add to the growing body of

knowledge about useful plants in Uganda. The present study safeguards the EVK availability for future generations of the traditional communities concerned, for the entire socio-cultural Karamoja cluster (southeast Sudan, northwest Kenya, and southwest Ethiopia where other closely-related ethnic groups still practice a transhumant lifestyle), as well as for the R&D community at large.

Samenvatting

De huidige studie presenteert de catalogisering en documentering van inheemse veterinaire kennis van Karamojong herders als onderdeel van een doorlopend ontwikkelingsprogramma over de gezondheid van vee in de gemeenschappen, opgestart door niet-gouvernementele organisaties.

De regio van Karamoja, met een oppervlakte van zo'n 28 000 km², bevindt zich in Noordoost Oeganda, in Oost-Afrika. Deze regio kampt met een aantal problemen die dit onderzoek rechtvaardigen. Deze problemen worden hieronder opgelijst. Ten eerste heeft Karamoja een broze inheemse kennisbasis die gevoelig is aan fragmentatie. Deze bestaat voornamelijk uit mondelinge overlevering en bevat zeer weinig geschreven gegevens. Het toenemende aantal lokaal bedreigde medicinale planten is een ander, verwant probleem. Het gebied is onveilig en heeft mede hierdoor een grote ontbossingsnelheid. Aangezien de Karamojong bevolking een semi-nomadisch pastoraal volk zijn met weinig ervaring in landbouw, zijn ze daarenboven niet of weinig vertrouwd met agroforestry, plantenvermeerdering, behoud en bescherming van grondstoffen. De Karamojong volkeren hebben een *gemarginaliseerde levensstijl*. Hun thuisland heeft een gebrekkige infrastructuur en een hoog ziekte- en sterftecijfer. Het gebied is gekenmerkt door periodieke droogte en hongersnood. De verhouding tussen de Karamojong en de overheid is slecht, hetgeen bijdraagt tot de externe/omgevingsdruk op de kennis van de Karamojong. Tenslotte beschikt de Karamojong over de slechtst uitgebouwde veterinaire diensten van Oeganda, ondanks het feit dat vee een centrale rol speelt in de cultuur en levensstijl in het gebied. De inheemse kennis in de Karamojong (IK) blijkt uitzonderlijk veerkrachtig ten opzichte van de fysisch onherbergzame omgeving, maar in veel mindere mate tegen de verschillende soorten sociale druk die hierboven vermeld zijn. Tijdens het leven van de ouderen is de ecologische omgeving harder geworden en is de oppervlakte van de graslanden verkleind. Als gevolg van deze milieuveranderingen, is de afhankelijkheid van externe hulp en elementen die het systeem van buitenaf binnenkomen, vergroot, waardoor de inheemse mechanismen om met deze problemen om te gaan verzwakt worden.

De catalogisering van de inheemse veterinaire behandelingen begon tien jaar geleden. Het doel was de behandelmethoden waarin de Karamojong het meeste vertrouwen hebben te integreren in regionale veterinaire opleidingen. In de volgende onderzoeks- en ontwikkelingsfase werden een paar van de planten die gebruikt worden in de behandelingen, geselecteerd voor wetenschappelijke validatie in veldexperimenten en om te promoten in agroforestry. Tijdens deze fase van veldwerk werd geobserveerd dat geiten aan automedicatie deden. Aangezien er zeer weinig geweten is over dierlijke zelf-medicatie, hebben we een andere studie opgezet om de zoofarmacognosie van het vee beter te begrijpen. Voortgezet onderzoek bracht de diepte en breedte van de Karamojongs IK aan het licht. Ondertussen hebben externe belanghebbenden een glimp opgevangen van IK's potentieel voor capaciteitsopbouw van de gemeenschap en van de dierenwelzijnswerkers van de gemeenschap (CAHW). Dit onderzoek combineerde endogene en exogene ideeën en onderzoeks- en ontwikkelingsnetwerken. De endogene aanpak bestond uit zowel wetenschap als traditie en droeg op deze manier bij tot beide domeinen. Methoden om Karamoja's ethnoveterinaire kennis (EVK) te 'herontdekken', opnieuw uit te vinden en systematisch beschikbaar te stellen voor gebruik door de gemeenschap, waren onderdeel van deze fase. In de laatste fase werd onderzocht hoe goed deze gemengde EVK zich in de gemeenschap verspreidde.

De herders van Zuid-en Centraal-Karamoja hebben veel inheemse kennis en beschikken over een grote verscheidenheid aan planten waaruit ze kunnen kiezen om in hun onderhoud en de gezondheidszorg van hun vee te voorzien. Deze studie registreerde etnoveterinaire kennis over 209 plantensoorten, verspreid over 116 genera en 54 families. In totaal werden 130 verschillende gebruiken van EVK opgelijst. Het meest voorkomende gebruik was tegen anaplasmose; 29 plantensoorten die hiervoor gebruikt worden, zijn hier gerapporteerd. Veel van de planten in deze inventaris werden nooit eerder gedocumenteerd als gebruikt in zorg voor het vee. Andere planten zijn wel al eerder gedocumenteerd, maar niet voor de specifieke gebruiken die hier opgetekend zijn (HOOFDSTUK III).

Om inzicht te geven in de validatie en standaardisatie van een traditioneel geneesmiddel, werd ter illustratie een veldproef beschreven waarin een belangrijk traditioneel medicijn om te ontwormen, *Albizia anthelmintica,* getest werd onder veldomstandigheden. De EVK behandeling bleek werkzaam te zijn op een niveau dat overeenkomt met de veterinaire farmaceutische standaarden voor nieuwe behandelingen. De Karamojong EVK bevat dus potentieel voor de ontwikkeling van lokale geïntegreerde beheerplannen voor vee in het studiegebied, gebaseerd op de aanwezige hulpbronnen, en bij uitbreiding, voor andere ontwikkelingslanden (HOOFDSTUK IV).

Deze thesis maakt niet alleen een inschatting van de wijsheid en kennis van de herders, maar ook van de ‘intuïtie’ van het vee. De hypothese dat dieren zichzelf medicijnen toedienen werd onderzocht aan de hand van een combinatie van veterinaire, etnobotanische en inheemse onderzoekstechnieken. We hebben aangetoond dat het vee zich duidelijk zelf behandelt. Er zijn redenen om te veronderstellen dat een deel van de etnomedicinale kennis in Karamoja ontstaan is vanuit zorgvuldige observatie van de dieren. Voor zover wij weten, was dit de eerste keer dat deze technieken gecombineerd werden in de zoofarmacognosie en één van de zeldzame studies die ooit gepubliceerd zijn over automedicatie van vee (HOOFDSTUK IV, V).

De resultaten van etnografisch actie-onderzoek tonen aan dat lokale belangstelling voor natuurbehoud versterkt werd door de groei van een levensvatbaar EVK netwerk in Karamoja. Niet enkel het vee, maar ook de mensen die van het vee afhankelijk zijn voor hun levensonderhoud hebben baat bij de aanmoediging van EVK en een verhoogde beschikbaarheid van medicinale planten. Deze informatie-uitwisseling en interactie heeft de dialoog tussen antagonistische groepen, binnen families, clans en stammen tot zelfs over de grenzen heen gestimuleerd. De versterking van lokale instituten die zich toeleggen op EVK en het beheer van natuurlijke hulpbronnen, creëert een context voor vrede als bijproduct (HOOFDSTUK VI).

Etnoveterinaire kennis is beter gekend en wordt meer gebruikt op plaatsen waar genezers deze kennis actief uitgewisseld hebben. De resultaten van dit werk geven aan dat geregistreerde genezers hun EVK effectief hebben uitgewisseld en de verspreiding ervan in de studiegebieden aangemoedigd hebben. Deze resultaten staven de hypothese dat kennis niet verdwijnt als ze gebruikt en (mondeling, schriftelijk, en via de praktijk) doorgegeven wordt door alle beschikbare netwerken – indigene, endogene en exogene. Dit kan een soepelere overgang naar de volgende era van culturele identiteit mogelijk maken, waarin de Karamojong in relatie tot de moderne context een duurzame, onafhankelijke levensstijl kunnen bereiken (HOOFDSTUK VII).

De geschreven neerslag van dit onderzoek presenteert Karamoja's etnoveterinaire kennis en valideert de etnobotanische kennis van de herders door systematisch wetenschappelijk onderzoek. Deze thesis heeft deze kennis zowel bevestigd als versterkt en heeft meer wegen geopend voor verdere validatie van deze kennis: een degelijk fundament voor ontwikkelingsinitiatieven.

In het licht van de centrale rol van het vee in Karamoja, bevelen wij aan dat ontwikkelingsprogramma's voor de gemeenschappen een initieel onderzoek van de EVK incorporeren als een integraal deel van hun kernmethodologie, -dynamica en –aanpak. Deze thesis draagt significant bij tot het inzicht dat de EVK zich in het hart van de Karamojong cultuur bevindt. Inspanningen om deze te behouden, te promoten en te beschermen zullen de cultuur als geheel ten goede komen.

Deze etnoveterinaire studie, in een tot nog toe ononderzocht gebied en met een slecht gedocumenteerde bevolking die er nog steeds een traditionele levensstijl op nahoudt, heeft additionele elementen toegevoegd aan de groeiende kennis over nuttige planten in Oeganda. De huidige studie waarborgt de beschikbaarheid van de EVK voor de toekomstige generaties van de betrokken traditionele gemeenschappen, voor de volledige socio-culturele Karamoja cluster (in Zuidoost Soedan, Noordwest Kenya en Zuidwest Ethiopië, waar andere, dichtbijzijnde etnische groepen er nog steeds een semi-nomadische levensstijl op nahouden), en voor de onderzoeks- en ontwikkelingsgemeenschap in zijn geheel.

Ngakiro nguna euruaka

Erae akisiom na gina iwaritere aosou gina ke ekitoe a gibaren a Ngikarimojong a lotoma a losikinet gina a ngiriongeta ata lojokotau analosikinet kec eyakautene eyare a ngibaren. Ebuku ngolo a Karimojong erae ngamairei 28,000, eyai kuju kide Uganda, kide Afrika.

Guna epolok alotoma eripiripiye anakisiom ana ikech nu; Erai aosou ngina a ngitunga a karimojong gina eyai epalag ka atakatiaka. Erae eemut mam guna igirir. Ace toonis erae ngikito a ngikarimojong gulu ageut angopiyar. Erae akwap na ngina angatomwian ngina elal ejie ka akinyas ngikito. Ikwangina erakatar ngikarimojong ngikeyokok ngibaren nooi kitaeta iwadio, edit ikec akidup ka athare ngikito, akiyok ngamon ka akiuriarit. Erae akiyar a ngikarimojong ngina isidioro. Erae ekec buku ngolo emam ngadukioto, elal atwanare ka adiak. Erae akwap ngina elal akolong ka eron. Eyakautene apukan ka ngitunga emam-ngejok, inges iyatakinit akimuriakin aosou ngina a ngamon ka nginyomen amunaar. Guna ka awasia ngitalio ka eyare angikarimojong erae lobaren emiat., todit bo awosou ngina ka angaleu ka ekitoi angibaren alotoma Uganda. Nait etakani awosou angikarimojong ingarakinit ngilopeyek tar kerono eyakautene ka akec kwap. Amunaar kona eyakautene ngolo ka akwap akudiokut tar nginya a ngibaren nyikoni neni kolong sek angikasikou. Ikwangina elocokinor akwap, alalari kona akitere ka ariamunit akingarakino alokinga inges nait enyas aosou ngina sek eyakatar ngikarimojong.

Akidiat akitoi angibaren ngolo angikarimojong ageuni ngikaru ngitomon gulu alunyar, area alosikinet akinyalakin ekitoi ngolo isitiyaete ngikarimojong ka ngulu angibukui anguluche alotome ekitatame ngolo ka akiyar angibaren. Nguna nabo alosikinit aripirip na area atheun ngikito ngulu ajokak kotere iyatakinio akidup ka akisiem kisitiyaete ejok. Alotoma akisiem ngikito lu aponi toriamunae atemar, amaseete ngakinei ekitoe make. Ikwanginapei nyeyenere sek epite ngolo imukeetar ngibaren make aponi nabo kiyatakinae aripirip epite ngolo emaseta ngibaren ekitoi make. Alotoma aripirip aponi toriamunae atemar elal ka epol aosou ngina a ngikarimojong alotoma ekitoi ngolo angibaen. Apotu nait ngikayenak gulu alokinga kisitiyata aosou angikarimojong ka ngina sek eyakatar ikec akitatamia ngitunga ngulu epolokinito eyare angibaren. Abu aousou angikarimojong ka ngina a ngitunga a gulu alokinga kinyalakin kiatak eyene ekitoi angibaren. Aponi nait kiwarai epite ngolo imorikinere aosou ngina angikito alu kotere iyatakino ekec kisitayae aloreria.

Ngikeyokok ngibaren gulu alokwap ka kidding karimojong ikec aponitoriamunae eyakatar aosou ngina ke ekitoi angibaren ka elalak ngikito gulu elemere akitoi kotere imuketa ngibaren kec. Aponi alotoma aripirip kimarunae ngikito 209 eyelakina edolito 116 ka ngikalia 54. aponi toriamunae atemar esitae ekitoi lo toma ngirotin 130. nooi edeke areit area edeke anaoroi, adolito ngike kito 29. ekitoi lo ngolo alalan pa engirir kolong sek (EKEK III).

Anguna ka ajokis ke ekitoi angikarimojong, eyai akitodiunet epite ngolo isitiyaere ekitoi lo alemaria ngikur alobaren. Abu erionget ngolo eripiripi aosou angikito angibaren toriam atemar ithitiyae ekitoi lo ikwa ngikito ngulu angamachinio dang. Ikwanginapei eyakar ekitoi angikarimojong angogogu ngina epedorere akitolot inges kingaren alotoma akimukea ngibaren alo karimojong ka ngakwapin gunace dang (EKEK IV).

Akaritas naga mam pa ewarit awosou angikeyokok ngibaren bon, nait epite ngolo imukeatar ngibaren dang make. Esitiyao aosou ngina ka asegis a ngibaren, ka aripiripi aosou ngina a ngtunga ngilopeyeek. Itodiunitae atemar kire imukeasi ngibaren make. Eyai atametait atemar aosou ngina angikito angibaren alokarimojong itorunit tooma akiyokit epite ngolo angibaren (NGIKEKYA IV, V).

Nguna ariamun alotoma aripirip ngikito angibaren alokarimojong erae epito ngolo kona apolounio erionget ngolo eripiripi ngikito angibaren, kanabo alalau kona ngikarimojong akiyok akech moni. Akimukeun aosou a ngikito ngulu angikarimojong iitakini etiae angikito kotere imukere ngibaren ka ngitunga dang gulu isitaete ikes. Ayau aosou ngina angikito angibaren acunankin ngitunga alokalia, ngatekerin ka ngakwapin nguna alokinga dand. Akingarakin erionget ngolo iwarit aosou ngina angikito eyauni ayiuni ngamon ka nginyomen daadang ka eyauni ekisil nakwap (EKEK VI).

Aosou ngina angikito angibaren alalau kona ka elal kona ngikabokak ngikito akimor aosou ka nguluce. Ngikabokak ngikito ngulu igiritae ikes esilereut aosou ngina a ngikito.

Itodi aripirip na atemar ano kemora ngitunga aosou ka kisitiyaete emam nyengopiyari eyenut ngikito angibaren. Etamakina aosou kikobetei alotoma nganyameta ka ngatekerin daadang, inges nait iuriari aosou na nyengopia kitodolok ngina imorikinor aosou na ka ngina akwap angina epol (EKEK VII).

Igiritae ngakiro nguna ka aripirip aosou ngina ke ekitoi ka akitongogu epite ngolo isitiyata ngi keyokok ngibaren aosou naga. Eyatak aririp na aosou ka angaa ngirotin ngulu kitongogoget ekitoi ngolo karimojongaet angibaren, inges nait erauni epir ka akitopol etic logo.

Ikwanginapei erakatar ngibaren epir angikarimojong, ebeikinit ngiriongeta ngulu itoploete karimojong toyenut ka toripiripeta aosou ngina angikito angibaren, epite golo isitiyaere ka itolosere ngaren. Erae akigir na ngina ingarakinit alotoma akiyatakin eyenut aosou ngina angikito angibaren atemar eyai toma ngitalio angikarimojong. Nguna itayao daadang akiuriar aosou na ingarakini etal ka akiyar angitunga ka ngibaren.

Engarak akisiom ngina ka aririp aosou angikito angibaren ayenut ngikito ngulu ejokak alo Uganda, anarea emam kolong pa ayenen aosou na alopite angolo eroko karimojong isidiyoro. Iyokiuni akisiom na aosou ngina angikito angibaren kotere eriamunete nganyamete nguna alongaren dang, ka ingarakini ngatekerin angikarimojong daadang nguna eyakasi (kwap Sudan, Kuju kide Kenya, Kwaptoo Ethiopia neni eroko ngitunga eyarete ngolopei pite ikwa ngikarimojong) ka ingarakini ngiriongeta alotoma akitopol akwap ka ebuku daadang.

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Acronyms and abbreviations

ABEK	**Alternative-based Education Karamoja**
BoLI	**Bokora Livestock Initiative**
BTLHA	**Bokora Traditional Livestock Healers' Association**
CAHW	**Community Animal Health Worker**
CBAH	**Community Based Animal Health**
CBO	**Community Based Organisation**
CBPP	**Contagious Bovine Pleuropneumonia**
cc	**cubic centimetres or millilitres**
CCPP	**Contagious Caprine Pleuropneumonia**
ChIPS	**Christian International Peace Service**
COU	**Church of Uganda**
CVM	**Christian Veterinary Mission**
CVM/WC	**Christian Veterinary Mission/World Concern**
df	**degrees of freedom**
DPD	**diseases, processes and disorders**
DVO	**District Veterinary Officer**
ECF	**East Coast Fever or theileriosis**
EM	**Ethnomedicine**
EN	**Eastern Nilotic**
EPG	**Eggs per gram of faeces**
EVK	**Ethnoveterinary Knowledge**
EVM	**Ethnoveterinary Medicine**
FECR	**Faecal Egg Count Reduction**
FL	**Fidelity Level**
FMD	**Foot and Mouth Disease**
GO	**Governmental Organisation**
ICEB	**International Congress of Ethnobotany**
ICF	**Informant Consensus Factor**
IK	**Indigenous Knowledge**

K	**Kuliuk**
KACHEP	**Karamoja Christian Ethnoveterinary Program**
KAP	**knowledge, attitude and practices**
KEVIN	**Karamoja Ethnoveterinary Information Network**
kg	**kilogrammes**
km	**kilometres**
LC1	**Local Council One**
LEP	**Livestock Extension Programme**
LSD	**Lumpy Skin Disease**
m	**metres**
MAAIF	**Minister of Agriculture, Animal Industry and Fisheries**
NCD	**Newcastle Disease**
NGO	**Non- Governmental Organisation**
obs	**observed**
PCV	**packed cell volume**
PTLHA	**Pian Traditional Livestock Healers' Association**
PAR	**Participatory Action Research**
Q	**Quartile**
R&D	**Research and Development**
SD	**standard deviation**
SE	**standard error**
SM	**self-medicating remedy**
SN	**Southern Nilotic**
TH	**Traditional Healer**
TK	**Traditional Knowledge**
TLH	**Traditional Livestock Healer**
TLHA	**Traditional Livestock Healers' Association**
TM	**Traditional Medicines**
TP	**total protein**
UBOS	**Uganda Bureaus of Statistics**
UC	**Use Category of Disease or Usage Category**

UNDP	**United Nations Development Programme**
WAAVP	**World Association for the Advancement of Veterinary Parasitology**
WFP	**World Food Project**
WN	**Western Nilotic**
χ^2	**Chi Square**

BACKGROUND

CHAPTERS I - II

1 Introduction

1.1 Background

This research, the cataloguing and documenting of Karamoja's ethnoveterinary knowledge began as a component to an ongoing non-government organisation-managed animal health community program. Late in 1997, deep in the bush of Karamoja, three local non-government organisations (NGOs), (CHiPS, LEP and CVM/WC), were involved in a participatory training of community animal health workers (CAHW). This activity involved teaching how to diagnose and treat endemic livestock diseases based on western veterinary diagnosis and treatment protocols. Medicines were only scarcely available in the country at the time, and found reliably only in Kampala and Soroti, where they were sold in veterinary shops. The closest veterinary shop to Karamoja was 5 hours away by truck, in Soroti. This shop, facilitated by an international NGO (CVM/WC), was the only vet-shop east of the greater Kampala area, opened just months at that time. The medicines were manufactured in Kenya, India and Europe. During the CAHW training, it was noted that the Karamojong pastoralists possessed a high level of indigenous diagnostic acumen. Not only did they have local names for each of the different livestock diseases, they also knew a variety of local treatments to prevent/or and treat them. As far as the NGOs present at the training knew, this was the first time that the pastoralists had shared their ethnoveterinary knowledge relating to their prized livestock. This was just the 'tip of the iceberg'.

The first phase of cataloguing the indigenous veterinary treatments began in March, 1998. The cataloguing was undertaken, in order to integrate the most confidently used treatments into regional trainings. The next phase of documentation entailed selecting a few of the plants to promote in agroforestry and in scientific validation field trials. During this field trial phase, goats were observed to be self-medicating. As very little is known about animal self-medication, we set up an additional study to better understand livestock zoopharmacognosy. Continued research activities revealed the depth and breadth of Karamojong indigenous knowledge (IK). Meanwhile, external shareholders got another glimpse into IK's potential for community and CAHW local capacity building. The research blended endogenous with exogenous ideas and networks. Endogenous approaches mingled both science and tradition, thereby adding value to both.

This phase included ways to ‘re-discover’, re-invent and make Karamoja’s ethnoveterinary knowledge (EVK) systematically available for community use. The final phase investigated how well this blended EVK diffused into the community.

If the oral history and veterinary knowledge is written, validated and used in community groups, it will not disappear and could even be used to strengthen their society, to prevent them from entering a cultural limbo and help them transition as the world around them changes dramatically.

1.2 Problem statements

Karamoja has a *fragile indigenous knowledge data base*, prone to fragmentation. It is primarily oral history with very little written data , < 10% literacy (Uganda Bureau of Statistics, 2007). The Karamojong protect their indigenous knowledge and fear sharing it. Indigenous knowledge (IK) consists of beliefs, values and practices as it relates to their cosmology. They share IK through stories, ceremony, legends, dance, songs, drama and even local customs. They will only share exhaustively IK of traditional medicines, including human and spiritual treatments with their very close peers and children. However, most mainstream livestock knowledge is freely shared with other clan members. The encroachment of modern approaches, e.g. in school and allopathic treatments, constitutes an attack on the IK data base and culture. The young generation is developing interest in school, external health care methods and even adopting non-pastoralists’ values and goals. Cultural erosion is evident in their changed approach to IK including: language, ethnomedicines, ethnoveterinary knowledge, cooking, building, security, weather, raiding, etc.

The growing number of *locally endangered medicinal plants* presents another and related problem. The area has high small arms insecurity and deforestation indices. Many trees are cut for dense protection fencing and firewood. Since they are semi-nomadic pastoralists with limited agriculture experience, they have little familiarity with agroforestry, propagation, resource conservation and protection. Additionally, less land area is available for dry season grazing than their ancestors due to government restrictions (Mamdani *et al.*, 1992). Their transhumant lifestyle can put high pressure on settlement and grazing areas, and provides no impetus for planting trees. Yet, insecurity and government restrictions interrupt the transhumant patterns which normally allow regular ecological renewal and intensify these pressures all the more.

Karamojong people have a *marginalised lifestyle*. Their region has poor infrastructure with high mortality and morbidity rates. The area is prone to drought and famine. There is some subsistence farming, but there is also a growing dependence on food relief since 1980.

The *government relationships* are poor. Most Ugandans have categorized the Karamojong as criminals and trouble makers, resulting in the attitude that they are not worthy of government services. The pre- and post-independence government focus has not been on development, but rather on containment and more recently - forced disarmament. The prevailing government and westernised philosophy is to transform the Karamojong lifestyle from pastoralism to a sedentary agricultural and non-livestock mode (Cisterino, 1979; Muhereza and Otim, 2002).

Finally, the *Karamojong culture and lifestyle* is focused on cattle, yet they have the poorest veterinary services available in Uganda. Their near exclusive interest in cattle, so common to Nilotic peoples, must have been a coping mechanism for the climatologically harsh and agriculturally poor environment (Kassahun *et al.*, 2008). It has also proven remarkably resilient in the face of inhospitable environments, less so regarding the social pressures mentioned above. Every culture, however, has a breaking point. A culture built on a single pillar, no matter how resilient, is extremely vulnerable to external forces. The likely result, here as elsewhere, is an unnecessary choice between tradition and modernity in which the Karamojong will find themselves in a free-fall. Shorn of their traditions and unable to participate in the modernism’s promised future, they most probably will enter a cultural limbo. Their unbalanced cultural structure is a problem, yet possesses resources for bridging this gap.

The ecological *environment* has become harsher and the grazing area more limited during the lifetime of the elders. Over 36% of Karamoja's land has been gazetted to game reserves that forbid settling and livestock grazing (Mwaura, 2005), and during the colonial era (1920-1962), 20% of Karamoja's grazing land was forcibly removed (Mamdani, 1982). Furthermore, agro-pastoralists neighbours and Karamojong themselves, have increased homesteads and agricultural activities in historical grazing areas. This increases animosity and distrust when pastoralists try to continue their age-old practices. As a result of these environmental changes, we see increasing reliance on external support and elements entering the system, thereby diluting their indigenous coping mechanisms. This dissertation is in response to the above problem statements.

1.3 Research overview, aim and objectives

If the oral history and veterinary knowledge is written, validated and used in community groups, it will not disappear. This thesis catalogued Karamojong indigenous veterinary knowledge, primarily on plant – based remedies, and share aspects relating to participatory action research process and local capacity building. This thesis highlights NGO-supported development efforts to incorporate EVK into community based animal health (CBAH) programs and schools within the region.

Cataloguing will help local institutions to re-empower the Karamojong with their elders' wisdom to better care for animals and to re-value their own culture. This ongoing work intends to introduce EVK into the school system and to develop and foster a sustainable traditional livestock healers (TLH) network in the region. These interventions will encourage conservation of traditional medicines (TM) both at the village and NGO level. They will create awareness of IK and EVK to curb their disappearance, promote use of EVK and establish medicinal plant agroforestry schemes. All of the above will encourage TLH to develop marketable value-added natural products by 'techno-blending' locally available treatments/preventatives and practices with allopathic knowledge.

The aim of this study was to investigate the indigenous veterinary knowledge of south and central Karamoja in Uganda and to compile and validate their oral (unwritten or poorly documented) veterinary history and knowledge.

This thesis had nine **specific research objectives** that are laid out in six results chapters and the appendices:

1. To document EVK remedies used to treat known diseases through verification of indigenous remedies, their preparation and administration, and the corresponding livestock disease terminology (Paper I- CHAPTER III AND APPENDICES I & II).
2. To confirm the corresponding livestock disease terminology within the previous objective (Paper I- CHAPTER III AND APPENDIX III).
3. To evaluate the anthelmintic effectiveness of *Albizia anthelmintica* Brongn. (Fabaceae) as a first step in investigating the hypothesis that livestock self-medicate (Paper II- CHAPTER IV).
4. To assess *A. anthelmintica*'s anthelmintic effect against natural infections of mixed gastrointestinal parasites in sheep under pastoral field conditions in northern Uganda (Paper III- CHAPTER V).
5. To investigate *A. anthelmintica*'s effective dose against natural infections of mixed gastrointestinal parasites in sheep under pastoral field conditions in northern Uganda (Paper III- CHAPTER V).
6. To investigate self-medicating behaviours of Karamojong livestock based on the field observations that generated the hypothesis that animals seek out and graze specific medicinal plants or employ other behaviours when sick. The survey addressed three specific research questions:
    a. do animals (domestic and wild) perform self-medicating behaviours? If so,
    b. what plants or other materials do they use? And finally,
    c. do people locally use these same remedies and/or strategies to treat disease in livestock and/or themselves (i.e., are they included in the local pharmacopoeia)? (Paper IV- CHAPTER VI).

7. To select and validate the use of plants and/or materials that had more potential for promotion within the subregion, e.g. establishing them in home gardens, follow-up field trials and possible drug development (Paper V- CHAPTER VII).
8. To document the ethnographic framework used to strengthen EVK and to encourage natural resource management through agroforestry and plant conservation (Paper V- CHAPTER VII).
9. To compare ethnoveterinary knowledge (EVK) in three study sites. Further, the study addressed the following research questions:
    a. has EVK diffused in Karamoja, as promoted by the traditional livestock healers' associations (TLHA)?
    b. is EVK being used in community groups? (Paper VI- CHAPTER VIII).

All of the above objectives provide a cumulative argument leading to the conclusion that writing, validating and using oral history and veterinary knowledge help protect it from disappearing (CHAPTER IX).

1.4 Study area

1.4.1 Location and climate

The region of Karamoja, 28,000 km^2, almost the size of Belgium, is located between 1˚30′ - 4˚ N and 33˚30′ - 35˚ E in northeastern Uganda. This study, however, was conducted primarily in Bokora and Pian administrative counties in Moroto and Nakapiripirit districts, respectively. The majority of our data comes from the area between 1˚50′ - 2˚40′ N and 34˚15′ - 34˚55′ E. Further, data were compared with information from a baseline comparison survey was held in Dodoth county, Kaabong district (3°30′ N and 34°09′ E; Figure 1-1). The region has a semi-arid to arid agroecology, characterized by an intense hot and dry season (October to April). There is a single rainy season with peaks in May and July. December and January are the driest months, typically with strong wind storms. Mean rainfall is 100 mm to 625 mm annually (Inangolet *et al.*, 2008). Daily temperatures average 30-35˚ C year round. Annual rainfall in the plain is rarely more than 25 cm. As a result, the plants grow under very dry conditions and the dominant species are xerophilous while the soil is rather basic (Wilson, 1959).

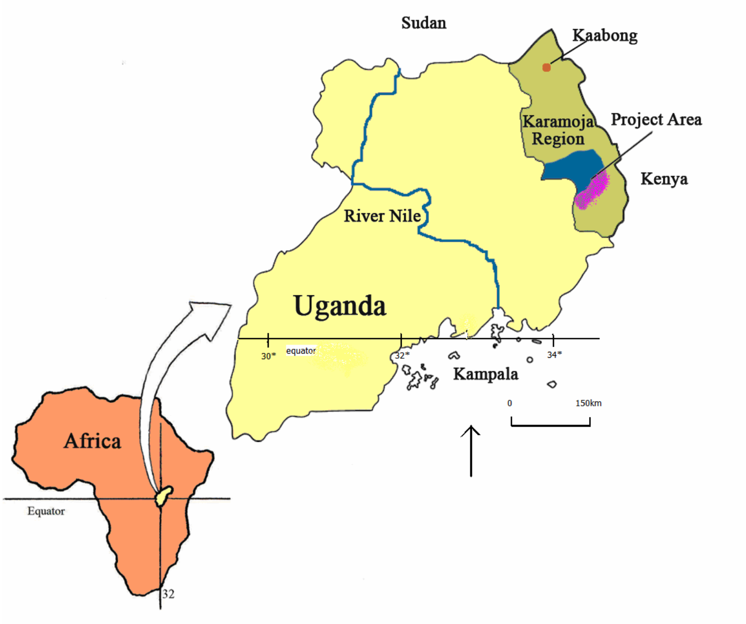

Figure 1-1 Map of project area in Karamoja region (green), Uganda. The projects sites are noted, Bokora (blue) and Pian (pink) and a small area around Kaabong in the north.

The terrain consists of flat grasslands with a few scattered thorn bushes and trees, except along the seasonal rivers, where thickets and sporadic forests are found. The plains, averaging 1400 m above sea level sloping to the west, are punctuated by a triangle of three extinct 3000+ m volcanoes each about 100 km apart from another (Weatherby, 1988).

Karamoja consists of five administrative districts. These are further divided into counties, sub-counties, parishes and finally smaller units called local council one (LC1) areas. These, in turn, are composed of villages, locally named *manyattas* or NGIERE. Counties are commonly named after the dominant ethnic group inhabitants.

1.4.2 Vegetation and soils

The vegetation of arid-semi-arid Karamoja is distinct from the rest of Uganda. It is more similar to that of the cross border areas of Kenya, Sudan and Ethiopia within the Karamojong cluster. Thomas (1943) described the vegetation of Karamoja as consisting of *Acacia-Combretum-Terminalia* woodland species associations, with a grass layer of *Hyparrhenia, Setaria, Themeda, Chrysopogon* and *Sporobolus* species. Karamoja's soil surface has been greatly compacted by a combination of erosion factors including: extensive livestock trampling, reduction of plant cover, direct exposure to rain and desiccation in the dry season (Wilson, 1962).

1.4.3 People, economy and population

The Karamojong still practice a semi-nomadic or transhumant lifestyle like that of the rest of the socio-cultural Karamojong cluster (Gulliver, 1952; Lamphear, 1992), found in the arid-semi-arid area of northeast Uganda, southeast Sudan, northwest Kenya, and southwest Ethiopia (Figure 1-2). Men and their livestock become seasonal nomads in search of adequate pasture and water during the intense annual dry season (October – May). This often stretches into extensive drought at their home *manyatta* (locally called 'ere'), a semi-permanent collection of mud huts surrounded by imposing, protective thick thorn bush walls, protecting families and livestock from raids. Here, the women, children and elders remain while the men travel with the livestock in search of grass during transhumant periods. External contacts in Karamoja are negligible and virtually all of the population rely primarily on traditional health practices for themselves and their livestock (Gradé *et al.*, 2007).

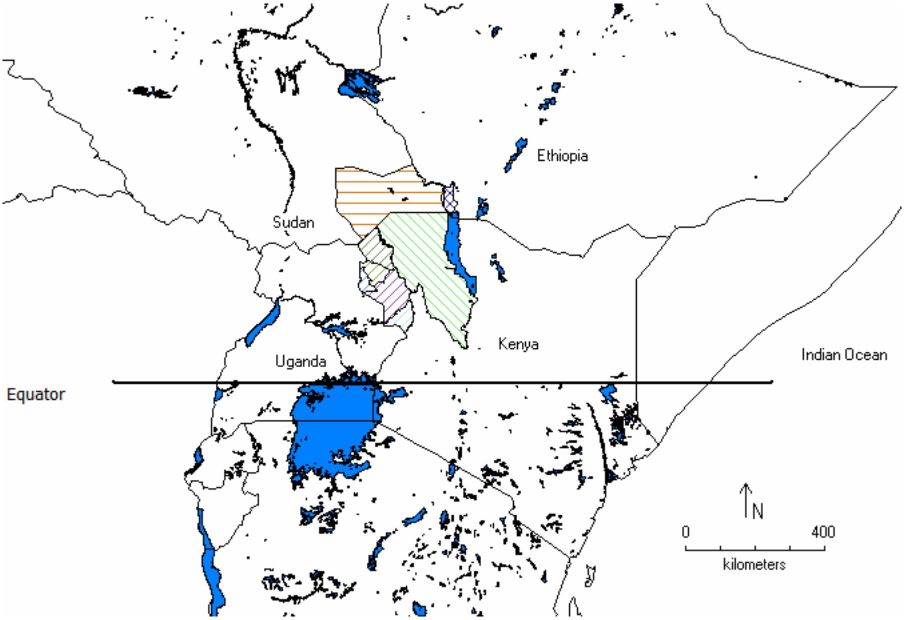

Figure 1-2 Karamoja cluster geographic location in East Africa. Countries include: SE Sudan, Toposa (horizontal red); SW Ethiopia, Nyangatom (criss-cross blue); NW Kenya, Turkana (diagonal green) and NE Uganda. Uganda part is divided into five districts with Nilotic peoples and Kuliak people groups, Nakapiripirit (Pian criss-cross light blue), Moroto (Matheniko and Bokora (purple diagonal), Kotido and Kaabong (green diagonal), and Labwor district (criss-cross light blue).

Karamoja's total population is around 935,000 (Uganda Bureau of Statistics, 2002). The people known as the Karamojong belong to many ethnic groups. The Karamojong comprise five distinct Nilotic (Karimojong, Dodoth, Jie, Labwor, Pokot) people groups in the plains and two small Kuliak (Sor and Ik) groups living along the mountains (Gulliver, 1952). See CHAPTER II, Table 2-1, for more about Karamoja's inhabitants' linguistic classifications. Karamojong is a generic term for the assertive plains people of Karamoja: Dodoth, Jie, and Karimojong. The Karimojong are further divided into Pian, Matheniko and Bokora ethnic groups. Each of the people group names has an explanation ; Dodoth refers to the 'first milk of a cow which has just delivered', Jie means 'fighters'. Karimojong means 'elders', and stems back to an oral history story that while moving in pursuit of settlement land, the elders got tired and remained and some even died there, while the energetic continued to modern day Teso land (considered the 'nephews') to the west. Even though all Karamojong people share the strenuous transhumant pastoral lifestyle, customs and ritual, they rarely interact with other those outside their specific clan due to frequent tribal warfare (Gradé *et al.*, 2008a).

This thesis surveyed communities in the administrative units of Bokora and Pian counties, home to Bokora, Pian and Tepeth ethnic groups, and a few smaller clans. Bokora county population is estimated at 95,000, while Pian has about 38,000 people (Uganda Bureau of Statistics, 2002). Tepeth population was last estimated to be 4,000 (Weatherby, 1988). However, the Tepeth population is thinly spread around the mountains not just in Bokora county, but also in Checkwii and Matheniko counties. We therefore estimate Bokora people to be 88,000 and Tepeth total to be 10,000.

Bokora and Pian ethnic groups share the same Eastern Nilotic language, i.e. Ngakarimojong, with slight tonal differences. However, due to armed reciprocal cattle rustling, there are strong cultural taboos against sharing livestock information between clans (Mirzeler and Young, 2000).

The Tepeth are Kuliak. They live on the three separate volcanic mountains (Mounts Kadam, Napak and Moroto), surrounded by different ethnic groups - Karimojong (Matheniko, Bokora and Pian), as well Turkana and Pokot. They have their own language (Ngitepes), unintelligible to the Karamojong, although most Tepeth also use Ngakarimojong. Whereas the plains people are fiercer, taller and live in huts, the Tepeth are less aggressive and many still sleep in caves (Weatherby, 1988; Gradé personal observations).

The Karamojong, as a whole, are said to be obsessed with the cow as the definition of wealth and status (Knighton, 2005). However, this cultural wealth translates poorly to western standards. By that standard, 80% of Karamoja's inhabitants live below the poverty line and 76% of the Karamojong are part of Uganda's lowest wealth quintile (Uganda Bureau of Statistics, 2007). Sixty percent of the women have at least one co-wife and 20% have more than two. Karamoja's basic health statistics are the poorest in the country, with only one health care bed available for over 5100 patients and Uganda's greatest chronic malnutrition problem, with stunting affecting over half the children population (Gray, 2008; Uganda Bureau of Statistics, 2007). The most dire nutrition status was during the 1980 famine (Biellik and Henderson, 1981). Only 1.1% of the population have completed primary school (Uganda Bureau of Statistics, 2007).

1.4.4 Livestock

Livestock rearing is a key economic activity in Uganda and represents 7.5% of the country's Gross Domestic Product (World Bank, 2008). The highest livestock numbers are found in the cattle corridor which extends diagonally across Uganda, from the pastoralist Ankole area to Karamoja region bordering Sudan and Kenya. The cattle corridor inhabitants' (Banyankole, Iteso and Karamojong) primary income is from livestock, however, only the Karamojong culturally have cattle at their cultural centre. Their seasonal calendar revolves around grazing patterns. Animals are used for food (milk, meat and blood), whereas hides are fashioned into clothes and sleeping mats. They are used for ceremony – religious, warfare and marriage and it is not unheard of for a suitor to pay 100 cows for one of his wives. Not only are cattle important monetarily, peoples' very self-worth and existence depends on livestock ownership. In fact, the districts in Karamoja are the only ones where there are more cattle than people, even more sheep and goats than people (Uganda Bureau of Statistics, 2007).

The livestock commonly found in Karamoja include: short-horned zebu cattle (Karimojong breed), sheep, goats, donkeys, camels, chicken, guinea fowl, turkey, ostrich and a few pigs. The Karamojong also keep dogs for hunting, protection and herding.

Common animal diseases include: tick-borne diseases (anaplasmosis, babesiosis, heartwater (cowdriasis) and theileriosis (east coast fever or ECF) and contagious diseases (anthrax, foot and mouth disease (FMD), contagious bovine pleuropneumonia (CBPP), foot rot, haemorrhagic septicaemia, malignant catarrhal fever, tuberculosis, trypanosomiasis, peste des petits ruminants, sheep pox and goat pox, fowl cholera, fowl typhoid, newcastle disease (NCD), strangles and camel pox). Reportable animal diseases include: lumpy skin disease (LSD), rabies, and rinderpest. Serious zoonotic diseases include: brucellosis, rabies, tuberculosis and anthrax (DVO, 2005). These diseases' Ngakarimojong translations are found in Appendix III. Very little livestock epidemiology data in Karamoja is available, but we found some limited data on tuberculosis prevalence taken from slaughter samples at the Moroto arbattoir (Pritchard *et al.*, 1975) and field surveys (Inangolet *et al.*, 2008), both of which showed relatively low prevalence ranging of less than 1.5%.

Karamoja region has various weekly cattle markets in Kangole, Moroto municipality, Iriiri, Matany, Lolachat, Achorichor, Namalu, Panyangara and Bartanga (ACTED, 2008). Kotido municipality hosts one daily and it is poorly attended. The most active cattle market is in the centre of Karamoja, in Kangole. Most of the cattle sold are hauled out of Karamoja for slaughter. The entire region has only one abattoir, built in Moroto this decade; however it is still not in use at the time of writing. Each trading centre has a ghasab to perform basic, primitive slaughter in Muslim accordance, so that the meat is saleable.

2.

2 Literature review

Literature on Karamoja has been quite sparse; Pub-med had only 19 hits at the time of writing. Three of these citations were for 2008, whereas zero for 1998-2006. Web of Science had 37 hits, yet only 28 were actually articles. The fields of interest were anthropology (5/28), ecology (5/28) and veterinary science (5/28). The earliest literature found is from an British expedition report from 1897-99 journeying through Karamoja en route to Juba (Macdonald, 1899a, b, c); the second expedition was also catalogued (Brooke, 1905), see maps in appendix IV.

Figure 2-1 Playbill for a 1954 film produced by exploitation filmmaker Kroger Babb. Has scenes that would be shocking to an American audience, including advertising announcing that the tribe wore "only the wind and live[d] on blood and beer." (Friedman, 1990).

2.1 Traditional Knowledge Systems, pastoralism and coping mechanisms

Pastoralism, characterised as seasonally migrating subsistence-oriented cattle and small-stock herding is a traditional coping mechanism developed in semi-arid and arid environments with unpredictable climatic conditions (Dahl *et al.*, 2001). The Karamojong are considered semi-nomadic or transhumant pastoralists (Dyson-Hudson, 1966). Over a hundred years ago, they devised extensive mechanisms to ensure the continued productivity of their grazing lands. Through Karamoja's traditional knowledge system, the elders have developed a system of land utilisation with permanent villages (*manyattas* or NGIERE), situated on permanent water supplies most often found in the beds of sand rivers, extending north and south through Karamoja region (Dyson-Hudson, 1972b; Mamdani, 1982). During the rainy season, all production takes place around the manyattas, involving cultivating sorghum and livestock grazing. During the dry season, young men herd most of the livestock and set up temporary camps (*kraals* or NGAOWII) in areas to the distant east and west, their herds thriving on grazing land that had been left to fallow, unoccupied during the rains, and perhaps longer, depending on how long the elders had set that particular area aside. In these savannas, the herders practice slash and burn methods. In the eastern and western areas, where seasonal droughts are common, they burn the plains toward the end of the dry season. The burn removes old, unpalatable and nutritionally poor fodder. The fire also controls shrub overgrowth (thickets) thereby promoting regrowth of trees and grass savanna (Joubert *et al.*, 2008; Savadogo *et al.*, 2008). Secondly, fires keep control tick and harvester ant populations. Ticks carry dangerous livestock diseases (anaplasmosis, babesiosis, heartwater (cowdriasis) and theileriosis (ECF)) and the ants, free to roam, destroy ground cover, destroy perennial grasses, allowing annual grasses, herbs and shrubs to flourish. Finally, fire remnants become nitrogen-rich fertilizer (Mamdani, 1982). Gray *et al.* (2003), Knighton (2005) and Novelli (1988, 1999) have more detailed discussions on Karamojong pastoralism practices, including their seasonal calendar, and aspects of community living, ritual and age-sets.

Nevertheless, there are evidences in arid areas that traditional coping mechanisms are becoming less viable due to several recurrent themes: rangeland degradation, recurrent droughts and lack of policy changes (Kassahun *et al.*, 2008; Oba and Kotile, 2001).

2.2 Community development approach

Blaikie *et al.* (1997) gives an overview of different community development approaches, contrasting three development paradigms: classic, neo-liberal and neo-populist. They also state that the main "challenge for development practitioners is to develop flexible ways in which exogenous and local actors and their knowledge can interact".

The approach that we have primarily adhered to is one of participatory action research as a part of endogenous development. A development manual compiled as a part of a masters project proved to be helpful in these participatory learning and training processes, as it gives practical tips and straight-forward guidelines for participatory techniques and community development design (Stewart, 1998). Wadsworth (1998) in his research came to the conclusion that participatory action research is:

> "a description of social research per se (albeit social research which is more *conscious* of its underlying assumptions, and collectivist nature, its action consequences and its driving values) "

Endogenous livestock development was given a good overview through Ethiopian pastoralists' case study (Homann *et al.*, 2008). Endogenous development is defined as 'development from within' or 'development based mainly on local strategies, knowledge, intuitions and resources' (Jenkins, 2000). Practical resources for endogenous development can be found through the Compas conference series and magazine (Arce, 2004; Foundation and Compas; Maffi, 2005; McCorkle, 1999).

2.3 Acculturation

Acculturation was a term first coined in 1880 by an American anthropologist, J.W. Powell (1882) to characterise “culture change in progress, and people’s associated physiological changes”. However, Plato was the first to describe this social process in 5th century B.C. (Kraut, 1992; Rudmin, 2003). One of the most cited works on acculturation defines it as “cultural change resulting from continuous, first-hand contact between two distinct cultural groups” (Redfield *et al.*, 1936). Acculturation has been taking place for millennia, but contemporary interest in research on acculturation grew out of a concern for the effects of colonial European domination of indigenous peoples (Berry, 2005; Hallowell, 1945). Later acculturation studies focused on immigrants, whereas recently immigrant status has also included refugees and expatriate professionals in cross-cultural settings (Berry, 2005; Berry *et al.*, 1987; Del Pilar and Udasco, 2004; Katz *et al.*, 1963; Rudmin, 2003; Stewart, 1999).

The phenomenon of acculturation has been the subject of much attention and research in the social sciences. Acculturation research has amassed over 68 different approaches with various terminologies (Rudmin, 2003). One widely researched approach to acculturation was outlined by Berry (2003). His analysis included a category for deculturated individuals. Four distinct varieties of acculturation were identified: (a) assimilation, which is the result of complete identification with the dominant society; (b) integration, whereby a strong identification with the societies involved is maintained; (c) rejection, which involves retention of the cultural identity but rejection of the dominant society; and (d) deculturation, in which the people involved fail to acculturate to the dominant society and also fail to retain their own cultural identity (Del Pilar and Udasco, 2004). Furthermore, while originally applied to group-level occurrences, it is also widely recognised as an individual-level phenomenon (Berry *et al.*, 1987). Research on the individual level shows widespread evidence that most people who experience acculturation are not destroyed or greatly demoralised; rather they find opportunities (Berry, 2003).

2.4 Karamojong ethnography

The earliest mention of the tribes in Karamoja is from a British military expedition in 1897. It contains a variety of ethnographic information including notes on customs, including physical characteristics, mode of subsistence, religion/laws, arts and manufactures, personal adornments their general character. According to these first records the Karamojong "were singularly honest people, the most honest savages I had ever met" (Macdonald, 1899b). This early expedition suggested the tribal history as it relates to their present and past geographic distribution and also listed 105 vocabulary words (Macdonald, 1899b).

2.4.1 Ethnic groups

The people known as the Karamojong belong to many ethnic groups, which can lead to confusion (Table 2-1). Colonial records in 1899 classified them ethnolinguistically as Nuba-Fulla, and more specifically Hamitic (Macdonald, 1899a), yet later as Nilo-Hamitic (Dyson-Hudson, 1963). Twenty-five years later, they were called the central group of the 'Nilotes of the Plains' (Novelli, 1988).

The Karamojong comprise five distinct Nilotic peoples (Karimojong, Dodoth, Jie, Labwor and Pokot) in the plains and two small Kuliak groups (Tepeth and Ik) found along the mountains. Karamojong is used as a generic term for the dominant plains people of Karamoja: Dodoth, Jie, and Karimojong. The Karimojong are further divided into Pian, Matheniko and Bokora ethnic groups. Knighton (2005) charted out the ethnic relationships with the two major groups of 'Nilo-Saharans' and Afro-Asiatics. All groups living in Karamoja fall in the Nilo-Saharans group and all continue to be together in the sub-group Eastern Sudanics. Classifying the Tepeth is the most problematic, both ethnographically and linguistically. Tepeth are surrounded by strong Nilotics influences. As a consequence, their language is getting absorbed, similar to the now extinct Nyangiya (Table 2-1) language (Bender, 2000). They are usually put loosely as a Kuliak group, where the Ik (Tueso) of remote northeastern Karamoja are more confidently assigned (Blench, 2000; Knighton, 2005).

2.4.2 Linguistics

The first explorers through Karamoja did not characterise the language(s) of Karamoja (Brooke, 1905; Macdonald, 1899a, b). Although Macdonald (1899 a, b) suggested a common origin with seven languages, including those of Turkana, Donyiro and Maasai, whereas Brooke(1905) mentioned that the Karamojong language extends up to southern Abyssinia (Ethiopia). There is still an ongoing debate among philologs over connections and divisions when classifying languages found in Karamoja (Bender, 1996, 2000; Blench, 2000; Bryan, 1945; Ehret, 1967; Ehret, 2001; Goodman, 1970; Greenberg, 1948, 1957; Greenberg, 1963a, b; Huntingford, 1956; Knighton, 2005). There is general agreement on Greenberg's phyla classification, cataloguing all African languages into four phyla (Bender, 2000; Greenberg, 1963a). Of these phyla, Nilo-Saharan is the least widely accepted; unfortunately this is where all the languages of Karamoja are found (Bender, 2000). Dyson-Hudson (1966) identified their language and ethnicity as Nilo-Hamitic. They have also been grouped as Nilotic, Hamito-Semitic and central Nilo-Hamitic, specifically the Teso group together with Jie, Dodoth, Toposa and Turkana, while the 'others group' in central includes: Labwor, Nyakwai and Npangeya (Huntingford, 1956). The Pokot language (Suk) falls in the Southern Nilo-Hamitic languages, which also comprises Maasai, the best-known ethnic group internationally (Blench, 2000). Others put Pokot in Southern Nilotic division within the Kalenjin group, far removed from Maasai who are grouped in the Eastern Nilotic division. There is a linear linguistic classification chart of Ngakaramojong charted in Knighton's book (2005), which is adapted below, however different than that of Blench (2000). For the sake of this thesis, we will follow the table below.

Table 2-1 Ethnic groups and their linguistic classification in Karamoja (adapted from (Gulliver, 1952; Knighton, 2005)

Inhabitants of Karamoja, Uganda =Karamojong[a]	**Inhabitants of Karamoja cluster area**		**Members of the ethno-social Karamoja cluster**
	Country	**people, LINGUISTIC GROUP**	
Karimojong (Bokora*, Pian*, Matheniko) EN Dodoth EN	SW Ethiopia	Donyiro = Nyangatom EN	Karimojong (Bokora*, Pian*, Matheniko) EN Dodoth EN
Jie EN Pokot = Upe SN	SE Sudan	Toposa, EN Jiye EN	Jie EN Toposa EN Donyiro EN
Labwor = Tobur WN Tepeth* = Sor K	NW Kenya	Turkana EN, Pokot = Suk SN	Turkana EN
Ik = Teuso K [Nyangiya K] ~extinct	Uganda	Karamojong[a] EN, Pokot = Upe SN	

[a]Karamojong = all the people living in Karamoja Uganda, regardless of ethnicity. All the groups listed in the first column
*ethnic group discussed in this thesis
Linguistic classification: EN – Eastern Nilotic, SN – Southern Nilotic, K – Kuliak, WN – Western Nilotic. All these languages are part of the Nilo-Saharan phylum – one of the four phyla of African languages. All, except K – Kuliak (i.e. Ik and Tepeth) are of the Chari-Nile sub-phylum and the Eastern Sudanic family and the Nilotic Branch, which has three divisions, i.e. Southern, Eastern and Western
There are other smaller ethnic groups in Karamoja that are not listed

Now, a brief discussion on the key ethnic groups (Pian, Bokora and Tepeth) surveyed in this dissertation according to their language groupings (denoted by * in Table 2-1). As was said earlier, there are four African language phyla, and all peoples in the Karamojong cluster are included in the Nilo-Saharan phylum (Knighton, 2005). Bokora and Pian ethnic groups share the same Eastern Nilotic language, i.e. Ngakarimojong, classified to the Tunga language group, more specifically in the Lotuko-Maa subgroup where the Maasai and Samburu languages fall. Dodoso (Karamojong people living in northern Karamoja, Uganda) use an Itunga dialect of Ngakarimojong. However, the rest of the Karamojong cluster falls in the Itunga/Karamojong subgroup and use the Ngajie language. Ngajie has at least four dialects, i.e. Donyiro (Dongiro), Toposa, Jiye and Turkana (Knighton, 2005).

Tepeth, also called Sor or Soo in the literature, is in a different subphylum with Ik and Ngangiya of Karamoja, Uganda, which make up the Kuliak branch of languages. This ethnolinguistic group has proved to be difficult to categorise and confusion and debate on its exact status continues today. Their language, Ngitepes or Soo, is unintelligible to the Karamojong, although most Tepeth also use Ngakarimojong.

2.4.3 Research in Karamoja

The earliest study of Karamoja was taken from a distant etic approach by British military detach, surveying for natural resources, obvious in its aloof description of people they observed. Karamoja has always held fascination by outsiders, probably because the traditional pastoralists' lifestyle and environment were so different from their own. Eventually, the focus changed to a more social research approach and gradually a more enculturation approach and emic vantage point ensued. Documentation was exclusively by foreigners, eventually by Africans and Ugandans, and it was not until this decade when the first Karamojong has started his PhD. Although, even he takes an outsiders vantage-point as he is studying the wildlife and not his own culture.

As related above, the earliest ethnographic study of the Karamojong was by Mcdonald (1899b). The next reference we found was more brief, gleaned from a 1903 expedition. The people were differently named 'Karamojo' and subsequently described as "treacherous and of a low negro type, sooty black, though splendid runners, and averaging over 6 feet in height… they are very excitable and objectionable, and one must be careful in dealing with them" (Brooke, 1905). The latter author noted their adornments "the Turkana pad (atop their head) plastered with mud at the back of the head, also iron and ivory bracelets and iron collars". The same author wrote that the Karamojong were "evidently once the dominant race, but as a result of rebellions, as well as of the Hamitic invasion, became split up into smaller tribes". Wayland likewise wrote from an expedition vantage point, on a geological tour (Wayland, 1931). Although he wrote in a more detailed ethnographic way, self-admittedly his writings lacked true anthropological tools. However, he did capture quite a bit of information. It would be another 30 years before a team would systematically record both anthropological and ecological data on the Karamojong, Neville and Rada Dyson-Hudson, a husband/wife team (Dyson-Hudson, 1963; Dyson-Hudson, 1966, 1972a; Dyson-Hudson, 1972b; Dyson-Hudson and Dyson-Hudson, 1980). Their accounts were much fuller as they were social anthropologists working directly with the pastoralists. Dyson-Hudsons wrote the most complete study of the Karimojong (Novelli, 1988). Barber (1962) published a paper entitled ‘The Karamoja District of Uganda - a pastoral people under colonial rule’ details, from an etic perspective, why Karamojong have poor relationships with the government and further, well earned “resentment of the Karamojong to government control” (Barber, 1962). However, his knowledge did not stem from social research, but rather literature search from government documents and policies, starting with 1898 when a military expedition, led by Macdonald, set up treaties with local inhabitants. Most of these documents proved difficult to find, but Barber’s paper is well written and persuasive. Mamdani picks up in the middle of where Barber was going, advocating for the traditional knowledge systems and coping strategies in relationship to ecology and famine prevention, till the British government stepped in (Mamdani, 1982). The next residents to take interest in cataloguing their observations of Karamojong social networks were three different Italian Comboni priests, i.e. A. Pazzaglia, B. Novelli and M. Cisternino (Novelli, 1988; Pazzaglia, 1982). Cisternino wrote his M.A. thesis (Sawnsea, Wales 1979) with the provocative title ‘Karamoja, the human zoo’. Whereas Novelli spent 14 years working in Karamoja, one of his roles was teaching the local language and sociology to newcomers. As part of the preparation of the present thesis, I have followed lessons with Novelli. Catholic priests commonly change their parish locations every few years, thereby living among different Karamojong tribes, so that they can garner quite a bit of perspective. Sandra Gray, following her PhD (Kansas University, 1992) in nearby Turkana, has authored quality social anthropology with nutritional and conflict components in Karamoja (Gray *et al.*, 2006; Gray *et al.*, 2003; Gray, 1997, 2000, 2008). More recently, there has been some graduate research carried out in Karamoja and a few are still in progress, including the first one by a Karamojong – game warden Daniel Aleper at Norway’s Agricultural University of Life Sciences, studying the roles of elephants and fire in the regeneration of acacia trees in Kidepo National Park. An American economist, M. D. Quam (Indiana University 1979) wrote his thesis on pastoral economy and cattle marketing in Karamoja, whereas British theologian, B. Knighton not only wrote his Ph.D. (University of Durham, 1990) about the Karamojong, but did it through an enculturation approach, living among the people for two years in the mid-80’s (Knighton, 2005), similar to this thesis with 5years enculturation. Quam went on to do more work on pastoral economics (Quam, 1978), while Knighton has similarly continued to use Karamoja as a favourite case example in much of his research since finishing his graduate school as he now is a dean at Oxford.

2.5 Karamoja Vegetation survey

The vegetation of arid-semi to arid Karamoja is distinct from the rest of Uganda. It is similar to the environment of their cross border neighbours of Kenya, Sudan and Ethiopia within the Karamojong cluster, filled with shrub thickets, characteristic of very dry areas. It is thought that in the early 1920's that bulk of Karamoja was divided into three natural zones, corresponding to different climate conditions. Grass and tree steppe were found in the dry parts. A lush grass savanna covered the moist areas, whereas forests were found in the uplands and larger mountains. Shrub thickets were then confined only to the exceptionally dry parts (Dyson-Hudson, 1972b; Mamdani, 1982; Wilson, 1962).

The earliest available vegetation literature for Karamoja is from an economic botanist, A. S. Thomas in 1943, where he gives a brief description of the topography, soils and pastoralists of Karamoja. He examined a 'considerable numbers of specimens' that he and others had collected: Liebenberg in 1931, W. J. Eggeling (1936), N. V. Brasnett (1937) and three of his own collection trips (1936, 1939 and 1940) in order to write his 'preliminary account' of Karamoja's vegetation (1943). In his reference list, he cites other references that are no longer accessible. Thomas (1943) admitted Karamoja flora is not completely known due to travel difficulties in rainy weather, when herbs are in active growth form and as many of the woody plants have very short flowering period. Furthermore, he failed to obtain fertile material for specific identifications. The latter author, however classified eight main vegetation types:

1) open grasslands of the plains in the south and west (grass steppes);
2) woodlands of the hills in the south and west (tropical savanna woodlands);
3) grasslands of the broad valleys in the centre (marsh grasslands);

4) grasslands in the east (grass steppes and savannas);
5) riverain forests (tropical riverain forests);
6) woodlands in the east and north (tropical savanna woodlands);
7) acacia woodlands and thickets in the east (tropical thornland);
8) mountain vegetation – woodlands, forests, shrubby moorlands, grass moorlands (tropical savanna woodlands, tropical upper mountain rain forest, tropical alpine elfin woodland, mountain grassland)

Other mentions of Karamoja vegetation were found in Wilson's report (1962). It refers to Forest Working Plans of Mts. Moroto, Napak and Kadam (Philip 1955-58) but has very little information on the montane savanna composition. Eggeling (1938) wrote 'Savanna and Mountain Forests of South Karamoja'. Wilson (1962) put particular emphasis on the 'disastrous' effects of overgrazing – at the same time correcting Thomas' observation that cattle caused soil compaction. Wilson (1962) concluded that abundant evidence shows that 40 years ago much of Karamoja was a grass savanna. In a review of the latter's work, it was pointed out that extensive observations were made from looking from the road, tracks and footpaths without indication that he went deep into the bush, but rather used aerial photographs to classify and map out Karamoja's vegetation (Goodier, 1963).

Other references of Karamoja's floristic composition were found in ecology articles investigating cheetah habitats (Gros and Rejmanek, 1999). This text created a digitised map reportedly from Langdale-Brown's 1964 vegetation series, although it was most probably done from Wilson's report on Karamoja (see above) which was part the same series that Langdale-Brown had compiled for the rest of Uganda. For a brief time, vegetation densities and compositions were found on the internet, www.karamojadatacentre.org – unfortunately, this website is no longer available.

Mahmood Mamandi, Ugandan anthropologist and political scientist, reviewed historical vegetation records in 1982, discussed the deterioration of vegetation as a result of colonial rule and their exploitation of the Karamojong. This included 'alienation' of grazing lands, outlawing hunting and de-stocking of cattle as the solution to the resulting over-grazing (Mamdani, 1982).

2.6 Ethnobotanical studies

There have been no ethnobotanical studies in Karamoja. There was only one in the cluster, namely in Turkana in 1980 (Morgan, 1981). Ethiopia has the most plentiful ethnobotanical and ethnoveterinary documentation in the area (Gemedo-Dalle *et al.*, 2005; Giday *et al.*, 2003; Giday *et al.*, 2007; Teklehaymanot *et al.*, 2007; Unruh, 2005; Wondimu *et al.*, 2007; Yineger *et al.*, 2007), although none of them have been Ethiopia's corner of the Karamoja cluster. Recently, WWF has started a project in the ecoregion which includes Karamoja. The expected outcome of this project is to protect the species-rich natural resources from perceived threats from people and livestock, including poaching and potential desertification from soil erosion and perceived livestock overgrazing (WWF, 2008). They have a partnership with Plants and People to undertake ethnobotanical studies with Samburu pastoralists (www.wwf.org).

2.7 EVK surveys and EVK R&D in pastoral Africa

Ethnoveterinary knowledge (EVK), synonymous to veterinary anthropology, was first coined by social anthropologist C. M. McCorkle (McCorkle, 1986, 1989a; Sollod and Knight, 1983). The accepted EVK definition is "…the holistic, interdisciplinary study of local knowledge and its associated skills, practices, beliefs, practitioners, and social structures pertaining to the healthcare and healthful husbandry of food, work, and other income-producing animals, always with an eye to practical development applications within livestock production and livelihood systems, and with the ultimate goal of increasing human well-being via increased benefits from stockraising" (McCorkle, 1995). McCorkle and veterinarian E. Mathias did much of the EVK research, especially in the socio-cultural realm (Mathias *et al.*, 1996; Mathias and McCorkle, 2004; McCorkle, 1995; McCorkle, 1986, 1989a, b; McCorkle and Mathias-Mundy, 1992; McCorkle *et al.*, 1996). More recent EVK research has been led by people from developing countries, where EVK is still widely used (Bizimenyera *et al.*, 2005; Bonet and Valles, 2007; Gakuya, 2001; Gathuma *et al.*, 2004; Githiori, 2004; Githiori *et al.*, 2006; Githiori *et al.*, 2003; Koko *et al.*, 2000; Kokwaro, 1976; Kone and Atindehou, 2008; Naidoo *et al.*, 2008; Namanda, 1998; Nfi *et al.*, 2001; Njoroge and Bussmann, 2006, 2007; Tabuti *et al.*, 2003a; Tamboura *et al.*, 2000; Yineger *et al.*, 2007). Traditional veterinary practice is based on indigenous knowledge passed on from generation to generation.

A rather exhaustive compendium of ethnoveterinary medical practices in Africa has been published in two Intermediate Technology books that Mathias and McCorkle teamed up to edit with other actors (Martin *et al.*, 2001; McCorkle *et al.*, 1996). These books are unique as they have painstakingly drawn from hard-to-find grey literature

There have been no ethnoveterinary medicine studies in Karamoja, other than those by this author (Gradé *et al.*, 2008a; Gradé, 2001; Gradé *et al.*, 2008b; Grade and Longok, 2000; Gradé and Shean, 1998; Gradé *et al.*, 2008c; Gradé *et al.*, 2007; Kuglerova *et al.*, 2007). Literature has one article about Karamojong EVK, but it has no information on treatment and focuses on EVK disease identification techniques of rinderpest in comparison to serological laboratory diagnosis (Jost *et al.*, 1998). Only one study has been done in Uganda, although in a different ecosystem, as a fraction of Tabuti's PhD research where he listed 38 plant species that the people (non-pastoralists) of Bulamogi county use to treat cattle (Tabuti *et al.*, 2003a). Likewise, limited data was found for only one tribe within the entire Karamojong cluster (Turkana in Kenya) (Wanyama, 1997a, b). This was within a how-to manual by an international NGO on the Samburu tribe (not in the cluster), but it did also have some data on the Turkana pastoralists living near the Samburu border. In the neighbouring countries, Ethiopia has the most plentiful ethnobotanical and ethnoveterinary documentation in the area (Gemedo-Dalle *et al.*, 2005; Giday *et al.*, 2003; Giday *et al.*, 2007; Teklehaymanot *et al.*, 2007; Unruh, 2005; Wondimu *et al.*, 2007; Yineger *et al.*, 2007), although none of them have Ethiopia's corner of the Karamoja cluster. Pastoral EVK studies have taken place with the Fulani (Alawa *et al.*, 2002; Leeflang, 1993; Nfi *et al.*, 2001), Samburu and Turkana (Bussmann, 2006; Wanyama, 1997a, b) and Maasai, (Jacob *et al.*, 2004; Ole-Miaron, 2003). They all invariably agree that EVK has evolved by trial and error over generations and that it is shared by oral tradition. Jacob *et al.* (2004) agrees with our study in that one should embrace the best of western and EVK in order to develop the best comprehensive animal health care service for pastoralists. We were able to access two PhD theses that were based on EVK, one from Creole farmer West Indies (Trinidad and Tobago) (Lans, 2001 at Wageningen) and another from Kenya (Githiori, 2004 at Uppsala). Both authors' field research took place in their birth country, although their studies were completed in Europe. Lans' impressive thesis documented EVK of Trinidad and Tobago's livestock sector (0.1% to the GDP), primarily small stock holders, and then she explored avenues for to complement allopathic knowledge and practices (Lans, 2001). Githiori thesis (2004) evaluated eleven common livestock dewormers used by pastoralists and small stock holders in western Kenya, where livestock sector contributes over 10% to the GDP. This thesis assessed anthelmintic activity in vitro and in vivo in sheep and mice and found that none of the plants were effective at the standard he set of 70% (Githiori, 2004).

Other than the abstracts that the Intermediate Technology editors found (Martin *et al.*, 2001; Mathias *et al.*, 1996), literature is sparse on participatory validation of EVK, Catley attempts to review participatory approaches in dryland Africa, however it focused on epidemiology, namely disease identification and not validation (Catley and Leyland, 2001). However, the ANTHRA project led by a women's NGO in India, has farmers actively participating in the evaluation process (Ghotge *et al.*, 2002). Indeed, India is in the forefront with EVK and other grassroots innovation and dissemination through the Honey Bee Network, although it can be difficult to access the information and they are rarely found in peer reviewed journals. One manual was found that also used participatory validation of EVK in villages, also in India and part of the Honey Bee Network (Vivekanandan, 2000).

2.8 Field trials on plant dewormers for livestock

This thesis focused on one deworming plant, *Albizia anthelmintica* Brongn. (Fabaceae), a slow growing tree whose bark has previously been reported to contain triterpenoid saponins, histamine, tannins, and other phenolic compounds (Carpani *et al.*, 1988; Khalid *et al.*, 1996; Johns *et al.*, 1999). East Africans widely use *A. anthelmintica* to control helminth parasites in human and animal medicine in Sudan (Koko, Galal & Khalid, 2000), Ethiopia (Desta, 1995) and Tanzania (Minja, 1994).

This plant has been well-studied, in field trials and in vitro lab and chemical studies (Chapman *et al.*, 1997; Desta, 1995; Gakuya, 2001; Gathuma *et al.*, 2004; Githiori, 2004; Githiori *et al.*, 2006; Githiori *et al.*, 2003; Gradé *et al.*, 2008b; Gradé *et al.*, 2007; Johns *et al.*, 1999; Khalid *et al.*, 1996; Koko *et al.*, 2000; Runyoro *et al.*, 2006; Selman *et al.*, 2002; Stepek *et al.*, 2004; Tabuti, 2007; Tschesche and Forstman, 1957; Ying and Kubo, 1988). Efficacy findings have varied from ineffective to marginal to efficacious. (see CHAPTER V, Table 5-1).

2.9 Self-medication in animals

Evidence for animals' self-medication has accumulated over the past two decades (Engel, 2002; Hart, 1990; Huffman, 2003; Lozano, 1998). Research has concentrated on Africa's great apes. Janzen (1978) was the first to suggest that ingested secondary plant compounds actually help animals to combat parasites. Research has since identified chimpanzees' self-treatment for internal parasitism through leaf-swallowing of *Aspilia* spp. (Asteraceae) (Wrangham and Nishida, 1983) and bitter pith chewing of *Vernonia amygdalina* Delile (Asteraceae) (Huffman and Seifu, 1989) as well as other species (Lozano, 1998). Other studies approach proving self-medication by identifying and isolating biologically active compounds responsible for specific pharmacological effects, for example *V. amygdalina*, (Huffman *et al.*, 1993) *Albizia grandibracteata* Taub. (Fabaceae) and *Trichilia rubescens* Oliv. (Meliaceae) (Krief *et al.*, 2005) from which antiparasitic and antibacterial compounds have been isolated following observations of chimpanzees. Watt and Beyer-Brandwijk (1962) earlier documented that indigenous East and South African people use some of these plants as medications.

The study of self-medication in animals is known as ‘zoopharmacognosy’ (Rodriguez and Wrangham, 1993), defined as the study of secondary plant components or other non-nutritive substances used by animals for self-medication (Huffman, 1997b). Huffman (Huffman, 2008) recently broadened the definition to include behaviour and non-plant substances used to suppress disease or to enhance animal health. Use of soils and their properties has been well-documented in non-human primates and elephants (Engel, 2002) as have other behaviours (see CHAPTER VI) that do not include ingestion of soils or plants (Clark and Mason, 1985; Lozano, 1998).

There has been little reference to livestock or other domestic animals in the field of zoopharmacognosy. Moreover, most research has been by behaviourists’ observations of wild or zoo animals, predominantly primates. On the other hand, many farm animals lack access to self-medication because they are confined and given a specifically developed diet that has little bearing on what they would get in the wild (Engel, 2002). Research has shown *in vivo* antiparasitic effects of tanniferous plants that small ruminants may browse and graze (Niezen *et al.*, 1998; Paolini *et al.*, 2004). However, definitive work on sheep self-medicating, when challenged with illness-producing foods, was the first demonstration of multiple malaise-medicine associations supporting zoopharmacognosy (Villalba *et al.*, 2006).

RESULTS

CHAPTERS III –VIII

3.

3 Ethnoveterinary Knowledge in Pastoral Karamoja, Uganda

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Abstract

Ethnopharmacological relevance: The people of Karamoja of northern Uganda chiefly rely on ethnoveterinary knowledge (EVK) to control common livestock health problems. In spite of cattle's central role in Karamojong culture and livelihoods, there has been no systematic recording of their ethnoveterinary plant-based cures to date.

Aim of study: To document the remedies used to treat the known diseases, their preparation and administration.

Methods: Data were collected using semi-structured interviews, guided questionnaires, group discussions, direct observations and collection trips.

Results: We present information on 209 plant species and 18 non-plant materials. Plant species are distributed over 116 genera and 54 families. The most common medicinal use was treatment against anaplasmosis. *Balanites aegyptiacus*, *Carissa spinarum, Warburgia salutaris* and *Harrisonia abyssinica* had the most uses of all species. All different plant parts were used, without one part being considerably more common than any other. Most remedies listed used a single ingredient, typically soaked in water; only 12.85% remedies used multiple plants. The route of administration was primarily oral followed by topical applications. Almost all plants are collected from in wild; none of the few cultivated plants used had been planted for medicinal purposes.

Conclusions: The pastoralists in the study site possess a wealth of EVK which they use to maintain animal health. Their rich knowledge and high diversity of plants was recorded here for the first time.

Keywords: Ethnoveterinary knowledge; Traditional medicine; Pharmacopoeia; Ethnic groups; Ethnobotany; Pastoralists

3.1 Introduction

Livestock rearing is a key economic activity in Uganda, representing 7.5% of the Gross Domestic Product (World Bank, 2008). Highest livestock numbers are found in the cattle corridor which extends diagonally across Uganda, from the pastoralist Ankole area in the southwest, touching Rwanda and Tanzania, to the Karamoja region bordering Sudan and Kenya in the northeast. The cattle corridor inhabitants' (Banyankole, Iteso and Karamojong) primary income is from livestock. However, Karamojong even have cattle at their centre, culturally and socially. Not only are cattle important monetarily, but also the people's very self-worth and existence is linked to livestock ownership. In fact, the Karamoja districts are the only ones in Uganda where there are more cattle than people, including even more sheep and goats than people (MAAIF, 2003). The Karamojong and other closely-related ethnic groups within the (socio-cultural) Karamojong cluster (Gulliver, 1952), found in the semi-arid area of northeast Uganda, southeast Sudan, northwest Kenya, and southwest Ethiopia, still practice a transhumant lifestyle. Men and their livestock become nomads in search of grazing areas during the long annual intense hot and dry season (October – May). This often stretches into drought back at the home manyatta (semi-permanent family housing units) where the women, children and elders remain during transhumant periods. External contacts and influences in Karamoja are minimal and 99% of the population exclusively rely on traditional health practices for themselves and their livestock (Gradé *et al.*, 2007).

The Karamojong appear marginalized due to: 1) limited access to and use of allopathic livestock medicines; 2) poor veterinary service provider coverage; 3) high uncontrolled levels of both endemic and epidemic diseases; and 4) negligible economic development (Jost *et al.*, 1998; Oxfam, 2001; Uganda Bureau of Statistics, 2002). This fosters pastoralists' long term and continued reliance on traditional animal health care practices or ethnoveterinary knowledge (EVK). This reliance on EVK is compounded by: high livestock/km^2 density; strong reliance on livestock for livelihood; and richness in both cultural history and biodiversity (Muhereza and Otim, 2002; Nanyunja and Baguma, 2005). As a consequence, Karamoja has virtually no alternatives to local medicines for livestock and human health. Their human health statistics however are considerably better than those of neighbouring Kitgum district - this suggests they have great aptitude in using indigenous health systems (Oxfam, 2001). However, rapidly decreasing trends in both Karamojong medicinal plant biodiversity and sources of income over the last 50 years were observed by (Nanyunja and Baguma (2005).

Ethnoveterinary knowledge was first defined by McCorkle in 1995 as:

> "…the holistic, interdisciplinary study of local knowledge and its associated skills, practices, beliefs, practitioners, and social structures pertaining to the healthcare and healthful husbandry of food, work, and other income-producing animals, always with an eye to practical development applications within livestock production and livelihood systems, and with the ultimate goal of increasing human well-being via increased benefits from stockraising."

By far the most-studied element of EVK has been that of medicinal plants.

Ethnoveterinary knowledge, like other traditional knowledge (TK), is passed on by word of mouth. Therefore, EVK is prone to fragmentation (Yineger *et al.*, 2007); particularly in Karamoja where its language was first transcribed ca. 1950. As in other parts of the world, this EVK is thought to be disappearing at an alarming rate. Despite the centrality of cattle and the almost 100% reliance on EVK in Karamoja, there has been no systematic recording of veterinary cures in Karamoja to date, or even in the entire Karamojong cluster. We encountered only one article for the cluster that was written almost 30 years ago about the closely related Turkana of Kenya (Morgan, 1981).

The aims of this study were to document the indigenous veterinary knowledge of south and central Karamoja in Uganda and to document the remedies used to treat the known livestock diseases and other animal husbandry indications, highlighting their preparation, processing and administration.

3.2 Materials and methods

3.2.1 Study site

The region of Karamoja is located between 1˚30' - 4˚ N and 33˚30' - 35˚ E. However, the majority of our data comes from the area between 1˚50' - 2˚40' N and 34˚15' - 34˚55' E. Mean annual rainfall ranges from 100 to 625 mm, with the higher amounts in the surrounding mountain ranges. Daily temperatures average 30-35˚ C. The region has a semi-arid to arid agroecological environment and is prone to cyclical droughts that may last 5 – 15 months. The terrain is flat grassland with a few scattered thorn bushes and trees, except along the seasonal rivers, where thickets and patches of gallery forests are found. The plains are punctuated by a triangle of three extinct 3000 m volcanoes each about 100 km apart from another, supporting dry montane forests (Thomas, 1943; Weatherby, 1988).

Thomas (1943) described the vegetation of Karamoja as consisting of *Acacia-Combretum-Terminalia* species associations, with a grass layer of *Hyparrhenia, Setaria, Themeda, Chrysopogon* and *Sporobolus* species.

Total population is around 935,000 (Uganda Bureau of Statistics, 2002) and contains five distinct Nilotic peoples in the plains and two small Kuliak groups (Tepeth and Ik) found along the mountains (Gulliver, 1952). Karamojong is used as a generic term for the dominant plains Nilotes of Karamoja: Dodoth, Jie, and Karimojong. The Karimojong are further divided into Bokora, Matheniko and Pian ethnic groups. Our survey covered communities in administrative units of Bokora and Pian counties, named after the main ethnic group inhabitants; however other clans reside within some counties. Bokora county population is estimated at 95,000, while Pian has around 38,000 people (Uganda Bureau of Statistics, 2002). Tepeth population was last estimated to be 4,000 (Weatherby, 1988). However, the Tepeth population is thinly spread around the mountains not just in Bokora county, but also in Checkwii and Matheniko counties. We therefore estimate Bokora people to be 88,000 and Tepeth total to be 10,000. All these groups share a transhumant agro-pastoral lifestyle. The Bokora and Pian ethnic groups share the same eastern Nilotic language, i.e. Ngakarimojong, with slight tonal differences. However, due to reciprocal armed cattle rustling, there are strong cultural taboos against sharing livestock information between clans (Mirzeler and Young, 2000). The Tepeth, also known as Sor, live on the three volcanic mountains described above. They have their own language (Ngitepes), unintelligible to Pian and Bokora, although most Tepeth also learn and practice Ngakarimojong. Whereas the plains people are fiercer, taller and live in huts, the Tepeth are less aggressive and many still sleep in caves (Weatherby, 1988; Gradé personal observations).

The above pastoralists of Karamoja rely almost entirely on livestock for survival and cultural events. They are semi-nomadic and have minimal formal health care infrastructure for livestock; there is only one veterinarian per 90,000 livestock (Gradé *et al.*, 2008b). Culturally, people rarely disclose the true number of animals they own, so even this low ratio may be overestimated.

3.2.2 Data collection and analysis

Data for this project were collected from May 1998 to August 2005 by the first author. Data were collected using semi-structured interviews with pastoralists. These were complemented with 250 guided questionnaires in face to face interviews; 75 group discussions, direct observations, and collection trips with key informants (walk-in-the-woods) (Martin, 1995; Phillips and Gentry, 1993; Thomas *et al.*, 2007). Additional data were compiled from personal observations. Data collected included plants and other materials used to treat livestock ailments, disease terminology; vernacular names of the plant species together with other use purposes, and methods of drug preparation. Because most species were encountered more than once, their uses were discussed repeatedly with several informants from one or more areas allowing corroboration and expanding the list of unique preparations. Indigenous disease terminology was matched with informants' descriptions and that of veterinary extension workers. The first author, a confirmed and experienced veterinarian, further verified disease jargon via physical examination. Both indigenous and scientific terms were compiled. Together with key informants, we collected vouchers of plant species mentioned by respondents. Plants were authenticated according to Flora of Tropical East Africa by either Nairobi National Museum in Kenya (1998-2000) or Makerere University in Uganda (2000-2005). Vouchers are kept at

Makerere herbarium in Kampala and the community herbarium located at partner NGO, KACHEP, in Nabilatuk, Karamoja. Data were entered into Microsoft Excel spread sheets. The software, SPSS 15 was used for data management, and to generate contingency tables and descriptive statistics.

3.3 Results

3.3.1 The plants and their medical application

The informants from Karamoja provided information on 209 plant species and 18 non-plant materials (appendix I). Identified species were distributed over 116 genera and 54 families. Trees were the most commonly used growth form, followed by herbs, then shrubs, distantly liana and vines. Fabaceae was the best-represented family, having 39 species (Figure 3-1). It was also the most commonly used: it had 48 different indications for use and Fabaceae were ingredients in 104 EVK recipes. Other species-rich families include: Euphorbiaceae and Solanaceae (10 spp.), Asteraceae (9 spp.) and Capparaceae (7 spp.).

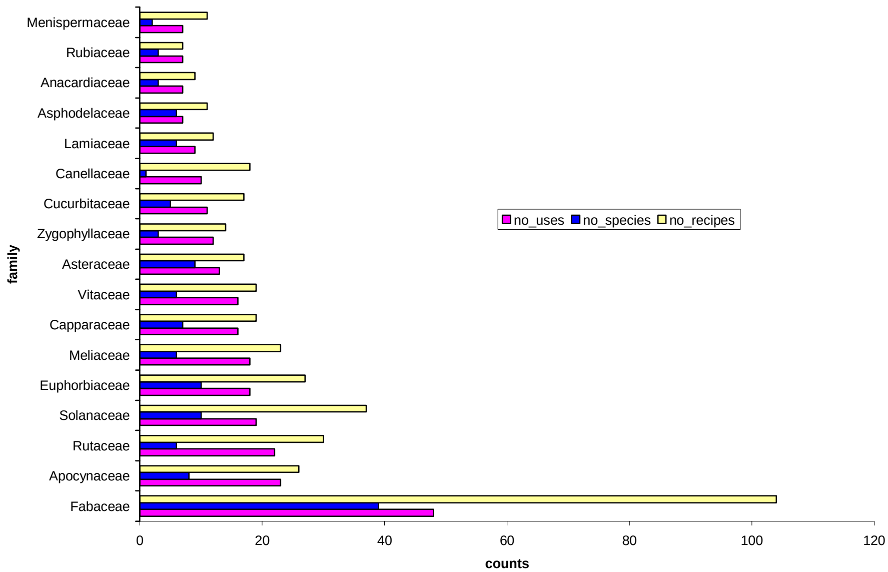

Figure 3-1 Most common plant families used for EVK by respondents

The most abundant genus was *Acacia*, 16 species; *Solanum* had six species, whereas *Albizia* and *Euphorbia* each had four. Analysis of ethnobotanical info data revealed that *Carissa* spinarum (syn. *C. edulis*) (Apocynaceae) had the most uses of all species (12); the next most useful species were *Balanites aegyptiacus* (Zygohyllaceae) with 11, whereas *Warburgia salutaris* (Canellaceae) (syn. *W. ugandensis)* and *Harrisonia abyssinica* (Rutaceae) both had 10 uses (Table 3-1). Note that the author names are not included in the text, but may be found in the tables and a complete list in Appendix I. One non-plant remedy was used to treat 11 different ailments, ABALANGIT, identified as coral reef ($CaCO_3$), a sediment rock formed by deposition of material over time.

There were 130 separate Karamojong EVK uses listed. The most common indication was against anaplasmosis, for which 29 species were reported (Figure 3-2). Anaplasmosis is a tick-borne blood parasite, as are the fifth and sixth most common uses, theileriosis (east coast fever, ECF) and heartwater, respectively.

Table 3-1 Most common species and material reported by respondents for Karamoja EVK

remedy	family	no. of uses
Carissa spinarum L.	Apocynaceae	12
Balanites aegyptiacus. Delile	Zygohyllaceae	11
ABALANGIT, $CaCO_3$	not applicable	11
Harrisonia abyssinica Oliv.	Rutaceae	10
Warburgia salutaris (Bertol.f.) Chiov.	Canellaceae	10
Azadirachta indica A. Juss.	Meliaceae	9
Euphorbia bongensis Kotschy & Peyr.	Euphorbiaceae	9
Solanum incanum L.	Solanaceae	9
Albizia amara (Roxb.) Boivin. spp. *sericocephala* (Benth.) Brenan	Fabaceae	8
Capparis sp.	Capparaceae	7
Chasmanthera dependens Hochst.	Menispermaceae	7
Cissus quadrangularis L.	Vitaceae	7
Zanthoxylum chalybeum Engl.	Rutaceae	7

Respondents from Bokora mentioned the highest number of EVK recipes, 383; respondents from Pian mentioned 194 and the Tepeth 112. Some of these citations overlap. Rarely would ethnic groups disagree with the particular plant use and occasionally, preparation. However, there was one plant on which people from different communities heavily disagreed: *Coccinia adoensis.* (Cucurbitaceae), EDALDALKISIN, whose dangling, red fruits, locally named after the old mothers heavily-nursed breasts, are considered edible by one group, yet poisonous by another.

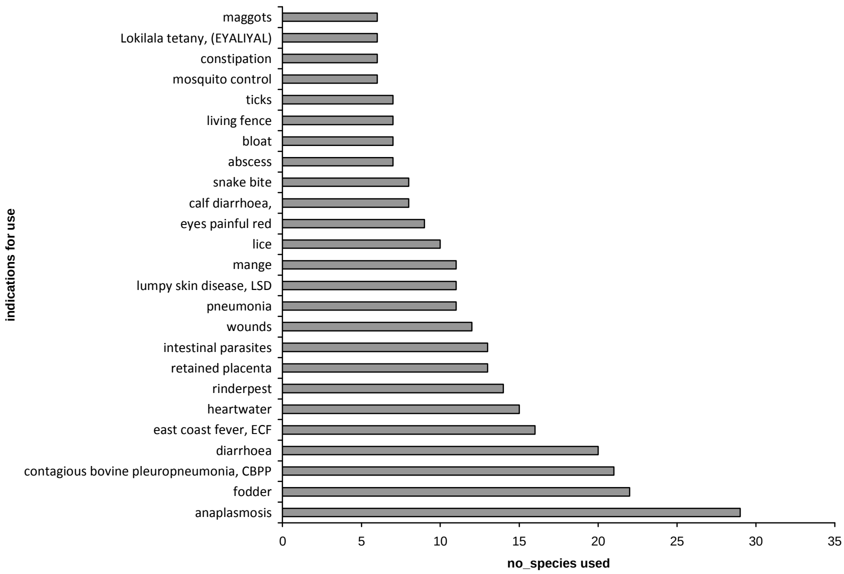

Figure 3-2 Most common use indications and number of species reportedly used for animals

3.3.2 Plant parts used, preparation and administration

The most commonly used parts are bark (26.8 %), underground organs (roots and tubers) (24.3), leaves (19.2) and fruit (13.7) (Figure 3-3). Some preparations call for only one part whereas others allow for more. Plants used for medicine are usually processed fresh. Plant parts are commonly lightly crushed. If the preparation includes drying, it is done in the shade whereby the material is subsequently ground into powder. Crushing and grinding is done with two rocks. These grinding stones are used for the processing of food also – the exception being for producing costly and pungent oil from ripe *Azadirachta indica* (Meliaceae) seeds or crushing *N. tabacum* leaves into the precious ETABA snuff; these have their own specific grinding stone. For *A. indica*, both rocks are flat and hard, so that they will not splinter or produce shards which would soak up oil. The pounding rock for making snuff must be round, smooth and white, able to fit into the hand comfortably.

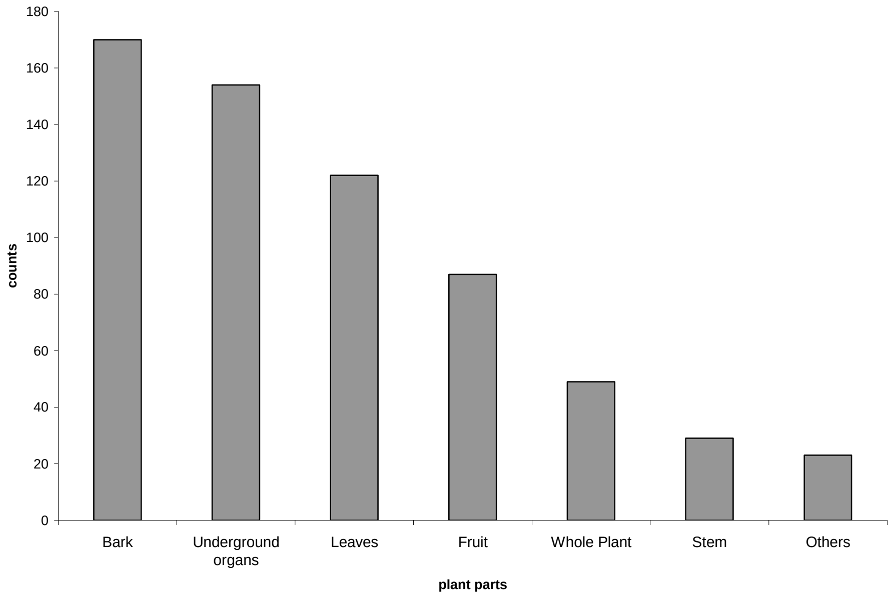

Figure 3-3 Plant parts used in Karamojong EVK

Medicines are rarely stored, except for purchased strips of *W. salutaris* bark or the finely crushed bark of *Albizia anthelmintica* (Fabaceae), whose powder, if stored, will be used within the month, occasionally carried to the kraals to deworm an entire flock. Likewise. *Chasmanthera dependens* (Menispermaceae) tubers (tabulated in the underground organs, Figure 3-3) may be dried and stored as powder for anaplasmosis.

Most listed remedies used a single plant ingredient (87.2 %), typically soaked in water; only 12.8% of recipes were preparations that used more than one plant. Occasionally, a plant was used in combination with a non-plant ingredient, i.e. $CaCO_3$, milk, butter, yogurt, oil, blood, urine, or salt. As noted above, $CaCO_3$ was the most common. Cold water extraction was by far the most common preparation used. The route of administration of the remedies was primarily oral (63.3%), followed by topical applications (27%) whereas others were applied on the eye or in the ear, nose or injected.

Only 4.3% of the remedies employed more than one route. The dosage was usually dependent on the species and their age/weight.

3.3.3 Market availability and collection patterns of medicinal plants

Several remedies are sold. The bark of *W. salutaris* is frequently available at one trading centre near one of the two mountains where it grows in the wild, sold only by one old man at the time of this study. A few respondents in 1998 claimed *Neorautanenia mitis* (Fabaceae) tubers (~roots) are sporadically available, used to kill external parasites, although we never witnessed it in the market during the entire study period. However, some multi-use remedies are widely available at weekly markets and sometimes sold in shops; the most common non-plant remedy, i.e. ABALONGIT, $CaCO_3$, *Tamarindus indica* (Fabaceae) fruits and a value-added snuff form of prepared *Nicotiana tabacum* (Solanaceae) leaves, called ETABA. However, *W. salutaris* is the only medicinal remedy marketed whose sole sales' appeal is for medicine (animal and human), but no other domestic use. Furthermore, the only medicinal plants cultivated or encouraged to grow at the homestead were dual-purpose plants, like tobacco or pumpkin. Therefore almost all remedies are collected from the wild in Karamoja.

3.3.4 Vernacular nomenclature of EVK treatments

Informants had at least one vernacular name for almost all (99.6%) of the plant species except for one, *Commelina simplex* (Commelinaceae), whose leaves were cooked for food. One hundred percent of the non-plant materials had a local name. The Karamojong plant names were 87% specific to one species, that is, only 24 vernacular-named plants referred to more than one botanical species. ECUCUKWA had five vouchers, two were fully identified, *Aloe dawei* and *A. tweediae* (Aloaceae), but three other vouchers were only identified to genus level. Similarly, ETULELO (sodom's apple) had four vouchers; three were identified to species level, and one voucher was simply identified as *Solanum* sp. However, ELIGOI, with its characteristic milky latex, had its four vouchers spread over three families (Apacynaaceae, Asteraceae and Euphorbiaceae).

Alternatively, 7 botanical species had two different Karamojong names. For example, *W. salutaris* is called ABWACH by the Bokora and Matheniko; however, Pian and Tepeth people tend to call it EMUKWA. Likewise, *Acacia tortilis* (Fabaceae) has two vernacular names, ETIR when it is a young tree, and EWOI, which means tall, when it is a mature tree, over a few meters and the thorns and tree shape has changed. Most informants, however, are aware that it is the same tree.

3.4 Discussion

3.4.1 The plants and their medical application

This study revealed that ethnoveterinary medical practitioners residing in central and south Karamoja have a rich knowledge of livestock husbandry, especially disease and treatments. They reported a wide diversity of plant species, 209 used in the treatment of 130 different EVK uses, primarily livestock ailments. This high level of traditional knowledge (TK) held by the Karimojong may be related to their secluded lifestyle. Communities that are highly cut off from the main population centres are usually forced to depend on their TK and natural resources for healthcare (Somnasang and Moreno-Black, 2000). This TK appears to be very important for the livelihoods of the Karamojong whose way of life depends on cattle (Gradé, *et al*., 2008a). In Karamoja, traditional medicines are the only readily available form of treatment for livestock (personal communication Dr. Inangolet Francis, government veterinary officer, Bokora). The evaluation of traditional medicines and associated TK from Karamoja may provide important bio-prospecting leads for the development of new allopathic medicines in the livestock sector. This important TK, which has been left largely undocumented, is threatened and appears to be declining everywhere in Uganda and the world (Tabuti *et al.*, 2003c). We believe Karamoja may not escape this global trend and that this knowledge must be conserved.

The development of allopathic medicines requires assessment of these EVK medicines for effectiveness and safety. It is not possible to validate all remedies reported here. We should start with a few, chosen from those with potential impact, i.e. based on market potential, indigenous worth and their ability to control disease. That is, those plants which have a long history of use within the community (van Wyk and Wink, 2004), are used to treat many diseases, are sold in the market, or are stored at household level.

Species with a long history of use or wide usage in Karamoja include *Warburgia salutaris, Balanites aegyptiacus, Carissa spinarum* and *Harrisonia. abyssinica*, furthermore *W. salutaris* and *Albizia anthelmintica* have a local sales' appeal. *Warburgia salutaris'* importance and use have been documented in other cultures. According to Njoroge and Bussmann (2007), *W. salutaris* is very important among Kenyan Kikuyu farmers' cattle treatments. Additionally, Kuglerova *et al.* (2007), showed that its bark, collected from Karamoja, had antimicrobial activity and strong anti-oxidative properties, exhibiting high potential for disease control. *A. anthelmintica* was shown to be efficacious against gastrointestinal parasites in dose determination studies in Karamojong field conditions (Gradé *et al.*, 2008b).

Additional bio-prospecting studies may look at treatments against tick borne diseases, as well as those against ticks directly. These diseases, anaplasmosis, theileriosis (ECF) and heartwater, are the most commonly treated ailments in Karamoja. Tabuti *et al.* (2003a) likewise found 73.5% of treatments in their study are against ECF. Tick-borne diseases not only cause high morbidity/mortality and are difficult to treat with allopathic medicines, but often cattle present mixed infections of both ECF and anaplasmosis. Therefore, traditional remedies against tick-borne disease have great market potential. Furthermore, it would be prudent to investigate remedies that attack ticks directly to aid in prevention. The most commonly mentioned anti-tick plant in this study was *Neorautanenia mitis*. The primary author, together with registered healers, has tested *N. mitis* efficacy against both lice and ticks with positive effect (unpublished data) and a few healers have planted tubers at their homesteads.

Fabaceae family is the most commonly used and species-rich in this study, followed by Solanaceae (Figure 3-1). Other Ugandan ethnobotanical studies (Okello and Ssegawa, 2007; Tabuti *et al.*, 2003a, c) likewise had Fabaceae as the most common family, although their observations took place in areas that had different flora and lifestyles. Fabaceae was also the most common family in Wondimu *et al.*'s (2007) study in the nearby semi-arid Arsi Zone in Ethiopia, followed by Solanaceae and Euphorbiaceae. Fabaceae is also one of the most plentiful families according to the 'rare' and 'dated' vegetation studies in which Karamoja has been considered (Thomas, 1943; Wilson, 1962). Even though Fabaceae had more uses than other families, only one of its species was among the most useful plants (Table 3-1) in our study. Here, Fabaceae has very few medicinal species relative to its size as in other investigations (see Moerman and Estabrook, 2003).

3.4.2 Plant parts used, preparation and administration

The Karamojong employ commonly used methods of medicine preparation and administration, such as water extractions that are then given orally, similar to other African cultures (Bussmann, 2006; Jeruto *et al.*, 2008; Kone and Atindehou, 2008; Magassouba *et al.*, 2007; Wondimu *et al.*, 2007; Yineger *et al.*, 2007).

This study uses a majority of mono-preparations, as is the case in a few cultures (Bussmann, 2006; Jeruto *et al.*, 2008; Kone and Atindehou, 2008). In contrast, other cultures usually use mixtures of herbal medicines for treatments (Abebe and Ayehu, 1993; Erdelen *et al.*, 1999; Kone and Atindehou, 2008; Okello and Ssegawa, 2007; Tabuti *et al.*, 2003a, c; Wondimu *et al.*, 2007). This means that traditional Karamojong medical practitioners, resembling allopathic medicine practitioners, use both precise, 'rifle' treatments (single remedy) and shotgun (mixed) remedies. However, precise treatment protocols are most commonly used in Karamoja. This may indicate that Karamojong may possess either more confidence or deeper EVK than those cultures that use mixtures. This is observed in classical Hahnemann homeopathy, where the highly trained and experienced practitioner carefully selects only one specific remedy whereas less trained individuals more typically use the 'shot gun' approach and combine multiple remedies until their skills develop. This multiple treatment protocol is likewise used in allopathic medical disciplines that are not well-mapped out or fully understood, like that of brain disorders or psychotherapy.

3.4.3 Collection patterns and market availability of medicinal plants

Collection patterns among the Karimojong are similar to those in other areas: they harvest bark and stem, and also collect from the wild (Asfaw, 1997; Asfaw and Nigatu, 1995; Bussmann, 2006; Giday *et al.*, 2003; Hamilton, 2004; Okello and Ssegawa, 2007; Tabuti, 2008; Tabuti *et al.*, 2003a; Wondimu *et al.*, 2007; Yineger *et al.*, 2007). Harvesting of bark and stem wood from woody species may result in the death of individual species (Cunningham, 1991; Hamilton, 2004). In our study, bark and roots were the most commonly used parts. As many chemicals are found in bark and roots, the Karamojong choice is correct from a plant physiology perspective. However, not all harvesters are careful to remove bark in such a way that the tree is not damaged. Therefore, efforts to encourage sustainable harvesting are warranted, through species specific strategies of bark removal and perhaps plant part substitution (Delvaux *et al.*, in press; Zschocke *et al.*, 2000).

Similarly, the harvesting of species from the wild is not sustainable because such species face numerous threats chief among which are unsustainable harvesting practices and intensities (Hamilton, 2004). Pragmatic initiatives should be worked out to cultivate some of these species for their protection and availability. Local NGOs, like KACHEP, have a role to play here. An opportunity exists in that some traditional medicine practitioners cultivate or protect some dual-purpose medicinal plants at their homesteads (Gradé *et al.*, 2008c). *Neorautanenia mitis* is one such species where tubers are transplanted by a few healers near their homes. KACHEP, together with registered healers and the primary author, tested *N. mitis* against external parasites, with positive effect (unpublished data).

Some of these medicinal plants and other material are sold in the local market. The remedies available at the market are *W. salutaris*, *T. indica, N. tabacum* and ABALONGIT, $CaCO_3$. ABALONGIT was noted being used in other parts of the Karamoja cluster for making pots (Wilson, 1973). These species may provide opportunities for income generation as they are already sold and thus have a market. Additionally, *A. anthelmintica* has a market as pastoralists frequently store in large amounts, and it has proved to be efficacious in dose determination studies in Karamojong field conditions (Gradé *et al.*, 2008b).

3.4.4 Vernacular nomenclature of EVK treatments

Informants had vernacular names for almost all remedies except for one, which is higher than the only other research done in the Karamojong cluster. Morgan (1981) and Stave *et al.* (2007) obtained vernacular names for 70% and 90% of plants, respectively. Morgan's lower linguistic results could be due to the fact he did not ask specialists, and, perhaps, for failing to determine use for more than half of the 512 collected species, whereby there were only 143 species with a use. Karamojong species names were 87% specific to one species; this congruence between local and scientific identification suggests local experts may be consulted for rapid and reliable identification for scientific identification (Stave *et al.*, 2007). This compares to Morgan's (1981) Turkana study that found 73% of locally named plants were specific to one botanical species. The 13% incongruence could be for a variety of factors: similar morphology (within genera *Aloe* and *Solanum*); low use value; or those plants that had conflicting names are extremely rare. Our results might even have been higher if we had gathered data from only one ethnic group, thus reducing linguistic variability. This variability was further mitigated in that the primary author has lived in the project area for an extended time, allowing her to daily deepen her local knowledge and especially important relationships and trust among the typically reserved Karamojong pastoralists, suspicious of non-family or clan members. These unique relationships and enculturation time allowed this rarely revealed knowledge to be documented, even though much of the raw data were collected in Bokora within her first six months of the study. Overall, the Karamojong's ability to correctly classify so many plants and their level of specificity evidences their depth and breadth of ethnoveterinary knowledge.

3.5 Conclusions

There is a wealth of EVK in the study site that the pastoralists have available to maintain animal health in their treasured livestock herds. A large number of Karamojong plant species, mainly from the Fabaceae family are used to combat endemic diseases. Their rich knowledge and high diversity of plants used was recorded here for the first time. Documentation of Karamoja's EVK could be capitalised upon in the entire cluster to protect and safeguard its cultural heritage and biodiversity from well-meaning development organisations. Regarding cultural heritage, we recommend such organisations begin with EVK surveys to both aid with effectiveness of their work and avoid common unintended consequences of their work. Secondly, regarding biodiversity, we recommend such organisations would partner with local NGOs, particularly through conservation programs for medicinal plants, to conserve this wealth of EVK. This large data list could then generate relevant information with a potential that could be integrated into community animal health worker trainings, domestication of high potential species and ultimately agroforestry schemes.

More specific actions could involve prioritising this large list and then conducting validation studies. We believe that there should be some studies of efficacy and safety of the listed species to foster wider acceptability and could start with *Balanites aegyptiacus*, *Carissa spinarum, Warburgia salutaris*, *Harrisonia abyssinica* and/or *Albizia anthelmintica* and those against tick-borne diseases. If further developed, it could add useful drugs to modern veterinary pharmacopoeia. This, in turn, would safeguard intellectual property by putting it in the public domain. Market potential lies with the above plants, as well as *Tamarindus indica, Nicotania tabacum, Neurotania mitis* and ABALONGIT ($CaCO_3$). This could enhance local product development and promotion of indigenous knowledge.

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statistics. Funding and logistical support has been through Christian Veterinary Mission, Seattle, USA.

Photo 3-1 EYELEL, the whistling thorn shrub, whose ant-galls make music in the hot wind of Karamoja. Animals fight against sharp thorns and biting ants to nibble off soft, nutritious leaves. Pastoralists use Eyelel to treat diarrhoea, lumpy skin disease, rinderpest and snake bite. *Acacia drepanolobium* and 'its cousin' *Acacia seyal* are both referred as EYELEL to the Karamojong

4.

4 Deworming efficacy of *Albizia anthelmintica* in Uganda: Preliminary findings

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Abstract

This study was conducted to evaluate the anthelmintic effectiveness of *Albizia anthelmintica*, as a first step in investigating the hypothesis that livestock self-medicate. In July 2006, an observational study was conducted with 56 young female lambs, to validate *A. anthelmintica* efficacy. Faecal egg per gram for *Coccidia*, *Strongyle*-type, *Moniezia*, *Strongyloides* and *Dicrocoelia* eggs were counted and analysed.

Results indicate that *A. anthelmintica* is effective in controlling infection with a variety of internal parasites in lambs, *Moniezia* was the most sensitive. Furthermore, treatment of *Strongyle*-type worms requires a biweekly dose of *A. anthelmintica* as an effective deworming protocol.

Key words: anthelmintic, ethnoveterinary, Karamoja, livestock, self-medication

4.1 Introduction

African traditional healers learn from experience, from one another (Tabuti *et al.*, 2003b), and also from observing the behaviour of animals (Huffman, 2003). There are numerous accounts of self-medication in the great apes (Huffman, 2003; Krief *et al.*, 2005; Page *et al.*, 1997; Wrangham and Nishida, 1983). Self-medication has not, however, been reported in livestock. In 2000, during a participatory deworming field trial in Uganda, we observed goats' browsing behaviours suggestive of self-medication.

This observation was strengthened by a shepherd who claimed to have observed goats grazing on EKAPANGITENG (*Albizia anthelmintica* Brongn., Fabaceae), followed by gross expulsion of worms in the goats' faeces. This observation was intriguing because animals generally avoid browsing the bitter leaves of *A. anthelmintica*. East Africans widely use *A. anthelmintica* bark, roots and leaves to control helminth parasites in human and animal medicine in Sudan (Koko *et al.*, 2000), Ethiopia (Desta, 1995) and Tanzania (Minja, 1994).

The objective of this study was to evaluate the anthelmintic effectiveness of *A. anthelmintica*, as a first step in investigating the hypothesis that livestock self-medicate. This research forms part of a larger ethnoveterinary study of the pharmacopoeia of Karamojong pastoralists.

4.2 Methods

4.2.1 Study site

Karamoja is located in the northeastern corner of Uganda, bordering Kenya and Sudan. It is characterized by a relatively flat savannah with some hills and mountains rising up to 3800 m. The semi-arid environment receives 350–750 mm rain per annum. The original vegetation was characterized as dry *Acacia-Combretum-Terminalia* woodland (Wilson, 1962). The herb layer is composed of *Hyparrhenia, Setaria, Themeda, Cymbopogon* and *Sporobolus* grass species. The short vegetation shows evidence of heavy grazing, in stark contrast with the neighbouring districts, where the people are less dependent upon livestock for survival.

The Nilo–Hamitic Karamojong numbering about 900,000 are transhumant agro-pastoralists widely dependent upon their cattle, supplemented by subsistence farming (Uganda Bureau of Statistics, 2002). Their semi-nomadic lifestyle is dictated by the grazing seasons of their livestock. Karamojong live in circular homesteads *manyattas* characterized by thick, thorny, concentric fences that encompass 2–5 acres and enclose ten to 30 mud-thatched huts. Women and children live in the *manyatta* year-round. During the dry season, the men and youth herd livestock to migratory cattle areas, where they sleep in the open or in low grass huts. External influences are minimal and 99% of the population rely exclusively on indigenous knowledge, medicines, and practices for themselves and their livestock.

4.2.2 Methods

An observational study was conducted in July 2006 to validate anthelmintic efficacy of *A. anthelmintica*. Fifty-six young female lambs were locally purchased from three Karamojong sub-counties. Baseline data were collected to chart out health variables and monitor changes during the field trial on each individual animal. These included: physical examination, live body weight, packed cell volume (PCV, an indicator of anaemia) and total protein (TP, a hydration status indicator) of blood samples. The numbers of parasite eggs per gram of faeces (EPG) were determined by the modified McMaster's technique (Campbell *et al.*, 1978), for five different parasites (*Strongyle*-types, *Moniezia*, *Strongyloides*, *Coccidia* and *Dicrocoelia*) for each sample. Based on the baseline data, 30 lambs were distributed into three groups of ten lambs each. Groups were created to ensure an even distribution of nine factors, including total EPG and district of origin.

The three groups were: negative control (no treatment), two test groups, one with an allopathic dewormer (levamisole, Wormicid®, Cosmos Limited, Nairobi, Kenya) at label dose, and another one using shade-dried *A. anthelmintica* bark, which had been prepared by crushing to make a powder and packed into standard gelatine capsules at the traditional healers' recommended dose of 0.8 g. Treatments were given orally on day 0. Bark was used, rather than roots or leaves, as per local healers' preferences.

In determination of the optimal dosing schedule for *A. anthelmintica*, half of the lambs in each treatment group were re-treated on day 14. Blood was collected for determination of PCVs and TPs on days 14 and 35. Body weight was repeated on day 35.

Coccidia, *Strongyle*-type, *Moniezia*, *Strongyloides* and *Dicrocoelia* eggs were identified. This preliminary study focuses on the first three parasite types, as they are the most clinically important. Anthelmintic efficacy was estimated as the percent faecal egg count reduction (FECR) using the following equation after Coles *et al.* (1992). Where T and C represent mean EPGs of the treated and control groups; subscript 1 refers to the EPG on day 0, and subscript n refers to EPG counts in a given week:

$$FECR = (1 - (\frac{T_n}{T_0} x \frac{C_0}{C_n}))x100$$

The FECR represents the per cent reduction change in the average EPG of animals in the treatment group, compared to the change in the average EPG of negative control animals. It is directly correlated to the efficacy of the treatment: a more effective medication correlates with a more highly positive FECR, up to a maximum of 100%. A negative FECR indicates that the animals in the treatment group showed either a smaller decrease, or a greater increase, in the average number of parasite eggs shed, than did animals in the negative control group.

4.3 Results and discussion

The FECR was positive for each of the parasite types, indicating efficacy of *A. anthelmintica* against all parasites examined in this study. As shown in Table 4-1, the FECR of *Strongyle*-type eggs, the most clinically important group, ranged from 71% to 78% for the first 3 weeks. Animals in the re-dosed group had an average FECR of almost

95% on week 3, tapering to 72% and 56% on weeks 4 and 5 respectively. The lambs' *Coccidia* level did not respond to herbal treatment *by A. anthelmintica* (average FECRs 15% to 30%); but re-dosed animals fared better, with averages of 47% and 55% in weeks 3 and 4. The FECR of *Moniezia* eggs was consistently over 94% after the first week.

Table 4-1 Efficacy of herbal medicine made from *Albizia anthelmintica* compared to allopathic dewormer (levamisole)

Week	*Strongyles*			*Coccidia*			*Moniezia*		
	Albizia	*Albizia* redosed*	Levamisole	Albizia	Albizia redosed*	Levamisole	Albizia	Albizia redosed*	Levamisole
1	71.3		99.9	-30.4		-64.7	38.2		75.0
2	78.3		99.2	-26.1		-49.2	98.1		89.5
3	77.8	94.6	98.4	-25.1	47.3	38	99.0	93.9	100.0
4	-85.1	72.1	82	-29.3	55.4	-103.5	99.3	100.0	-50.0
5	-141.2	56	37.5	-14.9	-9.2	6.9	99.9	100.0	88.2

The per cent faecal egg count reductions (FECR) of three different parasites in female lambs are shown.
*These columns refer to data form the half of the animals in each group which were retreated on day 14.

No differences were observed between groups in PCV, TP or live weight gain. This implies that the differences in worm-load had little effect on weight gain or anaemia; however data are still being collected.

Results of this study indicate that *A. anthelmintica* is effective in controlling infection with a variety of internal parasites in lambs. Furthermore, treatment of *Strongyle*-type worms requires a biweekly dose of *A. anthelmintica* as an effective deworming protocol. This study continues to further standardize the dosage according to body weight. Efficacy of *A. anthelmintica* will also be examined in other livestock species.

Photo 4-1 Oral treatment of calf with EKAPANGITENG (*Albizia anthelmintica*) bark extraction against helminthosis. This is a common treatment for all animals and humans. Ground bark powder and shade-dried bark strips are visible at lower left. Roots and bark are considered the strongest, although leaves are also used. EKAPANGITENG trees that grow in dark NAROO soil are said to be so strong that a strip of bark only needs to be tied around an animal's belly to work.

5.

5 Anthelmintic Efficacy and Dose Determination of *Albizia anthelmintica* against Gastrointestinal Nematodes in Naturally Infected Ugandan Sheep

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Abstract

Weight loss, stunted growth, and death caused by gastrointestinal parasites are major constraints to livestock productivity, especially in tropical and developing countries where regular use, and misuse, of anthelmintics has led to nematode resistance. *Albizia anthelmintica* Brongn. (Fabaceae) is traditionally employed throughout East Africa to treat helminth parasitosis in livestock. Reported efficacy has varied from 90% against mixed nematodes to just 19% against *Haemonchus contortus* alone. The objective of this study was to assess the anthelmintic effect of *A. anthelmintica* against naturally occurring infections of mixed gastrointestinal parasites, and to establish an effective treatment dose, in sheep under pastoral field conditions of northern Uganda. *A. anthelmintica* bark was collected and prepared according to local custom and packed into gel capsules. Fifty-five young female local mixed-breed lambs were randomly assigned to six groups, including a positive control group that received levamisole (synthetic anthelmintic) and a negative control group that received no treatment. Following the World Association for the Advancement of Veterinary Parasitology (WAAVP) dose determination guidelines, the other four groups were treated with varying doses of *A. anthelmintica*. Statistical analyses (using generalized linear models) were performed to assess treatment effect. There was a significant treatment (group) effect on parasite egg/oocyte counts per gram (EPG) for nematodes, but not for coccidia. The most effective dose against nematodes (0.8 g, 58.7 mg/kg) closely approximates what is usually given by traditional healers, 0.9 g/adult sheep. It provided major and significant reduction in EPG as compared to the negative control. Anthelmintic efficacy was estimated using percent faecal egg count reduction (FECR). Other than the positive control, animals in the standard dose group showed the greatest decline in shedding of nematode eggs, with an FECR of 78%. This study indicates that *A. anthelmintica* holds potential as part of an integrated management plan for the control of helminths in developing countries.

Key Words: Developing countries, *Albizia anthelmintica,* dose determination, integrated management plan, gastrointestinal nematodes

5.1 Introduction

Weight loss, stunted growth, and death caused by gastrointestinal parasites are major constraints to livestock productivity, particularly for small ruminants in developing countries (Perry and Randolph, 1999; Waller *et al.*, 1996). Currently, synthetic anthelmintics are the primary means of controlling parasitic infections. However, they have several disadvantages, including lack of availability in some areas, especially in developing countries; inconsistent quality in some countries; prohibitive cost; environmental contamination; and the potential for food residues (Hammond *et al.*, 1997; Krecek and Waller, 2006; Perry and Randolph, 1999). Furthermore, regular use, and misuse, of anthelmintics has led to nematode resistance, a problem which is most serious in sheep and goats in the tropics and developing countries (Coles *et al.*, 1992; Waller *et al.*, 1996). Routine use of anthelmintics also reduces development of natural immunity against helminths (Ketzis *et al.*, 2006). Targeted approaches such as improved grazing management may not be feasible for pastoralists who employ communal land ownership (Githiori *et al.*, 2003).

These problems have led to the search for alternative methods of parasite control. Methods under investigation include parasite-based vaccines, nematophagous fungi, condensed tannins, and immunonutrition (Ketzis *et al.*, 2006). These methods do not aim for total elimination of parasites; in fact, survival of some parasites *in refugia* can be of benefit (van Wyk, 2001; Vercruysse and Dorny, 1999; Waller, 1999). The aforementioned methods may act through direct parasiticidal activity, improving the immunity of the host, or decreasing exposure to the parasite, thus allowing reduced use of synthetic anthelmintics (Vercruysse and Dorny, 1999).

One promising area of investigation is the use of plant-based anthelmintics. Ethnoveterinary knowledge and plant-based anthelmintics were the mainstays of anthelmintic treatment prior to the advent of synthetic drugs, and are still widely used in many traditional societies (Gradé *et al.*, 2007; McCorkle *et al.*, 1996). Potential benefits of ethnoveterinary livestock anthelmintics are clear, as the latter societies often depend on livestock, and live in areas where synthetic anthelmintics are unavailable, unaffordable, and/or of poor quality.

The wider use and development of plant-based anthelmintics are often restricted, in part, by limited knowledge of the plants' actual efficacy against specific parasites, appropriate dosages, methods of preparation and administration for different livestock species, and possible toxicity (Githiori *et al.*, 2005). Although many plant species have been listed as having anthelmintic activity, only a few have been subjected to rigorous scientific validation (Hammond *et al.*, 1997).

Pastoralists throughout East Africa treat helminth parasitosis in livestock with *Albizia anthelmintica* Brongn. (Fabaceae), a slow growing tree whose bark has previously been reported to contain triterpenoid saponins, histamine, tannins, and other phenolic compounds (Carpani *et al.*, 1989; Johns *et al.*, 1999; Khalid *et al.*, 1996). In the past 15 years, anthelmintic properties of *A. anthelmintica* have been studied in Kenya, Sudan, and Ethiopia, using a variety of host animals, target parasites, and medicinal doses and preparations (Table 5-1). Efficacies of 100% have been reported against the liver fluke *Fasciola gigantica* (Koko *et al.*, 2000) and *Moniezia* spp. (Gathuma *et al.*, 2004) in sheep and against *Hymenolepsis diminuta* in rats (Galal *et al.*, 1991). Reports of efficacy against nematodes have varied: although two studies found reductions in faecal egg counts of 77% (Grade and Longok, 2000) and 90% (Gathuma *et al.*, 2004), a more standardized trial found only 19-34% efficacies against *Haemonchus contortus* (Githiori *et al.*, 2003).

The objectives of this study were therefore to assess *A. anthelmintica*'s anthelmintic effect against natural infections of mixed gastrointestinal parasites, and to investigate an effective dose, in sheep under pastoral field conditions in northern Uganda.

Table 5-1 Doses used and efficacies found in previous *Albizia anthelmintica* research

Reference	Parasite	Host	Part used[a]	Prep[b]	Dose[c]	N	Efficacy (%)
Gathuma *et al.* (2004)	Nematodes	sheep 9-10mo	Rt crushed	CE	5 g	5	89.8
	Cestodes *(Moniezia* spp.)	sheep 9-10mo	Rt powder	HE	26.5 g	6	100
Githiori *et al.* (2003)	Nematodes *(Haemonchus contortus)*	sheep 6-8mo	Bk whole	CE	25 g	5	19
					50 g	5	19
					100 g	5	19
		sheep 6-8mo	Bk whole	HE	25 g	5	28
					50 g	5	28
					100 g	5	28
		sheep 9mo	Bk powder	CE	25 g	5	34
					50 g	5	34
					100 g	5	34
Koko *et al.* (2000)	Trematodes *(Fasciola gigantica)*	goats 5mo	Bk powder	CE	9 g/kg[e]	3	95.5
Grade and Longok (2000)	GI count[e]	rumnt[f]	Bk powder	CE	2 spoons	8	77
Desta (1995)	Cestodes	people	Bk powder	N	21.4 g	6	50[g]
Galal *et al.* (1991)	Cestodes (*Hymenolepsis diminuta*)	rats	Bk	SE/BF	75 g/kg[d]	5	0
					150 g/kg[d]	5	0
					300 g/kg[d]	5	0
					450 g/k[d]	5	0
		rats	Bk	SE/BFR	15 ml[c]	5	0
		rats	Bk	SE/AF	30 g/kg[d]	5	68
					75 g/kg[c]	5	68
		rats	Bk	SE/AF	150 g/kg[d]	5	100
					300 g/kg[d]	5	100
					450 g/kg[d]	5	100
		rats	Bk	SE/PF	450 g/kg[d]	5	0

[a] Part used in the preparation, Bk: bark, Rt: root
[b] Prep: method of preparation. CE: cold extraction, HE: heat extraction, SE: soxhlet extraction, BF: butanolic fraction, BFR: butanolic fraction residue, AF: aqueous fraction, PF: polar fraction, N: no extraction; ground bark powder was mixed with honey
[c] Unless otherwise stated, dose was given once orally
[d] One-third of this dose was given three consecutive days
[e] Types of eggs were not differentiated
[f] rumnt: cattle, sheep, and goats
[g] The median effective single dose, defined as the dose that expels the parasite, partially or totally, in 50% of infested subjects

5.2 Materials and methods

World Association for the Advancement of Veterinary Parasitology (WAAVP) guidelines for evaluation of anthelmintic resistance in ruminants were used to guide animal selection, treatment procedure, faecal egg counts, and interpretation of data (Wood *et al.*, 1995). Field trial design was adopted from techniques used at Ghent University, Belgium (J. Vercruysse, personal communication).

5.2.1 Plant material

A. anthelmintica was harvested and prepared according to local custom. In May 2006, at the start of the rainy season, a traditional Karamojong veterinary healer harvested stem bark from three naturally growing trees in Pian county of Uganda’s northeastern Karamoja Region. Voucher herbarium specimens (JTG-251 and JTG-252) of these trees were confirmed to be *A. anthelmintica* at Makerere University Herbarium in Kampala (Angiosperm Phylogeny Group, 2003). These vouchers are kept at Makerere herbarium and at KACHEP field herbarium in Karamoja. Bark was shade-dried, and inner bark was removed and pounded into a fine powder. Powder was stored in a polythene bag at room temperature for two weeks, then uniformly packed by hand into gelatine capsules.

5.2.2 Animals

Fifty-five female local mixed-breed lambs aged three to six months, predominantly variants of East African Blackheaded Persian crosses or Karimojong sheep (T. Loquang, personal communication), and one nursing ewe were purchased from three different Karamojong counties (Pian, Bokora, and Matheniko). They were treated for external parasites topically with a synthetic pyrethroid (Protaid®), injected with two cc of multivitamin solution (Coopers®) subcutaneously, weighed, given a complete physical exam, and treated for any conditions not related to parasitosis. They were weighed again at 35 days post-treatment. The flock was housed in a fenced area with free access to a commercial salt lick for ruminants. They were observed while grazing on local pasture for eight hours daily, commingling with one another and other animals throughout the study. Free-choice water for one hour was provided daily. The milking ewe was restrained to supplement the diet of at least three younger lambs.

5.2.3 Treatment

The local standard *A. anthelmintica* dose used by several Bokora and Pian traditional healers for deworming sheep had previously been averaged and determined to be 0.9 g/sheep. Following WAAVP guidelines for dose determination studies (Wood *et al.*, 1995), it was decided to give treatment groups approximately one-half, one, two and five times this standard dose (Table 5-2).

Table 5-2 Treatments received and initial weight at day 0 by group

group	average live weight (kg)	treatment received	amount given (g)	average dose (mg/kg)
A	9.31	0.5 standard dose of *A. anthelmintica*	0.4	32.5
B	10.13	1 x standard dose of *A. anthelmintica*	0.8	58.7
C	9.35	2 x standard dose of *A. anthelmintica*	1.8	135.5
D	9.00	5 x standard dose of *A. anthelmintica*	4.7	358.5
E	8.97	levamisole (Wormicid ®) at labelled dose	0.185	14.11
F	8.72	none		

Baseline eggs/oocysts per gram (EPG) of faeces were determined using the modified McMaster technique, with a sensitivity of 50 EPG (Coles *et al.*, 1992). Coccidia oocysts were not sporulated. However, coproculture samples were taken on day 0 for larval cross-section of nematodes. *Haemonchus* was the dominant larval species, although *Trichostrongylus*, *Nematodirus*, and *Ostertagia* were also seen. Lambs were stratified first by nematode EPG, then county of origin, coccidian EPG, and body weight. They were then randomly assigned to six groups (n = 9, except for group C, n=10). Small, medium, and large gel capsules held 0.4 g, 0.7 g, and 1.1 g of *A. anthelmintica* bark powder, respectively. Therefore, lambs in group A received 0.4 g (one small capsule), those in group B received 0.8 g (two small capsules), those in group C received 1.8 g (one medium and one large capsule), and those in group D received 4.7 g (two medium and three large capsules). Animals in group E, the positive control, received the synthetic anthelmintic levamisole (Wormicid®) at the labelled dose (185 mg tablet for <20 kg). Group F was a negative control and animals received no treatment (Table 2).

Gelatine capsules and levamisole tablets were given orally in the morning at the base of the tongue. Pilling was followed with a small amount of water to facilitate swallowing.

5.2.4 Faecal egg counts

EPG determination was carried out twice before dosing, then every seven days for 35 days. All sheep had total EPG over 2500 and nematode EPG over 800 prior to treatment. At least three grams of faeces were collected directly from the rectum and put into clean, labelled containers for each sheep. Faeces were stored at 4°C for up to eight hours while awaiting analysis. EPG was determined by the modified McMaster technique (Coles *et al.*, 1992), differentiating between nematode eggs and coccidian oocysts. The first two authors independently determined EPG of each sample, for duplication. Faeces were maintained until results were compared and any discrepancies resolved.

Determination of anthelmintic efficacy

Anthelmintic efficacy was estimated calculating the percent faecal egg count reduction (FECR), according to the method described by Dash *et al.* (1988):

$$FECR = (1 - (\frac{T_n}{T_0} x \frac{C_0}{C_n}))x100 \qquad \text{(Equation 1)}$$

where T and C represent the arithmetic means of the EPG in treatment and negative control groups, and subscripts 0 and n denote counts before and after treatment, respectively.

5.2.5 Statistical analysis

Generalized linear models (GENMOD procedure in SAS version 9; SAS Institute Inc., 2003), which allow fitting various model types depending on the distribution of the response variable, were used to assess the treatment effect. In this procedure, fitting a normal distribution is equivalent to analysis of variance, while fitting a Poisson distribution corresponds to Poisson regression modelling. Response variables included EPG count on day 14 (hereafter "EPG count") as well as change in EPG between day 0 and day 14 (hereafter "change in EPG") for nematodes and coccidia. A logarithmic transformation for EPG count data of nematode (log_{10}+3) and coccidia (log_{10}) fulfilled required assumptions for analysis of variance (i.e. GENMOD with a normal error distribution). The variable "change in EPG" data did not require transformation in order to meet the underlying assumptions of an ANOVA. The treatment or group was the only predictor variable and was entered in our models as a categorical variable with six levels, as described above (see Treatment section, Table 5-2). When a significant group effect was detected, multiple comparisons were performed to determine which group(s) differed. Dunnett's test was used to compare means within each group to the negative control, as it is more powerful than other multiple comparison tests in this situation (Quinn and Keough, 2002). Means are however reported on an untransformed scale (± standard deviation). We used ANOVA to compare change in weight (weight gain) between groups, measured by the difference between weights on day 0 and day 35. All analyses were performed in SAS version 9 (SAS, 2003) and a significance level of 5% was adopted.

5.3 Results

5.3.1 Treatment effects

Using the generalised linear model, we found a significant treatment (group) effect for nematode EPG count (ANOVA model, $F_{5, 49} = 27.43$, $P < 0.001$, $r^2 = 0.74$). Two groups, *A. anthelmintica* at a dose of 4.7 g (group B) (2313.89 ± 1859.15) and the levamisole group (group E) (38.89 ± 53.20), significantly differed from the negative control group (group F) (9930.56 ± 5385.00), (Dunnett's test, $P < 0.05$). We also found a group effect ($F_{5, 49} = 3.40$, $P = 0.0102$; $r^2 = 0.26$) for change in EPG for nematodes. The major and only difference found using multiple comparisons was between animals receiving the standard plant dose, group B, and the negative control group, F (Dunnett's test, $P < 0.05$; Table 5-3). The difference between animals given levamisole (group E) and the negative control group also approached significance (Dunnett's test, $P = 0.055$; Table 5-3). There were no group effects on EPG count or on the change in EPG for coccidia (ANOVA, all $P > 0.05$).

Table 5-3 Group comparison for nematode change EPG count from day 0 to day 14. Significant differences are shown in bold, differences based on Dunnett's test

group[a] comparison	difference between means	simultaneous 95% confidence limits	
A to F	1628	-5609	8,864
B to F	**9853**	**2616**	**17,089**
C to F	4138	-2916	11,191
D to F	6006	-1231	13,242
E to F*	7133	-103	14,370

[a]Group A received 0.4 g *A. anthelmintica*, group B received 0.8 g *A. anthelmintica*, group C received 1.8 g *A. anthelmintica*, group D received 4.7 g *A. anthelmintica*, group E (positive control) received levamisole at the labelled dose, and group F (negative control) received no treatment

**This group comparison is 'nearly significant' if $P < 0.06$

5.3.2 Anthelmintic efficacy

For nematodes, levamisole at the recommended dosage resulted in 99.2% FECR (see equation 1), whereas for *A. anthelmintica* at the recommended dose of 0.8 g and the 4.7 g dose resulted in FECRs of 78.3% and 66.5%, respectively (Table 5-4). All groups had positive FECRs compared to the negative control after day 7. For coccidia, maximum efficacies observed were 90.5% for *A. anthelmintica* at 4.7 g, and 82.3% for group receiving *A. anthelmintica* at 0.4 g. All other groups had negative FECRs as compared to the negative control.

Table 5-4 Nematode EPG count (mean ± SD) and corresponding % FECR for each treatment group

group	EPG pre-treatment	EPG post-treatment	FECR (%)
A	4547 ± 5754	7547 ± 5821	11.4
B	8794 ± 8844	3569 ± 2798	78.3
C	4770 ± 1977	5260 ± 4543	41.1
D	3689 ± 4881	2314 ± 1859	66.5
E	2544 ± 1685	38.9 ± 53.2	99.2
F	5303 ± 3302	9931 ± 5385	

Group A received 0.4 g *A. anthelmintica*, group B received 0.8 g *A. anthelmintica*, group C received 1.8 g *A. anthelmintica*, group D received 4.7 g *A. anthelmintica*, group E (positive control) received levamisole at the labelled dose, and group F (negative control) received no treatment. Percent reduction in faecal egg count, Eq. (1). A more positive FECR (up to a maximum of 100%) is associated with more effective treatment

5.3.3 Change in live body weight

As seen in Table 5-5, on average lambs in the negative control group and the group receiving less than the healers' recommended dose of *A. anthelmintica* (group A) gained less than half as much weight as animals in the other groups. Weight gain was significant (P = 0.0001) within the sample as a whole, with a mean gain of 0.96 kg/animal. However, differences between groups were not statistically significant ($P > 0.05$).

Table 5-5 Mean change in weight by treatment group

Treatment group	Mean change (kg) (SD)	Weight gain (kg) (min – max)		Inter-quartile range (kg) Q1 – Q3
A	0.4 (1.5)	-2.5	+2.5	0.0 - 1.0
B	1.1 (1.3)	-5.0	+3.5	0.5 - 1.5
C	1.4 (2.1)	-2.5	+4.6	0.6 - 2.4
D	0.9 (2.0)	-1.5	+5.0	0.1 - 1.3
E	1.8 (1.4)	0.0	+4.0	0.9 - 2.4
F	0.4 (1.4)	-2.0	+2.0	-0.5 - 1.5

5.4 Discussion

The results of our study indicate that *A. anthelmintica* has activity against gastrointestinal nematodes in naturally infected sheep. At the dosage of 0.8 g/sheep (58.7 mg/kg), there was a significant reduction of EPG as compared to the negative control group, and as well as an efficacy level greater than 78%. This is somewhat lower than the 90% efficacy reported by Gathuma *et al.* (2004), but notably higher than the 19-34% found by Githiori *et al.* (2003). One possible explanation is the strength of medicine received by treated animals. Although Gathuma *et al.* (2004) and Githiori *et al.* (2003) both used much higher dosages than were used in this study (see Table 5-1), the parasiticidal element(s) of *A. anthelmintica* have not been isolated, and it is not possible to determine its concentration in any given formulation or if the active ingredient is present in the administered portion. There are many reasons why anthelmintic strength or activity may not be directly proportional to dose given, including region, season, plant part, preparation and extraction method. Githiori *et al.* (2003) found differences in efficacy between preparations of *A. anthelmintica* from different areas of Kenya. It has been proposed that a harsh and arid environment like that of Karamoja may be associated with more concentrated plant products, which may lead to more potent medicinal properties (Körner, 1999). Similarly, as *A. anthelmintica* is deciduous, seasonal variations in physiological processes may alter the composition or concentration of chemicals within the bark (Scogings *et al.*, 2004). In this study, bark was collected at the beginning of the wet season, which may correspond with peak concentrations of certain secondary metabolites that are expressed more in during growth spurts. Çirak *et al.* (2007a, b, 2008) found variations in the concentrations of several bioactive substances in *Hypericum* species at different stages of plant growth and in different plant parts. Plant shoots were found to have the highest concentration of during growth phases, as opposed to the vegetative or dormant dry season. Similarly, woody species of semi-arid savannas in southern Africa had elevated phenols during the growth season (Scogings *et al.*, 2004). Unfortunately, other *A. anthelmintica* studies have not noted the season or vegetative state the tree was in at bark collection, making comparisons difficult (Desta, 1995; Galal *et al.*, 1991; Gathuma *et al.*, 2004; Githiori, 2004; Githiori *et al.*, 2003; Grade and Longok, 2000; Koko *et al.*, 2000).

Differences in methods of preparation may also have affected *A. anthelmintica* efficacy. Our study used shade-dried, powdered bark administered directly inside gel capsules, while Gathuma *et al.* (2004) used cold aqueous extractions and Githiori *et al.* (2003) used both cold and hot aqueous extractions. Additionally, Githiori *et al.* 2003 used whole, uncrushed bark for the extractions in two out of three trials (Table 5-1), rather than the powdered bark that healers commonly use in the above areas. Both Githiori *et al.* (2003) and Galal *et al.* (1991) found differences in efficacy dependent on method of preparation. Interestingly, neither study found a dose-related effect, indicating that method of preparation may be of paramount importance (see Table 5-1). It is possible the whole bark material administered in this study led to a stronger effect. Teichler, while at the Andalusia internment camp in South Africa, obtained better anthelmintic results from powdered bark than from a decoction (Teichler 1954, in Watt and Beyer-Brandwijk, 1962). However, no quantitative studies have been done to determine if administering aqueous extraction filtrate vs. whole plant material administration increases or reduces *A. anthelmintica*'s anthelmintic effect.

Susceptibility of parasites may also vary, according to strain, geography, or previous exposure to anthelmintics. Githiori *et al.* (2003) used an artificially induced infection with a single strain of *Haemonchus contortus*. The strain of *H. contortus* used in that study, however, may have been more resistant to the active element of *A. anthelmintica* than the strains present in our study's naturally occurring mixed nematode infection, even though it was primarily consisting of *Haemonchus* spp.

The FECR of 78.3% found in this study does not meet the proposed minimum standard of 90% for development of a new anthelmintic (Vercruysse *et al.*, 2001) or even WAAVP's standard of 80% that indicates "moderate" efficacy (Wood *et al.*, 1995). However, these standards were set for industrial development of pharmaceuticals and have been suggested to be too high for ethnoveterinary medicines and other novel approaches (Githiori *et al.*, 2005; Ketzis *et al.*, 2006). Githiori *et al.* (2005) proposed a standard of 70% for ethnoveterinary medications, as was used in some of their previous studies (Githiori, 2004; Githiori *et al.*, 2003). This is in part because rather than seeking to eliminate parasitosis, novel control methods aim to keep infection levels below economic threshold, defined as the maximum level of infection that can be tolerated without causing production loss (Ketzis *et al.*, 2006). Estimating a specific economic threshold is a complex task. This involves optimizing parameters such as decreased feed efficiency, time and financial costs of medication, and effects on local market prices, which is beyond the scope of this paper (for more discussion, see Perry and Randolph, 1999). Based on this 70% standard, *A. anthelmintica* is an effective treatment. No statistical difference between groups was observed for weight change, but the negative control tended to gain less weight, implying that the differences in worm-load had little short term affect on weight gain, the measure of production.

The second objective of this study was to evaluate the appropriate *A. anthelmintica* dose for sheep in our study area, as a follow-up to our preliminary findings (Gradé *et al.*, 2007). The most effective dose against nematodes, 0.8 g/lamb or 58.7 mg/kg, closely approximates what Karamojong traditional healers give adult sheep (0.9 g/animal). This treatment group had the highest FECR, 78.3%, other than the positive control that received levamisole (group E). Moreover, it was the only group with a significantly greater change in EPG as compared to the negative control, group F (see Tables 5-3 and 5-4); however, we have to bear in mind that this treatment group did have an elevated initial worm load as estimated by EPG compared to other groups (Table 5-4) despite our effort to stratify the groups according to baseline EPG counts. So, although the healers' standard dose did not provide the highest efficacy, it did provide the highest absolute or raw reduction in infection load. This is most likely one reason why this dose is used by the local healers. Furthermore, as nematodes are by far the most clinically important gastrointestinal group of parasites in small ruminants in the tropics, it is not surprising that local healers have settled on using the dose most effective against them.

The dose we arrived at is markedly less than has been used in other studies. For example, Githiori *et al.* (2003) used 50 g/sheep, Gathuma *et al.* (2004) used 26.5 g/sheep, and Koko *et al.* (2000) used 9 g/kg for goats (3 g/kg for three consecutive days). All authors chose doses based on traditional healers' recommendations in their respective research settings. The vast discrepancies in doses may reflect geographic differences in *A. anthelmintica* potency, or may be cultural or traditional. In any case if, as this study suggests, some forms of *A. anthelmintica* are effective at this dose, there are clear benefits as to the amount of work and availability of bark required to treat a flock, and to sustainability and conservation in harvesting.

Given reports of anthelmintic activity in the plant's leaves and trunk bark (Desta, 1995), it is warranted to assess the anthelmintic activity of leaves, twigs, and other aerial parts that would allow for less destructive harvesting (Zschocke *et al.*, 2000). Over-harvesting of bark could lead to the death of this slow growing tree and, if used routinely on a flock-wide basis, local supplies could be quickly depleted.

5.5 Conclusions

Although other studies have found *A. anthelmintica* to have less activity, this study indicates administration of *A. anthelmintica* holds potential as an effective treatment for nematode parasitosis in sheep. The best dose for mixed nematode infection was found to closely approximate what is usually given by traditional healers, 58.7 mg/kg. Plant-based treatments, such as *A. anthelmintica*, could be made of part of an integrated management plan for control of helminths in developing countries. Not only does our study provide evidence for the relevance of the traditional healing system, it also calls for a need to ensure long lasting availability for the species used to treat promote and maintain the health of livestock in the tropics.

6.

6 Botany by Instinct: Indications of Self-Medicating Livestock

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Abstract

Following observations of goats' possible self-medication browsing the anti-parasitic plant, *Albizia anthelmintica* Brongn., an ethnobotanical survey was undertaken to examine whether livestock engage in other self-medicating behaviours, and if people also use the same medications. Information was gathered over a five-month period from 147 Karamojong pastoralists and healers using a checklist of questions. There were 124 observations for 50 proposed self-medicating behaviours, primarily eating plants, to treat a total of 35 disease conditions. Of the plant species, 72% were also prepared by informants to treat human or veterinary diseases. Species importance was estimated by four factors: >3 user citations, informant consensus factor >0.4, fidelity level >40% and presence in the local pharmacopoeia. Eight species fulfilled all of these factors, and 12 had at least three. These results provide support for the hypothesis that animals graze specific plants when ill and suggest that people have developed some of their knowledge through animal observation.

Key Words: Animal self-medication, *Albizia anthelmintica*, ethnoveterinary knowledge, pastoralists, zoopharmacognosy, ethnobotany, pharmacopoeia

6.1 Introduction

Evidence for animals' self-medication has accumulated over the past two decades (Engel, 2002; Hart, 1990; Huffman, 2003; Lozano, 1998). Research has concentrated on Africa's great apes. Janzen (1978) was the first to suggest that ingested secondary plant compounds actually help animals to combat parasites. Research has since identified chimpanzees' self-treatment for internal parasitism through leaf-swallowing of *Aspilia* spp. (Asteraceae) (Wrangham and Nishida, 1983) and bitter pith chewing of *Vernonia amygdalina* (Asteraceae) (Huffman and Seifu, 1989) as well as other species (Lozano, 1998). Other studies approach proving self-medication by identifying and isolating biologically active compounds responsible for specific pharmacological effects, for example V. *amygdalina* (Huffman *et al.*, 1993) *Albizia grandibracteata* (Fabaceae) and *Trichilia rubescens* (Meliaceae) (Krief *et al.*, 2005) from which antiparasitic and antibacterial compounds have been isolated following observations of chimpanzees. Watt and Beyer-Brandwijk (1962) earlier documented that indigenous East and South African people use some of these plants as medications.

The study of self-medication in animals is known as 'zoopharmacognosy' (Rodriguez and Wrangham, 1993), defined as the study of secondary plant components or other non-nutritive substances used by animals for self-medication (Huffman, 1997a). Huffman (2007) recently broadened the definition to include behaviour and non-plant substances used to suppress disease or to enhance animal health. Use of soils and their properties has been well-documented in non-human primates and elephants (Engel, 2002) as have other behaviours that do not include ingestion of soils or plants (Clark and Mason, 1985; Lozano, 1998).

Ethnoveterinary knowledge (EVK) refers to people's knowledge, skills, practices, and beliefs about the care of their animals (McCorkle, 1986). EVK has documented many local remedies, or ethnoveterinary medicines (EVM), that animal keepers use for livestock health. These EVMs are often taken to mean the use of medicinal herbs, but also include wild plant and mineral products, and processes such as bone setting and vaccination. However, EVK always has a human intervention component (McCorkle *et al.*, 1996).

There has been little reference to livestock or other domestic animals in the field of zoopharmacognosy. Moreover, most research has been by behaviourists' observations of wild or zoo animals, predominantly primates. On the other hand, many farm animals lack access to self-medication because they are confined and given a specifically developed diet that has little bearing on what they would get in the wild (Engel, 2002). Research has shown *in vivo* antiparasitic effects of tanniferous plants that small ruminants may browse and graze (Niezen *et al.*, 1998; Paolini *et al.*, 2004). However, definitive work on sheep self-medicating, when challenged with illness-producing foods, was the first demonstration of multiple malaise-medicine associations supporting zoopharmacognosy (Villalba *et al.*, 2006). This paper investigates self-medication by domestic animals, as observed by Karamojong pastoralists of northeastern Uganda, where the only fodder animals get is what they forage.

In 1998, an ethnoveterinary survey catalogued over 70 different medicines pastoralists in central Karamoja use to treat and prevent livestock diseases (Gradé and Shean, unpublished). Some of these veterinary remedies are also used to treat human afflictions. Following this survey, validation field trials of selected EVMs were undertaken to evaluate their efficacy in the field (Gradé, 2001). Early in one such study, an abrupt drop was observed in individual goats' internal parasite loads (measured by daily faecal eggs per gram and faecal egg count reduction), whereas this was not observed in other species studied (unpublished data). Shepherds suggested that this was related to selective browsing of a bitter plant, *Albizia anthelmintica* Brongn. (Fabaceae). It was explained that goats suffering from internal parasites tend to graze *A. anthelmintica,* followed by expulsion of gross worms in the faeces and improvement in their symptoms (Gradé *et al.*, 2007). This observation led us to search for other self-medicating behaviours by similar livestock in the project area.

The primary objective of the present study was to investigate self-medicating behaviours of Karamojong livestock, to examine the hypothesis that animals seek out and graze specific medicinal plants or employ other behaviours when sick. The survey addressed three central questions: Do animals (domestic and wild) perform self-medicating behaviours? If so, what plants or other materials do they use? And finally, do people locally use these same items to treat disease in livestock and/or themselves (i.e., are they included in the local pharmacopoeia)? A secondary objective was to select those plants/materials that were most important in order to validate their use potential for promotion within the subregion, e.g. establishing them in home gardens, follow-up field trials and possible drug development.

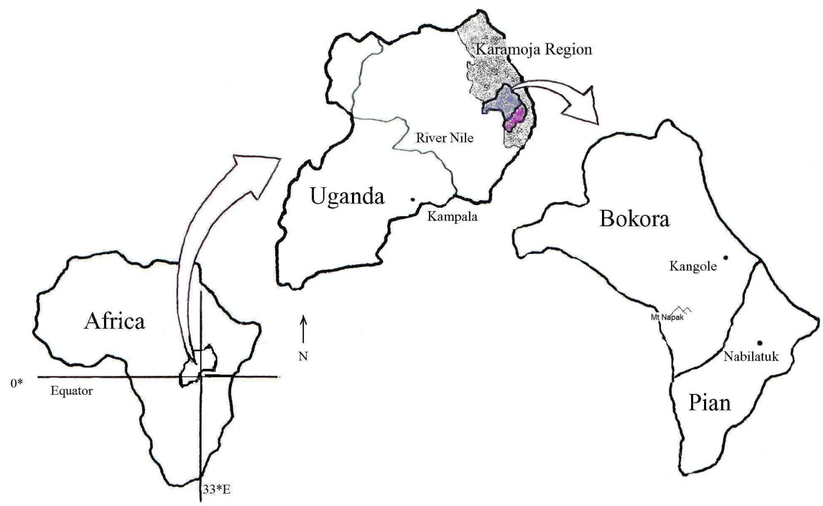

Figure 6-1 Study area (credit: John O. Grade)

6.2 Methods

6.2.1 **Study Site**

The region of Karamoja is located in northeastern Uganda. This study took place in south-western Karamoja between 2˚ to 2˚03' N and 34°15' to 34°40' E (Figure 1). Mean annual rainfall ranges from 500 to 750 mm, with 380 to 500 mm in the plains and higher levels in the surrounding mountain ranges. Daily temperatures average 30-35˚ C. The region has a semi-arid to arid environment and is prone to cyclical droughts. Pratt and Gwynne (1977) grouped Karamoja in Eco-Climate Zone VI of East Africa, in which evaporation greatly exceeds precipitation (Karamoja Data Centre unpublished data).

Thomas (1943) described the vegetation of Karamoja as consisting of *Acacia-Combretum-Terminalia* woodland species associations, with a grass layer of *Hyparrhenia, Setaria, Themeda, Chrysopogon* and *Sporobolus* species. In contrast with neighbouring districts, the short vegetation shows evidence of heavy grazing.

Karamoja consists of five geopolitical districts. Total population is around 935,000 (Uganda Bureau of Statistics, 2002) and contains five distinct Nilotic peoples in the plains and two small Kuliak groups found along the mountains (Gulliver, 1952). All of these groups live in conflict with one another and neighbouring tribes. One of the Eastern Nilotic ethnic groups in Uganda, the Karimojong, has three major clans, from which the county names are derived. Two of these clans, Bokora and Pian, are the focus of this paper. The Bokora county population is 95,000, while Pian has 38,000 people (Uganda Bureau of Statistics, 2002). They share a transhumant agro-pastoral lifestyle and speak the same language, with slight differences. However, due to armed bilateral cattle rustling, there are strong cultural taboos against sharing livestock information between clans (Mirzeler and Young, 2000).

These pastoralists rely almost entirely on livestock for survival and cultural events. Karamojong are semi-nomadic and have minimal health care infrastructure for humans or livestock, with only one doctor per 57,133 people (Netherlands Development Organisation unpublished) and one veterinarian for 90,000 livestock (Moroto District

Veterinary Office unpublished; Uganda Wildlife Authority unpublished). Culturally, people rarely disclose their true number of animals, so even this low ratio may be overestimated. Thus, the Karamojong rely almost exclusively on local knowledge and medicines for treating diseases in both people and animals (Gradé *et al.*, 2007).

Daily patterns and problem solving revolve around their livestock: when to graze, when to water, when and how to protect livestock from wild animals or raiders, how often to milk or bleed for human consumption, which animals to select for sacrifice, and so on. Thus, they are highly motivated to observe and well-manage their livestock.

6.2.2 Methods

We conducted our study, interviewing 12 groups (Table 6-1), from April to August 2005. Twenty four traditional healers participated, not only in discussions, but also in collections. These healers are representatives of the Bokora and Pian registered traditional healer associations. An additional 123 pastoralists from the community joined the discussions; of these 147 total respondents, 55% were from Bokora and 45% were from Pian. One survey was performed at a cattle market in Pian, while 11 were held in home villages of traditional healers.

Table 6-1 Breakdown of community member numbers surveyed

	Groups: (home, market) [a]	Registered Traditional Healers: (men, women)	Non-healers: (men, women)
Pian	8: (7, 1)	21: (16, 5)	60: (31, 29)
Bokora	3: (3, 0)	3: (2, 1)	63: (31, 32)
total	12	24	123

[a] number of groups and their interview location

Information was gathered by a checklist of questions performed during field excursions and group discussions (Martin, 1995). Participants were asked to list behaviours in livestock that were performed indicative of self-medication or symptomatic relief of disease conditions; and also whether these practices, behaviours and remedies were used by people in the treatment of disease in animals and/or people. Data were crossreferenced by the first author's observations to determine if the observed self-medications were part of the pharmacopoeia of Karamojong-prepared medications. They were also asked from where they believed their indigenous knowledge had originated.

Informants were asked to narrate observations with the following processes: 1) animals having an obvious ailment (one the pastoralists could visually diagnose); 2) these animals displaying behaviour that is absent or rare when healthy, such as grazing an unpalatable plant part; 3) following this behaviour, they observe an improvement in the animals' symptoms; and subsequently 4) the animal ceasing the said behaviour as symptoms improve. Provided their observation included step two (i.e. animals displayed a behaviour that is absent or rare when healthy) and most of the other steps, the observation was included in the results. We are intrigued by the possibility of a fifth step, in which after observation of steps one through four, pastoralists experiment with using the relevant self-medicating material as a prepared medicine. For points one through four, we relied upon the pastoralists' observations, memories, and willingness to share information. Pastoralists are the best resource for self-medicating livestock observations due to their constant close proximity to the animals, high motivation to observe and monitor disease, and years of accumulated experience on animal care, diagnosis, and treatment. It is important to note the potential barriers and layers of translation between the author and the animals in this study. There was a clear barrier between the animals and pastoralists, who discerned disease conditions – including subjective conditions such as headache and nausea – from healthy animal behaviour. There were also barriers separating the first author and pastoralists, due to differences in language, and in cultural views of disease aetiology, medication, and livestock behaviour. Therefore indices of informant consensus factor (ICF) and fidelity level (FL) were used to guide interpretation of our observations and efforts were made to draw responses from the emic perspective.

Indigenous disease terminology was verified by the primary author, an experienced veterinarian. Diseases, processes, and disorders were grouped according to the usage category standard for human symptoms and ailments developed by Cook and Prendergast (1995). In alphabetical order, the usage categories are as follows: digestive system disorders, ill-defined, infection/infestations, injuries, metabolic disorders, nutritional disorders, pregnancy/birth/puerperium disorders, prophylaxis, respiratory disorders and skin disorders. Self-medicating remedies were grouped according to botanical family (Angiosperm Phylogeny Group, 2003), if plant-based; as ‘mineral’ if inorganic; or as ‘water’ if water was a component.

Plants mentioned by participants were photographed and collected *in situ*. Collected plants were sent to Makerere University Herbarium in Kampala for botanical identification according to Flora of Tropical East Africa. Karamojong names for some plants are connected to more than one scientific name; we refer to these data as ethnospecies (Reyes-Garcia *et al.*, 2006). All plant species and material are listed with small caps in vernacular. Vouchers are kept at Makerere herbarium and a community herbarium located at the study’s partner NGO, KACHEP, in Nabilatuk, Karamoja.

We conducted our survey as part of KACHEP’s ongoing community development project focusing on animal health care, local capacity building and EVK awareness. Key informants were healers whose associations were registered at the national level with whom the first author has a long standing (8 years) relationship, facilitating their associations’ formations, development of intellectual property rights awareness, and their goals and vision; therefore prior consent was obtained.

6.2.3 Data Analysis

Interview responses were compiled into narrative form, coded and entered into an Excel spreadsheet. Analysis included calculation of ICF (Equation 1) and FL (Equation 2). ICF was adapted from Trotter and Logan’s informant agreement ratio (1986) to measure informant groups’ consensus and thereby infer consensus among different animals observed. We specifically looked into three areas; individual self-medicating remedies and categories of these remedies, and usage categories of disease (e.g. a specific plant species, and a particular plant family and category of disease as described by Cook). In this method, the relative importance of each use is calculated directly from the degree of consensus in informants’ responses (Phillips, 1996). The importance of different plants or uses is assessed by the proportion of informant groups who independently corroborate different animals’ self-medicating behaviours. The ICF has a maximum of 1.0 (maximum consensus) and a minimum of 0 (no consensus). ICF for an individual self-medicating remedy, for example, is calculated, as follows: number of observations of the remedy (obs) subtracted by the number of ailments (use category of disease, UC), divided by the number of observations of the particular remedy minus one:

$$ICF = \frac{obs - UC}{obs - 1} \qquad \textbf{Equation 2.}$$

We used ICF to evaluate the hypothesis that livestock self-medicate. A self-medicating behaviour (SM) with a positive ICF indicates that livestock in different areas displayed a consistent behaviour; i.e. that local people observed animals with a given disease tended to perform a particular SM. Among usage categories, a positive ICF indicates specificity of the SM for a given disease condition; i.e., animals performing a given SM tended to have the same disease condition, rather than haphazardly chewing an unpalatable plant part for any illness. ICF for disease categories took into account a summation of observations within the category. Each SM was counted only once, even if it appeared in more than one disease within the usage category.

Fidelity level (FL, Equation 2) adapted from Phillips (1996), was used to determine the most important self-medicating species in each specific usage category. Fidelity level is derived from

$$FL(\%) = \frac{N_p}{N} \times 100 \qquad \textbf{Equation 3.}$$

where N_p is the number of observations of a particular self-medicating behaviour for one usage category, and N is the total observations for the behaviour for any use.

We are confident that our findings are significant, particularly given that Bokora and Pian forbid sharing livestock-related information between clans. Elevated ICF and FL are therefore strong indicators of multiple, independent and congruent observations.

We estimated plant/material importance as a function of four criteria. The species must have at least three uses in order to be considered. The other three criteria are: ICF >0.4 (Moerman, 2007), FL >40% and presence of the treatment in the local pharmacopoeia.

6.3 Results

There were 124 use citations (observations) for 50 proposed self-medicating behaviours used to treat a total of 35 disease conditions, as observed by 12 informant groups. The domesticated animals mentioned were goats, cattle, sheep, donkeys, camels, poultry and dogs, in decreasing order of self-medicating behaviour observations. Cats and pigs were not mentioned. There were single self-medicating behaviour mentions for three wild animal species; buffalo, kudu and guinea fowl. As stated in the methods section, to be considered a self-medicating activity, the informants observed animals displaying a behaviour that is absent or rare when healthy, as part of the following process: 1) animals having an obvious ailment (with symptoms pastoralists could visually diagnose); 2) these animals displaying behaviour that is absent or rare when healthy, such as grazing an unpalatable plant part; 3) subsequent improvement in the animals' symptoms; and 4) subsequent cease in self-medicating behaviour. All the 50 proposed self-medicating behaviours fulfilled criterion two, almost all of the 50 also fulfilled steps one, three and four with step four being the least, but still fetching > 70% of 124 observations.

6.3.1 Most Observed Self-Medicines

Table 6-2 shows the 50 observed self-medicating remedies and behaviours in alphabetical order, divided in three parts, i.e. specific oral remedies, non-specific oral remedies and non-oral self-medicating behaviours. The most commonly mentioned self-medicating behaviour was grazing EKOSIMABU (*Loudetia superba* De Not.), which was reported nine times out of the total of 124 reports. Three Karamojong remedies had eight observations: AKAWOO (*Cymbopogon giganteus* Chiov. or *Bothriochloa insculpta* (A. Rich.) A. Camus), EDOOT soils, and LOLETIO (*Eragrostis pilosa* P. Beauv.). Two species had six observations: ECUCUKWA (*Aloe tweediae* Christian or *A. dawei* A.Berger) and

EKAPANGITENG (*Albizia anthelmintica*). Note that both AKAWOO and ECUCUKWA are ethnospecies with more than one scientific name.

Forty-seven of the 50 self-medicating behaviours, or 94%, were taken orally (part a and b in Table 6-2). Only three behaviours had no oral component (part c, Table 6-2). Forty-two, or 84%, of the self-medicating behaviours documented here involved plants. Five had a water component, and six had a mineral component. Three behaviours spanned two of the above categories.

Figure 6-2 Goat browsing with possible self-medicative effects.

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Table 6-2 List of self-medication remedies and behaviours, (A) for specific oral treatments' (B) for non-specific oral (C) for behaviour, not ingestion of remedy, listed in alphabetical order of local name. Those self-medicating behaviours that have high importance factors are bold

material (part used)	Scientific name	Family	Obs	UC	ICF	PM	FL
(A)							
Abalongit	Mineral - soda ash	'mineral'	2	2	0	yes	50 R, D
Abir (wp)	*Sphaeranthus ukambensis* Vatke & O Huffm.	Asteraceae	1	1	0	yes	100 D
Abwach (b, l)	*Warburgia salutaris* (Bertol.f.) Chiov.	Canellaceae	3	3	0	yes	33
***Akawoo* (l)**	***Cymbopogon giganteus* Chiov.**	**Poaceae**	**8**	**3**	**0.71**	**no**	**50 I**
	***Bothriochloa insculpta* (A. Rich.) A. Camus**	**Poaceae**					
Akouma	Anthill or termite mound	'mineral'	1	1	0	yes	100 N
Amojoi (l, fl)	*Agave sisalana* Perrine ex Engelm.	Agavaceae	1	1	0	no	100 P
Apuna (l)	*Bulbostylis pusilla* (A. Rich.) C. B. Cl. subsp congolensis (De Wild.) R. Haines	Cyperaceae	5	4	0.25	no	40 N
Cassava (l)	*Manihot esculenta* Crantz	Euphorbiaceae	1	1	0	yes	100 D
Ecorgorum (l)	Not collected	NI	1	1	0	yes	100 I
***Ecucukwa* (l)**	***Aloe tweediae* Christian**	**Asphodelaceae**	**6**	**4**	**0.4**	**yes**	**50 X**
	***Aloe dawei* A.Berger**	**Asphodelaceae**					
Edapal (l, fr)	*Opuntia cochenillifera* (L.) Mill.	Cactaceae	3	3	0	yes	33
***Edipidipi* (l, b)**	***Erythrococca bongensis* Pax**	**Euphorbiaceae**	**3**	**2**	**0.5**	**yes**	**67 I**
Edoot	**Clay or anthill like soils**	**'mineral'**	**8**	**4**	**0.57**	**yes**	**63 N**
Egigith (wp-r)	*Cissus quadrangularis* L.	Vitaceae	2	2	0	yes	50 I, ID
***Ekadolia* (l, fr)**	***Capparis tomentosa* Lam.**	**Capparaceae**	**3**	**2**	**0.5**	**yes**	**67 X**
Ekamuria (l, b)	*Carissa edulis* (Forssk.) Vahl	Apocynaceae	1	1	0	yes	100 I
***Ekapangiteng* (l, b)**	***Albizia anthelmintica* Brongn.**	**Fabaceae**	**6**	**2**	**0.8**	**yes**	**83 I**
Ekapeliman (l)	*Acacia nilotica* (L.) Del.	Fabaceae	2	1	1.0	yes	100 X
Ekara (l)	not collected	NI	1	1	0	yes	100 X
***Ekere* (l, s)**	***Harrisonia abyssinica* Oliv.**	**Rutaceae**	**5**	**3**	**0.5**	**yes**	**60 I**
Ekorete (l, fr)	*Balanites aegyptiacus* (L.) Delile	Zygophllaceae	1	1	0	yes	100 X
***Ekosimabu* (wp)**	***Loudetia superba* De Not.**	**Poaceae**	**9**	**5**	**0.5**	**no**	**43 I**
Eligoi (wp-r)	*Euphorbia tirucalli* L.	Euphorbiaceae	2	2	0	yes	50 N, X
	Cissus spp.	Vitaceae					
Elira (l, b)	*Melia azedarach* L.	Meliaceae	1	1	0	yes	100 X
Eminit (l, b)	*Acacia gerrardii* Benth.	Fabaceae	1	1	0	yes	100 X
Epederu (l, fr)	*Tamarindus indica* L.	Fabaceae	1	1	0	yes	100 X

***Epeeru* (wp-r)**	***Cassia nigricans* Vahl**	**Fabaceae**	**5**	**1**	**1.0**	**yes**	**100 I**
Epetet (l, b, fr)	*Acacia oerfota* (Forssk.) Schweinf.	Fabaceae	2	2	0	yes	50 I, J
Erogorowete (l, b)	*Capparis* spp.	Capparaceae	2	2	0	yes	50 I, X
Eteteleit (l, b)	*Acalypha fruticosa* Forssk.	Euphorbiaceae	2	2	0	yes	100 X
Etirir (l, b)	*Acacia spirocarpa* Hochst. ex A. Rich.	Fabaceae	1	1	0	yes	100 X
Ewonokori (l, b)	*Capparis* spp.	Capparaceae	2	1	1.0	yes	100 I
Eyelel (l, fr)	*Acacia drepanolobium* Harms ex B.Y.Sjöstedt	Fabaceae	1	1	0	yes	100 X
Jokpolon (l)	*Hyparrhenia* spp.	Poaceae	1	1	0	no	100 I
Khat (l)	*Catha edulis* (Vahl) S.Endlicher	Celastraceae	1	1	0	yes	100 ID
***Loletio* (l)**	***Eragrostis pilosa* (L.) P. Beauv.**	**Poaceae**	**7**	**4**	**0.5**	**no**	**57 N**
Longarwe (l, b)	*Cissus* spp.	Vitaceae	1	1	0	yes	100 I
	Synadenium grantii Hook. f.	Euphorbiaceae					
Losgirai (l)	*Amaranthus spinosus* L.	Amaranthaceae	1	1	0	yes	100 I
Mumwa (wp-r)	*Sorghum bicolor* (L.) Moench	Poaceae	1	1	0	yes	100 X
water of *Ari Ekosimabu* (l)	***Ari* = bend in the river, lined with *L. superba***	**Poaceae and 'water'**	**3**	**2**	**0.5**	**no**	**67 I**
(B)							
Bad water	non-plant	'water'	1	1	0	no	100 ID
†Bitter, smelly plants (l, b)	**not specific**	**NI**	**3**	**1**	**1.0**	**yes**	**100 X**
Burnt grass and its ashes (wp)	not specific	Poaceae	3	3	0	yes	33
Good grass and water (l)	not specific	Poaceae and 'water'	1	1	0	no	100 X
Ninya (l)	not specific	Poaceae	1	1	0	no	100 D
Sour grass near clay soil (l)	not collected	Poaceae	3	3	0	no	33
Water	non-plant	'water'	1	1	0	yes	100 I
(C)							
Fence rubbing	not specific	'mineral'	3	3	0	no	100 I
Rain standing	non-plant	'water'	1	1	0	no	100 I
Rocky soil	non-plant	'mineral'	1	1	0	no	100 I
TOTALS			**124**	**10**		**72%**	

part used = plant part used; l = leaves, b = stem bark, fr = fruit, fl = flower, r = root bark, wp-r = whole plant, wp-r = wp without roots. If the remedy is not a plant or is not ingested – this is left blank

Obs = # of observations or use citations of this self-medicating remedy by informant groups

UC = # of Usage Category 'treated' by this remedy

ICF = Informant Consensus Factor (Equation 1)

PM = medicine is also prepared for human and/or veterinary use

FL = Fidelity Level% (Equation 2). With the highest UC noted, except if FL 33% - thus three UC, where D: digestive, I: infection/infestations, ID: ill-defined, J: injury, N: nutritional, P: pregnancy/birth/peurperium, R: respiratory, S; skin diseases, X: prophylaxis

NI = not identified

† = group of 3-8 plants

Table 6-3 lists families associated with livestock self-medication, in decreasing frequency of observations. The Poaceae family was represented by 10 species, whereas Fabaceae had eight and Euphorbiaceae had five species that livestock had been observed to graze or browse when they are ill. A general category of 'mineral' was designated for geophagia (soil eating) and behaviours such as walking on rocks or rubbing against fences. This category had five remedies.

The Poaceae family also had the most observations, with 36 citations in six different usage categories. This included seven citations for EKICUYAN, a common but somewhat vague nutritional ailment described below. The Fabaceae family had 19 use reports for four usage categories, six of these reports involved internal parasites (part of infection/infestation usage category). The mineral group had 18 observations for six usage categories, including five for EKICUYAN.

Table 6-3 Families Associated with Karamojong Livestock zoopharmacognosy.

Family	# species mentioned	Obs	UC	ICF	most common UC observed
Poaceae	10	36	6	0.86	Infection
Fabaceae	8	19	4	0.83	Infection
'Mineral'[1]	5	18	6	0.71	Nutrition
Euphorbiaceae	5	8	4	0.57	Infection
Capparaceae	3	7	2	0.83	Infection
Vitaceae	3	5	4	0.25	Infection
Asphodelaceae	2	6	4	0.4	Infection
Other (13 families)	1	1	1	0	

UC= # of different usage categories 'treated' by this family
Obs = # of observations or events of particular family by informant/group
ICF =Informant Consensus Factor (Equation 1)
[1] = Mineral group was included as a common category, not as a botanical family

6.3.2 Most Commonly Observed Diseases, Processes & Disorders

Table 6-4 lists the 35 different disease conditions grouped according to usage category (Cook and Prendergast, 1995), in decreasing frequency. In order to protect Karamojong intellectual property rights, the specific medicinal applications of each plant are not given at this instance, although the most common remedy for each category is highlighted in table 4. Furthermore, the discussion will raise one example, *Albizia anthelmintica* for internal parasitism, as the plant and its use are widely distributed public knowledge and the NGO and CBO partners felt comfortable with this decision. Internal parasitism was the most common condition addressed by self-medicating behaviours. This condition was observed 13 times, with eight different self-medicating behaviours. Twelve observations each for disease prevention and health were noted, while EKICUYAN had 11 observations with eight different remedies. EKICUYAN, a culturally bound syndrome, can refer to human or veterinary disease and is described by pastoralists as heartburn or AKICWE, anthropomorphically described as 'salt-craving' or 'meat-deficiency.'

6.3.3 Usage Groups

Table 6-4 lists the usage categories in decreasing order of user citations. Infections/infestations had the most individual diseases, processes or disorders and the most user citations with 49, or 39.5% of total. Following this were the prophylaxis group with 31, 18 in nutritional disorders, and eight for milk production, which was the sole process mentioned in the pregnancy/birth/puerperium disorders category.

Table 6-4 Usage categories in decreasing order of observations (Obs), listed with individual diseases, processes and disorders (DPD) in decreasing order, number of unique self-medicating behaviours (SM) for each usage category and Informant Consensus Factor (ICF). Remedies in bold have high importance factors.

	Usage category	individual diseases, processes and disorders			Obs	SM	ICF	most common remedy
I	Infections/ infestations	Internal parasitism (13)	EBAIBAI - FMD	LOPID - anaplasmosis	48	22	0.55	***A. anthelmintica*** and ***C. nigricans***
		Tick infestation (6)	EYALIYAL ~ tetany	MALARIA fever				
		Heartwater (5)	Lice	EKORE - chest pain				
		LOKIT - ECF (4)	LOLEO - rinderpest	LOUKOI - CBPP				
		EMITINA - goat mange (3)	LOKECUMAN - black quarter	Scabies				
X	Prophylaxis	Disease prevention (12)	Health (12)	Non specific-health (7)	31	25	0.59	*A. nilotica* and ***C. tomentosa***
N	Nutritional Disorders	EKICUYAN ~'heartburn' (11)	Thin (low BCS) (5)	Anorexia (not eating)	18	8	0.2	***E. pilosa***
P	Pregnancy/Birth/ Puerperium	Milk production (8)			8	8	0	
D	Digestive System Disorders	EKITUBON - bloat	Constipation	Nausea	6	5	0.2	***L. superba***
		Diarrhoea						
ID	Ill-Defined Symptoms	Ill-defined	Lethargy	Weak calves	4	4	0	
R	Respiratory System Disorder	Coughing	Difficulty breathing		3	3	0	
S	Skin/Subcutaneous Cellular Tissue Disorders	Poor coat			3	3	0	
J	Injuries	Snake bite	Wound		2	2	0	
M	Muscular-Skeletal System Disorders	Headache			1	1	0	
	TOTALS				**124**	**50**	**0.6**	

***** = # observations (Obs) listed with individual DPD when ≥3; **SM** = # of self-medicating remedies used for usage category; **FMD** = Foot and Mouth Disease; **ECF** = East Coast Fever; **CBPP** = Contagious Bovine Pleuropneumonia; **BCS** = Body Condition Score; **ICF =** Informant Consensus Factor (~Equation 1)

$$ICF = \frac{obs - SM}{obs - 1}$$

6.3.4 Self-medication Indices:

As stated in the methods section, we estimated plant/material importance with following criteria: three use citations, ICF >0.4, FL >40% and presence of the treatment in the local pharmacopoeia.

ICF (Equation 1) was used to measure the level of consensus in individual self-medicating behaviours (Table 6-2), families (Table 6-3) and usage categories (Table 6-4, ICF = obs-SM/obs -1). Fourteen of the 50 identified self-medicating behaviours, or 30%, had an ICF >0.4. Four remedies had the highest possible ICF of 1.0. When considering remedy use at the individual ailment level, vs. the more general, grouped ailment usage level used in this study, *Albizia anthelmintica* has the highest ICF, 0.8. All but one of its observations was for internal parasitism (infections/infestations category); the other observation was under the prophylaxis category. The mineral group had an ICF of 0.71. Only two of the 10 usage categories (Table 6-4) had ICF >0.4: prophylaxis (ICF = 0.59) and infection/infestation (ICF = 0.55), whereas nutritional disorders and digestive system disorders both had low positive ICF of 0.2.

Table 6-2 shows the fidelity levels (last column) for each self-medicating remedy according to usage category. The infection category had the highest fidelity level. Not including those behaviours with only one user citation (which yields 100% FL by default); six remedies had perfect fidelity levels. There were 14 self-medicating behaviours with more than three use citations and a FL >40%.

Thirty-six of the 50 remedies, or 72%, were also used as a prepared medication by the informants to treat their animals and/or their families (Table 6-2)). Thirty-six, or 76.6%, of the 47 orally applied self-medicating remedies are also prepared medications. If the prophylaxis category is removed (in other words, counting only observations in apparently sick or weak animals), the overlap is 65.8% or 25 of 38; if we only include oral treatments, the overlap increases to 71% (25 of 35).

Table 6-2 sets the most important remedies in boldface. Four importance factors were considered, eight self-medicating remedies fulfilled all of these factors, and 12 had at least three factors.

6.3.5 Indigenous Knowledge Origin

When asked to free-list the sources of their indigenous knowledge (IK), informants identified three main sources: 1) Creator-God; 2) people, both dead and living; and 3) animals. All 12 participant groups reported receiving IK from the first two categories through dreams, visions, oral traditions, personal observation, and study of tradition. Only two informant groups noted obtaining IK from animals by observing the animals' behaviour; furthermore, it was only one or two individuals that admitted this – much to the laughter of others. From this occurrence we can assume that the results are even less than reported.

6.4 Discussion

6.4.1 Importance Factors

Although there are no universally agreed upon criteria for distinguishing self-medication (SM) from routine eating or other non-self-medicating activities, several tools have been proposed, such as evaluating plant parts bioactivities of chimpanzee diets (Krief *et al.*, 2006), Huffman's steps (Huffman and Seifu, 1989) and comparisons of what chimps eat as to what local people use medicinally (Huffman *et al.*, 1996; Krief *et al.*, 2005). The importance factors used in this paper drew on Krief *et al.*'s (2005) work comparing chimpanzees' diets with the pharmacopoeia of people throughout the world. We also relied on the field of ethnobotany, which has developed methods for studying consensus between cultures (Phillips, 1996). Any individual observation of a SM may be important and relevant to the argument that animals self-medicate. However, a SM that is reported more often (in this study, we set three use citations as an *a priori* minimum), we believe is more likely to represent a true SM. The self-medication hypothesis is further supported in this study by similarity in SM and Karamojong pharmacopoeia, >0.4 ICF, and >40%

FL. Therefore the self-medication hypothesis is especially supported by those boldfaced remedies in Table 6-2, as they fulfil the above criteria.

Our results show that most self-medicating behaviours were orally, and that most were plant-based. Both of these findings are consistent with the existing zoopharmacognosy literature (Clayton and Wolfe, 1993; Engel, 2002; Huffman, 2003; Krief *et al.*, 2005; Lozano, 1998; Negre *et al.*, 2006). Fur rubbing has also been observed in black lemurs and capuchins with millipedes, in several bird species with ants, other non-human primates with plant resins and leaves (Birkinshaw, 1999). However, in our study, the informants did not specify which tree species the livestock rubbed upon.

Small sample size is a possible limitation of this study, as it may not have been adequate to distinguish some valid self-medicating activities from background noise; therefore we set three use citations as a minimum for importance. Indeed, the sample size of this study is notably smaller than in other research involving ICF, which may involve thousands of user citations (Heinrich, 2000; Heinrich *et al.*, 1998; Trotter and Logan, 1986). On the other hand, zoopharmacognosy research has generally been anecdotal, following one animal or a small group of animals with much fewer use citations, in the range of one to 30 (Huffman and Seifu, 1989; Krief *et al.*, 2005; Wrangham and Nishida, 1983). However, due to the innovative style of this study, recording every observation supposed to be a self-medicating activity is important in that it would support the self-medication hypothesis.

One might assume that the more abundant a particular plant, the more commonly animals graze it. However, pastoralists did not remark on what their livestock typically ate, but rather what they specifically ate while visibly displaying an illness. Goats were the exception, as they routinely browse on bitter plants. Informants thought many of these remedies 'strengthened their animals and kept them from falling ill' which we etically translated to mean disease prevention, and overall health promotion. This is shown in the prophylaxis usage category which had 26 of the 50 different self-medicating remedies. This indicates that pastoralists associate more than half of their livestock's self-medicating behaviours as routine ways to enhance their health without shepherds' involvement. Prophylaxis is a difficult concept. Many of the observations appearing in this category, are those when the individual informant could not ascertain the animal's illness or why the animal they observed was acting 'queerly' or eating something that would be out-of-the-ordinary. So they in turn presumed that the animals' behaviour was to strengthen it or prevent it from falling ill. However, one might suspect that observers are anthropomorphizing: if they consider a plant to be medicinal-only or unpalatable as food, they may assume that their animals perceive it the same way and thus attribute a medicinal purpose to use by a healthy animal that may well not exist. Or, they might follow the line of reasoning, because they collect and prepare the same plant as medicine – the animal might be doing the same thing. However, Karamojong pastoralists do understand that diseases spread, from animal to animal, through vectors (animate and inanimate). They will separate and quarantine those animals that are ill, or keep their healthy animals from mingling with others they perceive as ill. They will lead their animals to certain grazing areas or natural salt-licks when the suspect illness or force-feed minerals or medicines to keep a new dam healthy or to 'strengthen' her (unpublished data).

Parasitic diseases, overall, are the most common ailment which livestock self-medicate as recognized by Karamojong pastoralists. Thirty-seven, or 29.8%, of the 124 self-medicating observations were for internal or external parasites and the diseases they transmit. This is consistent with existing zoopharmacognosy literature: the most studied plants, *Vernonia amygdalina* and *Aspilia* spp., act against internal parasites (Lozano, 1998) and parasitism is the most common ailment that has been noted in zoopharmacognosy (Engel, 2002; Huffman, 2003), additionally Clark and Mason (1985) reported on external parasites, i.e. nesting behaviour in birds. The most commonly mentioned dewormer for livestock and humans in our study was *Albizia anthelmintica*, which was also the remedy with the highest importance factors. Even using the more stringent usage level, ICF is 0.8 (i.e. internal parasitism vs. general usage category infection/infestation) and its FL (83%) was the highest for a remedy with >6 observations. FL was used to quantify importance of species for a given purpose (usage category).

The idea that pastoralists experimented with the relevant remedy as a prepared medicine is supported by the observation some respondents claimed part of their IK came from animal observation, and is further addressed with 72% self-medication to prepared medication overlap. The overlap was higher than the 36% that Krief, *et al.* (2005) found in comparing ethnobotanical uses to typical chimpanzee diets in Kibale, Uganda. Our higher levels could be that our study focused on self-medicating activities whereas their chimpanzee study examined the entire diet. Additionally, our study looked only at the local pharmacopoeia whereas theirs used a world-wide ethnobotanical database. In this instance, our higher level self-to-prepared medication overlap suggests that some of Karamoja's ethnomedicine origins were derived from animal observations.

Future objective and quantifiable research in this area should include:

a) Objective diagnosis and documentation of animals' disease condition with laboratory analysis.
b) Documentation of the frequency of behaviour that is absent or rare when healthy, such as grazing an unpalatable plant part.
c) Documentation of resolution or improvement in disease condition, through standardized observation and/or laboratory means.
d) Documentation of cessation of the unusual behaviour after improvement in symptoms.
e) Finally, reproduction of the beneficial effect in other diseased animals following administration of the relevant self-medicating behaviour.

Trained behaviourists would more objectively evaluate steps b, c, and d. Villalba *et al.* (2006) essentially performed the last step in their sheep study by proving that animals choose appropriate plants to ameliorate their illness as a learned behaviour.

Objective monitoring that is scientifically quantifiable and verifiable (steps a, c, and e), make internal parasitism attractive for further research. Much like *Aspilia* spp. and *Vernonia amygdalina* have drawn primatologists' attention (Lozano, 1998); *Albizia anthelmintica* is a particularly good candidate for further exploration of livestock pharmacognosy. In addition to its high importance factors in this study, *A. anthelmintica* has shown anthelmintic activity in several studies (Gathuma *et al.*, 2004; Githiori *et al.*, 2003; Gradé *et al.*, 2007; Koko *et al.*, 2000).

To the knowledge of the authors, this is the first time that pastoralists' wealth of knowledge has been utilized as part of self-medicating behaviour research, or that ICF and FL have been used to objectively evaluate the zoopharmacognosy hypothesis. Our results indicate that animals display multiple behaviours consistent with self-medication. There is also reason to suggest that pastoralists have developed some of their ethnopharmacological knowledge from careful animal observation. Finally, high importance species merit further investigations; identification/isolation of biologically active compounds (in particular those that are in the infection/infestations category), promotion at the local level, and perhaps drug development and primary health care.

7.

7 Building Institutions for Endogenous Development: Using Local Knowledge as a Bridge

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Abstract

In a pastoral area of northern Uganda, local institutions were supported in order to revive indigenous approaches to managing the natural resources on which pastoralists depend for their livelihoods. This was in response to elderly Karamojong assessments that their people were suffering from environmental stresses due to weakened traditional elders system and communal efforts. Participatory action research and an ethnographic framework were used to document and strengthen traditional veterinary knowledge and to encourage natural resource management through agroforestry and plant conservation. Three key outputs of this work were: strengthening of local institutions, conservation of plants and sharing of knowledge.

Figure 7-1 Bokora community involved in KACHEP's agroforestry project, supported by WFP and COU. There is hope in a tree...especially in a dry land

7.1 Introduction

Pastoral communities live in the midst of the natural resources on which they depend directly for their livelihood, with a very narrow margin of survival. They use water and grass to feed livestock; trees for medicine, food, and firewood; and wildlife to supplement their diet. When pastoralists are nomadic, environmental stress (even if extreme) is generally short-lived, because people and their livestock move elsewhere, allowing resources to recover. The constant challenge of coping with nature creates a depth of alignment in a community’s customs and habits of daily life.

This paper addresses change-agent efforts in the Karamoja semi-nomadic pastoral area in northern Uganda to relieve environmental stresses by creating infrastructure to revive indigenous approaches to natural resource management (NRM), with a focus on medicinal plants.

Karamoja’s cluster extends into Sudan, Kenya and Ethiopia. The semi-arid environment, remoteness from major urban centres, poor infrastructure and poor access to services have forced the Karamojong to rely heavily on the traditional elders’ system and indigenous knowledge (IK) for survival livelihoods.

When assessing the current situation of natural resources in their area, elders cited several problems that were not present, or were less severe, when they were young. These include: less rain, fewer water-catchment ponds and more contamination of the limited available water; diminished plant life, including fewer savannah trees; dramatically fewer wild animals; erosion; and lower soil fertility. They felt that the traditional IK system and communal efforts to manage resources had weakened. For example, local leaders used to guide teams to dig ponds for catching rainwater and to protect ponds to keep animals out. The communities had been proud of their ponds. Later, when the UN World Food Program gave money to dig or de-silt ponds, pastoralists perceived these ponds as being owned by outsiders. Local people sometimes even refused to clean their ponds unless paid. In an effort to help ‘modernise’ the culture, outsiders did not recognise traditional leadership structures and did not deal with Karamojong leaders directly. Communities were divided between looking to their traditional leaders or taking money from external players; and outside money trumped tradition.

Elderly pastoralists recalled a clan of women, the Ngiyepan, who protected trees in various ways, such as by enforcing conservation-related taboos through song, dance, drama and stories. As a group, they were persuasive verbally and sometimes even physically. It is unclear why they are no longer active, although people still remember some Ngiyepan songs.

During interviews, Karamojong were hard-pressed to recall any positive innovations that had come from outside during their lifetime or that of their parents. They could remember that there were more trees and more peace, that they did not have many cows but the food was enough, that colonists had built dams in the valleys but only one is still functional, that many boreholes were made but there was more water and food before that. They also recalled the strength of culture and respect they had for their parents and elders.

They perceived two more recent external innovations – automatic weapons and forced schooling – as having caused much damage to their culture and, thus, to their way of managing natural resources. AK-47s (Kalashnikov rifles) turbo-charged an existing self-destructive element in the culture, while both ‘innovations’ encouraged pastoralists to become more sedentary. Fear and insecurity caused people to band together in larger groups, where schools commonly were built. This increased pressure on already scarce resources in certain areas, while vegetation flourished in uninhabited areas within a days’ journey from the settlements. The school system also led people to look outside of their own ‘culture-box’ for new answers to the same problems. Elders saw tradition and schooling as mutually exclusive options.

In endogenous development, people seek a balance between modern and traditional practices. It is a collaborative process for local institutional development that involves a careful blending of internal with some external processes (e.g. ‘modern’ schooling with the traditional system).

One potential bridge to this process is the institution of traditional healers. Karamojong pastoralists are proud of their knowledge of how to use local plants. One elder explained that, even though Karamoja does not have 'powerful hospitals, the limited access to "modern medicines" has allowed us to greatly utilise our ancestor's medicine.' Because the Karamojong depend on cattle for both subsistence and cultural pride, one of the most important forms of IK is ethnoveterinary knowledge (EVK): the local knowledge, skills, practices and beliefs about the care of livestock (McCorkle, 1986). This includes various different treatments: store-bought, homemade, prescribed and/or prepared by traditional healers, mainly from plant extracts.

This EVK needs to be conserved, because it is threatened by the pull toward modernity, yet modern medicines are almost entirely out of the pastoralists' reach. Therefore, our goal was to help conserve and revive this knowledge by helping the pastoralists set up their own local organisations – e.g. non-governmental organisations (NGOs) and community-based organisations (CBOs) – and encourage documentation and practice of EVK as well as NRM through agroforestry and plant conservation.

7.1.1 From studying ethnoveterinary knowledge to forming an NGO

In 1998, a project was launched by the Bokora Livestock Initiative (BoLI), a cooperation of three NGOs working with livestock-keepers in Bokora County of Moroto District: Lutheran World Federation, Church of Uganda's Livestock Extension Programme and Christian International Peace Service. These organisations agreed to harmonise their veterinary services to fill gaps in Bokora's limited veterinary infrastructure. One joint BoLI activity was 'training of trainers' workshops for Community Animal Health Workers (CAHWs) facilitated by the international agency, Christian Veterinary Mission (CVM). BoLI mandated a study of local EVK in order to integrate this with introduced veterinary practices within the CAHW training (Gradé and Shean, 1998).

To strengthen EVK infrastructure, a participatory action research (PAR) approach and an ethnographic framework were used. PAR is 'research which involves all relevant parties in actively examining together current action (which they experience as problematic) in order to change and improve it. PAR is not just research which is hoped will be followed by action. It is action which is researched, changed and re-researched, within the research process by participants' (Wadsworth, 1998). Specific methods used included direct observation, semi-structured interviews, scoring and ranking, participatory field trials, exchange visits and 'free-listing' (Martin, 1995). The methods were continually readjusted in response to participant input in identifying problems and solutions in joint experimentation, as all learned together how to strengthen EVK.

During the study of EVK, the first author began training community members in documenting IK using a modelling framework created by CVM (Shean, pers. comm.). Livestock diseases, their prevention and treatments were documented through group discussions involving community members and BoLI staff. Staff were trained in ethnoveterinary surveys covering: formal and local name of disease, species of animal treated, name of treatment, description of medication, method of treatment (preparation, administration and dosage), pharmacological rationale and efficacy. BoLI extension workers identified pastoral communities and traditional healers to be contacted.

From these group discussions, active community members with obvious knowledge and commitment (traditional healers) were selected by BoLI staff. The first author confirmed these selections in one-on-one interviews. These community members – both men and women – were then involved in focus-group discussions, together with BoLI staff, to identify priority medicines to promote and to brainstorm on how to form a network of livestock healers. The initial plan was only to make an EVK database and hand it over to BoLI for the CAHW training programme. However, during the PAR process, the healers initiated monthly meetings and recruited new members. The first author, impressed by the depth and breadth of the healers' knowledge, also became more emotionally involved with the pastoralists' concerns and eager to cooperate in seeking solutions.

After finalising the BoLI document, two young Karamojong men, who had secondary level education and were freshly trained in documenting EVK, joined the first author to go to the neighbouring county, Pian, to compare their EVK with that of Bokora. The same PAR process was followed, bolstered by the lessons learned in Bokora. In addition to sharing and comparing EVK in Bokora and Pian, we invited livestock healers and

NGOs to discuss ways to disseminate the most confidently used EVK within their communities.

With renewed Karamojong interest in EVK and its dissemination, the first author’s work in Karamoja continued. What was to be a six-week programme continued without a distinct end, just with a desire to be part of the healers’ PAR cycle. When the supervisory international NGO, World Concern Africa, opted to leave Uganda in 2002, the staff – which included pastoral community members – decided to form an indigenous NGO to continue EVK development.

7.1.2 From EVK to agroforestry

A natural extension of EVK in a damaged environment is medicinal plant agroforestry. The healers’ associations selected particular plants for domestication and multiplication based on several factors, primarily their confidence in the plants’ medicinal efficacy. Confidence levels were established through ranking, scoring and defining ‘best bets’ (Martin, 1995). They also assessed whether the disease treated was common in Karamoja and whether therefore the plant would have potential economic benefit for disease control. They gave high priority to multipurpose plants. For example, one plant selected provides medicine for three diseases (one as a best bet, i.e. highest-ranking plant), fodder for livestock, food for people during hunger periods, and highly valued wood for construction and making charcoal. The species were then evaluated for their economic value for the local market. Low threat of biopiracy was another factor used in selection, e.g. if synthetic medicines were available for the disease for which a plant is used, that plant was considered ‘safer’ or less likely to be exploited. All of the above factors were used to rank a long ‘free-list’ of plants.

An additional key activity was to develop medical-product micro-enterprises using local EVK. This involved multiplying the species in production orchards.

7.2 Three key outputs of the PAR

7.2.1 Institutions built

Within the course of ethnographic action research, four organisations with a common mission to preserve, promote and protect EVK were formed and registered at national level: Bokora Traditional Livestock Healers Association (BTLHA), Pian Traditional Livestock Healers Association (PTLHA), Karamoja Ethnoveterinary Information Network (KEVIN) and Karamoja Christian Ethnoveterinary Programme (KACHEP). The first two are CBOs; the third is a consortium of government, NGOs and CBOs; whereas the fourth is an NGO.

A group of 12 male Bokora healers, which became the BTLHA, first gathered in mid-1998 as a focus group when EVK in Bokora was being catalogued. The Pian group (PTHLA) first gathered in the kraals (mobile cattle camps) in February 2000, when Bokora and Pian EVK were being compared. Since 2001, both associations have been setting their own schedules for meetings, at least quarterly, and both are registered in Uganda. Both were created with the aim that Karamoja would utilise their natural resources and EVK for sustainable development and poverty reduction.

The BTLHA has grown from the original 12 men to 50 subscribed members. After Pian healers first met, the ten core healers continued to meet with EVK project staff and other KEVIN members, at rotating locations, either near one of their *manyattas* or near the kraals, depending on the season. Pian membership grew to 22, then dropped slightly, but then expanded to 44 over the last two years. Initially, members were only elderly men but, as the association grew, younger men and women became interested and were invited to join. By 2007, over 92 association workshops have been held in Karamoja. Membership in BTLHA and PTLHA is open to livestock healers living in Bokora and Pian, respectively. Other individuals and organisations that share the associations' mission may also subscribe. The associations have elections for executive members, who in turn run their meetings, frequently inviting an external member to teach on a specific topic.

At association workshops, members from different communities take turns teaching and learning. They discuss cases they have treated (both failures and successes) in order to share new information and gain advice from other members. They are then able to pass on this information to their family and neighbours. The livestock healers promote the best practices with their direct contacts at household level and continue to experiment with EVK. Other activities of the associations include agroforestry and micro-enterprise, adding value through medicine extraction, packaging and distribution.

The network (KEVIN) originated from a three-day EVK-sharing workshop held in Pian in July 2000, which brought together regional stakeholders who shared case studies and best practices for livestock husbandry, disease prevention and disease cure. A unique feature of this workshop was that participants paid for it, making it ‘locally-owned’. At most gatherings of this type in Uganda, the organiser not only pays for transportation, lodging, food and training materials, but also provides per diems (also called allowances or ‘motivation’). This practice was introduced during the colonial era to ‘encourage’ attendance and is reinforced by NGOs and government agencies to this day throughout Africa. KEVIN’s formation created a forum for continuous sharing of ways to preserve, promote and protect EVK in Karamoja.

KEVIN members operate in four of the five Karamojong districts (a different group, the Labwor, who currently focus less on cattle, inhabit the fifth district). Membership is open to all government agencies and NGOs in Karamoja that are involved in any aspect of livestock management. Members include District Veterinary Officers and Veterinary Officers from Moroto and Nakapiripirit, as well as ten local NGOs and CBOs. Four member NGOs have agroforestry schemes, two are involved in EVK research and development, and four incorporate EVK in their CAHW training.

KEVIN is a conduit for disseminating EVK through extension workers who originate from, live in and work throughout Karamoja. The network empowers each stakeholder organisation to use the collective information to integrate IK into agriculture and livestock training at community and household level and to encourage adoption of a variety of innovations developed by the Karamoja healers.

KACHEP was registered in Uganda as a local NGO in June 2004, having grown out of the collaborative EVK project funded through CVM. The project was initially managed by the first author, but KACHEP is now run by a core staff of her former assistants, all of whom are local people. It seeks to preserve, promote and protect EVK in Karamoja through research and development as well as building the capacity of the livestock healers' associations. It is the key liaison agency that identifies EVK users and innovators and links them with interested organisations.

7.2.2 Plants conserved

One component of EVK preservation is documentation and conservation of the medicinal plants. As mentioned above, there used to be a clan of women, Ngiyepan, who protected trees. According to Nalem Rose, a Pian healer: 'When these women were active, we had plenty of rain and the tall [tree] shrines were well cared for'. Tree planting is not otherwise a part of Karamojong culture. The healers' associations, however, now promote agroforestry and protection of medicinal plant species. Their agroforestry scheme has focused on domestication of 32 tree species, 24 of which are indigenous (Table 7-1). The species were selected by livestock healers and other community members, based on their confidence that the plant effectively treats endemic livestock diseases and the importance of these diseases to the local economy. They identified internal and external parasites as key problems. Purchased medicines are not regularly available in these remote and resource-poor areas; therefore, plants with pesticidal qualities were given high priority, alongside plants used for treating wounds, snake bites and retained placentas.

Exotic fruit trees – custard apple, guava, papaya and pomegranate – were chosen because they are drought-resistant and have been cultivated in Karamoja for at least 50 years at Christian missions. In addition to its edible fruits, papaya is also used for medicinal purposes. Four of the medicinal plants domesticated by the Karamojong also provide valued edible fruits. Three medicinal trees – neem (from India), fish bean or *Tephrosia vogelii* (from Zambia) and *Moringa oleifera* (from Arabia and India) – are not indigenous, but have long been domesticated in Karamoja.

More than 70 healers' communities are involved in efforts to conserve medicinal trees through agroforestry schemes. Additionally, they teach family members and neighbours about conservation and sustainable harvesting techniques. Many make thick fences from thornbush branches to protect crops from wild animals and raiders. As a result of the efforts of the healers' associations, 50 communities now have living fences around their homes and/or medicinal gardens. These fencing plants are medicinal, fruit-producing and/or protective. Live fences reduce the cutting of thornbush and help protect against sun and wind. Also, 40 communities have established 0.5–1 ha woodlots, each with 60–200 trees of 15–25 different species of slow-growing indigenous medicinal trees, and 45 communities have backyard medicinal gardens with at least 12 indigenous and two exotic medicinal species. At least 12 communities have prepared nursery beds of medicinal, fruit and general-purpose tree seedlings. According to KACHEP's 2005 field report, more than 100,000 medicinal, fruit and live-fencing trees are growing around the 70 local-healer communities in Pian and Bokora.

Photo 7-1 EKORETE fruits or NGIMONGO, the Egyptian date palm, *Balanites aegyptiacus*. Children remove the hard case and eat it like a sweet, mothers pound the inner nut (ABALIT) and cook it as a hunger food, as well as their hardy leaves. Pastoralists use its sap to heal painful eyes and the surfactant from its leaves to kill guini worm in their hand dug ponds. Other parts are employed against muscle and joint pain diarrhoea, stomach pain, heartwater, mosquito control. Its wood is prized for stools, spear shaft and charcaol. It is a highly prized tree, yet had not previosly been cultivated or protected.

Table 7-1 Plant species in agroforestry schemes in Karamoja

EYELEL	*Acacia drepanolobium* Harms ex B.Y. Sjöstedt	*EKALIE*	*Grewia mollis* Juss.
EMINIT	*Acacia gerrardii* Benth.	*EPONGAE*	*Grewia villosa* Willd.
EWALONGOR	*Acacia sieberiana* DC.	*EKERE*	*Harrisonia abyssinica* Oliv.
EKADOKODOI	*Acacia senegal* Willd.	*ELIGOI*	*Kleinia odora* DC.
EYELEL	*Acacia seyal* Delile.	MORINGA	*Moringa oleifera* Lam.
EKWAKWA	*Albizia amara* Boivin	EBUTO	*Neorautanenia mitis* (A.Rich.) Verdc.
EKAPANGITENG	*Albizia anthelmintica* Brongn.	*EDAPAL*	*Opuntia cochenillifera* (L.) Mill.
ECUCUKWA	*Aloe* spp.	*EPAPAI*	*Piliostigma thonningii* (Schumach.) Milne-Redh.
Custard apple	*Annona* spp.	Guava	*Psidium guajava* L.
NEEM	*Azadirachta indica* A. Juss.	Pomegranate	*Punica granatum* L.
EKORETE	*Balanites aegyptiacus* Delile	*ABUKUT*	*Sansieveria* spp.
EKADOLIA	*Capparis tomentosa* Lam.	*ELAMORU*	*Steganotaenia araliacea* Hochst.
Papaya	*Carica papaya* L.	*LOKILE*	*Synadenium grantii* Hook. f.
EKADELI	*Commiphora abyssinica* Engl.	*EPEDERU*	*Tamarindus indica* L.
Kei apple	*Dovyalis caffra* (Hook. f & Harv.) Warb.	FISHBIN	*Tephrosia vogelii* Hook. f.
JERIMAN	*Euphorbia bongensis* Kotschy & Peyr.	*ABWACH*	*Warburgia ugandensis* Sprague

7.2.3 Knowledge shared

Four primary schools have created EVK clubs and established medicinal plant demonstration gardens on the school grounds. These clubs and gardens have encouraged preservation and promotion of IK in surrounding communities.

Photo 7-2 Boy sucking on NIGMONGO (*B. aegyptiacus* fruit); great to chase away hunger pains.

At least once a year since 2000, the BTHLA and PTHLA come together for a joint healers' workshop. Two exchange visits have taken place: 28 Karamojong went to southwest Uganda in the Ankole pastoralists' cattle corridor, and 12 healers and project staff visited Samburu and Turkana healers in Kenya. The Kenyan healers later attended a Karamojong joint healers' workshop organised by KACHEP. In the words of Dengel Lino, a livestock healer from Bokora: 'We used to share food and knowledge only with our family, but now I feel comfortable sharing with other healers from Pian and Kenya. It has helped me with my cattle'. The focus on sharing knowledge extends to association members sharing with other healers in their community, NGOs and neighbours. Peace has been an unintended consequence of these meetings, but is a critical component of development.

The healers' associations decided to focus on agroforestry schemes and the prevention of endemic diseases, mainly of cattle. Significant endemic diseases originate from internal and external parasites. For example, anaplasmosis, East Coast fever, babesiosis, and heartwater are all common and serious tick-borne diseases in the area. Unfortunately, allopathic medicines are rarely locally available, commonly mishandled and often ineffective against tick-borne diseases, even if administered properly. Therefore, the focus is on prevention rather than cure.

It was once common practice to remove ticks by hand, but this was all but abandoned after the colonial government constructed cattle dips with modern acaracides. A few problems resulted from this well-meaning introduced technology: limited resources to buy drugs led to increased strain on already inadequate finances; when acaracides are used properly, tick load is heavily reduced, leading to decreased resistance to tick-related diseases; and there have been some accidental poisonings of people.

Healers advocate keeping tickload at minimal levels, and recognising and treating tick-borne diseases early, before the blood parasites infiltrate the entire circulatory system. Karamojong keep tickloads low by reverting to removing ticks from animals by hand daily or with regular use of plant-based dips or, more rarely, commercial products. Pian had been using one plant to treat against ticks, Bokora another and Turkana a third. Since all three plants are found in each area, they now have greatly increased availability of effective botanical medicines, allowing for more regular treatments. Before the healers' sharing network, it would have been virtually unheard of for these groups to exchange knowledge with one another. It is rare even today, but with adopters in the ranks of the networks, they spread the other group's knowledge to their own neighbours, and all the pastoralists benefit.

7.3 Impact of sharing knowledge

Many tangible benefits, including self-sufficiency, have been realised through knowledge sharing. In the words of 28-year-old Pian healer Augustino: 'Our cows' milk yield has increased and people are eating a more balanced diet from the cows' milk, our new fruits and Moringa leaves, ever since our *manyatta* put up a backyard pharmacy'.

There have also been less tangible benefits. Regular meetings between healers from groups that are often at war have helped to improve, at least to some extent, relationships between groups. For example, in 2001, Loduk Joachim, a Pian traditional healer, escaped being shot at close range when an opposing Bokora warrior recognised him as a healer who had earlier taught him about a remedy that cured his prize bull.

An additional intangible, but vitally important, benefit of the promotion of EVK has been increased respect from both within and outside the culture for the knowledge of the traditional healers. A medical student said his teachers used to mock the slow students by telling them: ‘Don’t be like the Karamojong and get left behind!’ Now, a non-Karamojong teacher based in Bokora said: ‘I never thought the Karamojong knew so much. Now I use their EVK for my poultry and have taught my family about some of their treatments.’

7.4 Conclusions

7.4.1 Increased conservation

With the growth of a viable EVK network in Karamoja, local attention to nature conservation is increasing. Communities have planted their own trees, after handpicking the best seeds. At least four workshops take place each year to share knowledge about conservation and harvesting techniques. Twenty-four indigenous tree species have been domesticated and over 100,000 trees planted. Thousands of seedlings are growing in members’ nurseries to be planted during the wet season. Also outside the network, there is increased interest in indigenous tree species such as gum arabic, shea butter and amarula. This shows progress toward the objective of the four EVK organisations: preservation of medicinal trees.

7.4.2 Increased sharing

Whereas in the past this would never even have been considered, now inroads have been made toward open discussion between those formally educated and those not, between Pian and Bokora schoolchildren and their parents, and even with communities outside of

Karamoja and Uganda. Over 92 workshops have been held. This contributes to fulfilling the objective of protecting and promoting EVK.

7.4.3 Increased interest in EVK

Membership in the healers' associations has grown from 12 in 1998 to 94 in 2006. Also school children are keen to learn about EVK. All livestock NGOs in Karamoja are members of KEVIN. The high interest was evident in 2000, when individuals and organisations not only attended but also paid for Karamoja's first EVK workshop. The sharing within and between healers' associations has brought about institutional change. In the past, knowledge about healing animals was shared only with close friends and neighbours. Now the blanket of hospitality is spread more widely. Sharing of EVK has increased the number of people using it, which means that more medicinal plants are grown, protected and used.

7.4.4 Increased trust and security

Knowledge sharing is multiplied at monthly and annual gatherings, when healers from as many as five tribes share case stories and learn from each other. This sharing leads to greater respect among the local people, also the youth, for their culture and for one another. Gathering to share knowledge necessarily involves sharing food, water, firewood and other resources. In the Karamoja culture, after two people have shared a meal, they are like kin and cannot harm one another. This leads to decreased fighting, raiding and ambushing. More peace leads to more sharing, and the virtuous cycle continues. Therefore, encouraging EVK and increasing medicinal plant availability benefits not just the livestock, but also the people who depend on them. The sharing has encouraged dialogue between antagonistic groups, within families, clans and tribes and even across borders. Strengthening local institutions that address NRM may thus produce peace as a by-product. Further analysis could increase understanding of how bringing people together to share EVK can lead to increased trust and security.

The success may be due partly to the fact that it has been an endogenous movement (from within) rather than exogenous (initiated or led from outside). Since indigenous people have led the processes from day one, they have developed the skills and local capacity to continue without help from outside.

Acknowledgements

To the traditional livestock healers and other keepers of knowledge in Karamoja.

Photo 7-3 Lokure Joseph, Vice chairman of the Pian Traditional Healers' Association demonstrates how to treat a goat kid with Abukut as other healers observe at a training. The best way to learn is "see one, do one teach one". Especially in an oral culture where few people read or write.

8.

8 Embracing Ethnoveterinary Knowledge Diffusion in Karamoja: a Strategy to Strengthen

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Abstract

The Karamojong, semi-nomadic pastoralists found in northeastern Uganda, rely chiefly on traditional knowledge for their health and that of their prized livestock. There have been external efforts to introduce allopathic medicines with varying success and poor sustainability. Most have advocated reducing local medicine practices to welcome modernity, arguing that Karamoja is backwards. Others prefer embracing traditional knowledge systems to the region's advantage, bolstered by external resources to fill obvious gaps. We believe it is important to preserve, promote and protect Karamoja's traditional knowledge. We applied a knowledge, attitude and practices (KAP) survey to measure ethnoveterinary knowledge (EVK) as one of the steps to investigate ways to prevent EVK from fading and, as a by-product, use this EVK to strengthen the society studied. The KAP survey measured knowledge of local remedies and livestock diseases in three different communities in Karamoja. The first one, (Nabilatuk), is where registered healers regularly meet and afterwards, typically share their ideas with neighbours. The second (Lorengedwat), where those interviewed may have interacted with Nabilatuk community members and the third (Kaabong), where those interviewed have had virtually no chance to interact with members of the previous two communities. From May to June, 2007, 180 people were interviewed, evenly divided across gender, age and location lines. There were two sets of questionnaires, remedies and diseases; which included 16 remedies and 12 different livestock diseases, respectively. The distance from the healers' association significantly influenced the overall EVK score. Indeed, we found that EVK was higher in Nabilatuk than the others, and Lorengedwat was likewise higher than Kaabong. Their knowledge was evident for remedies': identification; knowledge of use – for both animal and human needs; growth habits, availability, conservation and harvesting; and recent actual use of the remedies in question. Furthermore, informants from Nabilatuk, on a whole, consistently received higher scores on each question on the disease questionnaire as compared to the others. This was evident in disease: symptomology, treatment and prevention; causality; epidemiology with both animal and zoonotic potential. They also appear to have more recently treated these diseases and therefore seem more confident and experienced in treating them. All these results indicate that the healers of Nabilatuk have been effective at sharing their EVK and promoting its

diffusion. These results support the working hypothesis that knowledge will not disappear if it is used and communicated through both traditional and introduced networks. This may help spare the Karamojong pastoralists from a ‘cultural limbo’ or deculturation stage that many cultures have experienced as modernity fractures and disrupts cultural systems and ecosystems. This may enable a more smooth transition to Karamoja’s inevitable change to the next socio-cultural way of life in conjunction to the modern context.

Key words: ethnoveterinary knowledge, KAP survey, pastoralist, EM, Knowledge diffusion

8.1 Introduction

The Karamojong, semi-nomadic pastoralists found in isolated north-eastern Uganda, rely chiefly on traditional knowledge both for their health and maintaining their prized livestock (Gradé *et al.*, 2007). There have been efforts to introduce conventional western medicine practices with varying success, as the latter are typically prone to poor sustainability. Most have advocated discouraging local medicine practices in order to depend on pharmaceuticals, arguing that Karamoja is backwards (Muhereza and Otim, 2002). Furthermore, there have been efforts to dissuade pastoralists from their traditional lifestyle, endorsing a more settled and less bovi-centric way-of-life (Dyson-Hudson *et al.*, 1998; Mandani, 1986; Quam, 1978). This has been the case with increasing government and non-government infrastructure, social services and schools in the region, that are, however still lagging behind the rest of pre and post-colonial Uganda.

Karamojong identified their IK sources as threefold: Creator-God, people (both living and dead), and from animal observation (Gradé *et al.*, 2008a). Transmission of medicinal plant knowledge can be conveyed vertically through the family model, horizontally by exchange through peers, or diagonally through traditional healers (TH) to student learners (Ladio and Lozada, 2001; Philander *et al.*, 2008). Historically, pastoralists have always shared their indigenous knowledge (IK) within their family structure by word of mouth and by directly teaching the youth. This has waned as children increasingly attend formal school. There, they are influenced by teachers and the scholastic system that drives them to adopt a different lifestyle, no longer linked to cattle keeping. Through these seemingly well-meaning interactions, many times in a boarding school environment, the youth disassociate themselves from their ancestral IK systems. This unintended consequence further discourages elders from interacting with 'perceived' stubborn and disinterested youth. Schools, by their very nature, take much of the time that was once available for pastoral cultures to engage in long periods of repetitive activities and imparting stories that constitute traditional Karamojong participatory learning methods. Therefore youth, exposed to formal school, no longer feel as much need and duty or even have adequate time available for patient elders to expose, teach and mentor these youth in such traditional, participatory formats as livestock care.

One educational approach has diverged from the typical Ugandan approach. Alternative-based Education Karamoja (ABEK) adjusts its school hours, locations and curriculum to better fit the pastoral lifestyle of Karamoja (Pailwar and Mahajan, 2005). Others, outside of primary education realm, likewise advocate embracing the traditional culture and lifestyle, and use it to the region's advantage, bolstered by external resources to fill obvious gaps. We believe it is important to preserve, promote and protect Karamoja's traditional knowledge for a variety of reasons. One of the latter is to equip people with appropriate coping tools to brace them in endogenous ways as they (and subsequent generations) stretch between modern and traditional culture. Especially, as they struggle in choosing between varying mixtures of changing cultural norms and habits, morals, attitudes and confidences. Cultural pride and also endogenous development coping mechanisms may help guide and protect them through this cross-cultural transition to a blended way of life so that the inevitable approach of modernity does not fracture their cultural identity. This fracture occurs when persons are unable to identify themselves as fully Karamojong and thus experience a 'cultural limbo', divorced (or at least separated) from their past yet not part of another, more modern or worldly culture, truly stuck between and stretched out into uncertainty.

As one of the steps to investigate ways to prevent ethnoveterinary knowledge (EVK) from fading and, as a by-product, use this EVK to strengthen the (studied) society, we measured EVK of remedies and disease in three different communities in Karamoja. We followed the 'knowledge and attitude' methodology of Somnasang and Moreno-Black (2000).

Initial phases of the research included documentation and dissemination of EVK through indigenous/endogenous and exogenous information networks. These pipelines are conduits to actively encourage EVK use for the communities, also used by partner organisations. During the documentation phase of this EVK research and development programme, a few innovative traditional healers two community-based organisations (CBOs) now registered at the national level (see CHAPTER VII). These CBO's, known as Pian Traditional Livestock Healers Association (TLHA) and Bokora TLHA, respectively, serve as examples of endogenous EVK networks. These associations increase the social (horizontal) networks of knowledge transmission and perhaps vertical, too, since youth and wives gather at THLA workshops to listen and watch. Increase social contacts will increase diffusion (Rogers, 1995).

The aim of this study was to compare EVK knowledge in three study sites as a first step to investigate how well TLHA-promoted/stimulated EVK has diffused in Karamoja, to show that it is being used in community groups and to support the hypothesis that if the oral history and veterinary knowledge is written down, validated and used in community groups, it will not disappear. We attempted to do this by surveying people in areas where EVK has (and *has not*) been written down, used and validated within TLHAs. That is, where registered healers live and or visit vs. areas where they do not live. The first study site, Nabilatuk, is one of the areas where registered Pian traditional livestock healers regularly meet with one another and subsequently share these topics with their family and neighbours. The second, Lorengedwat, where those interviewed may have interacted with Nabilatuk community members and the third, Kaabong, where those interviewed have had virtually no chance to interact with members of the previous two communities.

The objectives of this study are to score EVK knowledge expressed as a total score from questionnaires based on selected traditional remedies and common livestock diseases, and then to (1) see how these score varies between study sites; (2) to differentiate between the score for animal use and the score for human use; (3) to differentiate between indigenous and introduced plants remedies; and then finally within this subset (4) to distinguished any knowledge differences between newly introduced and well-established plants.

8.2 Materials and Methods

8.2.1 Study site

Karamoja region, 28,000 km^2, is located between 1˚30' to 4˚N by 33˚30' to 35˚E in northeastern Uganda. The present study was specifically conducted around three target areas: study site A – Nabilatuk, 2°03' N by 34°33' E; site B – Lorengedwat, 2°23' N by 34°35' E; and site C – Kaabong, 3°30'N by 34°09'E (Figure 8-1). These areas fall within the Karamoja Region climatic zone characterized by semi-arid to arid agroecology environment with an intense hot and dry season (November to March) (Inangolet *et al.*, 2008). There is a single rainy season, with peaks in May and July. Average annual rainfall is in the range of 100 mm to 625 mm (Kamanyire, 2000). Daily temperatures average 30-35˚ C. Vegetation is flat grassland with a few scattered thorn bushes and trees, except along the seasonal rivers, where thickets and sporadic forests occur. The plains, that average 1400 m in elevation and slope to the west, are punctuated by a triangle of three extinct >3000 m volcanoes each about 100 km apart from another (Gradé in press).

Thomas (1943) described the vegetation of Karamoja as consisting of associations of *Acacia-Combretum-Terminalia* woodland species, with a grass layer of *Hyparrhenia, Setaria, Themeda, Chrysopogon* and *Sporobolus* species.

Karamoja consists of five administrative districts; which are further divided into counties, sub-counties, parishes and finally smaller units called Local Council One (LC1) areas, composed of villages, locally named "manyattas" or NGIERE . Counties are commonly named after the dominant ethnic group inhabitants. Total population is around 935,000 (Uganda Bureau of Statistics, 2002) consisting of five distinct Nilotic peoples in the plains and two small Kuliak groups found on the mountains (Gulliver, 1952). The people known as the Karamojong belong to many ethnic groups. Karamojong is used as a generic term for the dominant plains people of Karamoja, i.e. Dodoth, Jie, and Karimojong. The Karimojong are further divided into Pian, Matheniko and Bokora ethnic groups. Each of the people group names have a meaning; Dodoth refers to ‘cattle colostrum’; Jie means ‘fighters’; Karimojong means ‘elders’, and refers to the story that while moving in pursuit of settlement land, the elders got tired and remained behind and some even died there, while the youth and energetic moved on. All the Karamojong share the transhumant pastoral lifestyle and ritual but they rarely interact with other clans due to tribal warfare (Gradé, *et al*., 2008a)

This study focused on three different sites (A, B and C) found within two districts; Nakapiripirit and Kaabong districts, respectively (see map, Figure 8-2). The first two sites are found in Pian county, Nakapiripirit; A is found in Nabilatuk sub-county, specifically Kosike parish (3 manyattas) and Moru-angibuin parish, (one manyatta), whereas B is found in Lorengedwat sub-county specifically Nasinyonoit parish (3 manyattas) and Kamaturu parish (2 manyattas). Site C is in the newly-formed Dodoth county, Kaabong rural sub-county and covers six parishes. All study sites are within a moderate walking distance from a small town, Nabilatuk, Lorengedwat and Kaabong, respectively. Site A and B people are from the Karimojong people group, more specifically Pian ethnic group; people at site C are Dodoth. None of the sites chosen are in direct conflict with another; however, they do not interact as their territories and the buffer zones between them are laced with insecurity, wide areas of uninhabited loneliness and rare transport opportunities.

The three study sites are similar in that they have minimal access to conventional western medicine compared to the rest of Uganda. For animal health, there are two NGOs teaching and treating with western medicines in the area; one is represented both in Nabilatuk and Lorengedwat whereas another is stationed in Nabilatuk. In 2006, a district veterinary officer (DVO) was assigned to Kaabong town, the district headquarters. Other than this recent change 6 months before the survey, each study site is more than two hours away from their respective DVO. Concerning primary human health care, Kaabong has a hospital, Nabilatuk has a health centre and Lorengedwat has a simple clinic connected to the Catholic Church. All these health posts, however, have staff, equipment and medicine shortages.

Site A is the base study site, from which we will test our hypothesis. This is also the place where some of the registered and active traditional healers (THs) live. Although some of those interviewed are THs, the majority of informants are not registered healers, yet all, save a few students are pastoralists. We assume that those interviewed in A would have had a high chance to interact with THs and/or their families.

The agro–ecology is similar between the three sites with some small differences. For example, rains and subsequent growing season at site C lags two months behind that of its counterparts. However, all plants and diseases that we asked about were commonly found near all three sites.

8.2.2 Methods

From May – June, 2007, we interviewed a total of 180 people, evenly divided across age, location and gender lines. The informants' socio-economic and demographic parameters were also noted. This included age, gender, clan, age-set (see Dyson-Hudson, 1966), village, parish, subcounty, and outward economic signs i.e. lack or quality/quantity of clothes, shoes or adornments.

We used a pre-tested knowledge, attitude and practices (KAP) survey on registered healers from both Bokora and Pian TLHA's (Somnasang and Moreno-Black, 2000). The KAP had two sets of questionnaires, remedies and diseases; consisting of 16 remedies and 12 different livestock diseases, respectively. These were selected from long list that healers had actively shared at their regular association meetings (KACHEP project report, 2005). The 16 remedies included 13 indigenous plants, one local mineral and two introduced plant species. All of the 12 livestock ailments are common throughout Karamoja. Four THs from both the Pian and Bokora associations served to pre-test the KAP survey. Thirty people were then randomly selected in each study site (A, B and C) for each of the two question sets, and also had about 1-3 extra informants in case of any data errors.

A total of four people acted as interviewers – the primary author performed the first five interviews while assistants observed. After this training, interview teams went out by twos – one to interview (in Ngakarimojong) and write in English, and an assistant to write answers in vernacular. Assistants were people living in the area: the LC1 leader, extension workers or traditional healers. One of the student interviewers asked questions in English whereas the assistant translated. All other interviews, therefore, were conducted in Ngakarimojong and followed a word-for-word format to decrease variability. Answers were written in both languages (English and vernacular) so that the primary author could meticulously analyse the answers. These texts were scored according to a created answer sheet, devised according to informant answers, key healers' feedback, TLHA partner NGO (KACHEP) lesson plans with guidance from Makerere University (Kampala, Uganda) Botany and Statistics departments (personal communication with third author). This shaped a scoring format to tabulate answers into a raw score. Scores were as follows: 0 if no knowledge, 1 if some knowledge and 2 if high knowledge. Later, scores were converted to 0 or 1 to have binomial variables 'no knowledge' and 'knowledge' for analyses (see analysis section and Somnasang and Moreno-Black, 2000).

The first KAP survey question was identification. For identification of remedies, laminated photographs were shown for each of the 15 plants, whereas for the 16th, a local mineral, an actual, real sample was shown (Somnasang and Moreno-Black, 2000; Thomas *et al.*, 2007). Informants were able to handle all materials while deliberating their answer. If they correctly identified it within a short time, their score was 2. If they took more time or if they initially guessed incorrectly, but eventually answered correctly - they received one point. The same scores were assigned if they used a synonymous name for a remedy. This was especially true for study cite C, in that the Dodoth language is different from that of Pian. If correspondents did not correctly identify the remedy (zero score), the interviewer revealed the correct answer so that they could still answer subsequent questions relating to the remedy (see below). For disease identification, informants were told the name of the disease and then asked to describe its symptoms, the same scoring ensued.

Figure 8-1 Survey of plant identification with laminated photos in Kaabong.

In addition to remedy identification, the KAP survey scored informants on their knowledge of use – for both animal and human needs; plant growth habits, availability, conservation and harvesting, and recent actual use (6 month, >1 year or never) and confidence of the particular remedies.

Furthermore, the questions relating to disease KAP included: disease symptomology (identification), treatment and prevention; causality; epidemiology with both animal and zoonotic potential; recent actual treatment (*any* treatment) and the difficulty to cure ill livestock with the particular disease.

We tabulated overall remedy score and disease score for each individual to form the informant's 'knowledge scores' (SK) according to Somnasang and Moreno-Black (2000). The latter were then summed up within each study site so that SK could be compared from site to site and to test the hypothesis that level of knowledge varies with distance from active, registered traditional healers' homes.

Some remedies were separated out from the SK to discern between those plant species that were indigenous vs. those introduced. We assume that introduced plants should be affected by diffusion of previous trainings and/or effectiveness of those trained to share with others, with the further assumption that the next generation of listeners would adopt the knowledge.

We applied a combination of tools to analyse the data. To assess whether knowledge differed between sites, we used generalized linear models (GENMOD procedure in SAS, (SAS Institute Inc., 2003) with score as the response variable and "sites" as the explanatory variable. We used two separate models for "remedies" and for "diseases". The variable "site" was entered as a categorical variable with three levels (corresponding to the three study sites) while the score was considered continuous. The score variable was not normally distributed for both models, even after several logarithmic transformations. Since our data had several "zeros" and were all integers, we fitted a Poisson distribution to our models with a log link.

8.2.3 Analysis

Generalized linear models were also used in order to compare people's knowledge of native (12 plants and one mineral) and introduced species between the three sites. Furthermore, we compared different sites' knowledge between the two introduced species i.e. recently introduced *Moringa oleifera* Lam. (Moringaceae) and well-established and domesticated, but not native - *Azadirachta indica* A. Juss. (Meliaceae).

To compare the score for animal use (a measure of "ethno-veterinary knowledge"; EV) to the score for people's use (a measure of "ethno-medical knowledge"; EM), we generated contingency tables (Tables 8-1 and 8-2) and performed tests of two proportions both between sites and within sites. To test proportion we utilised Pearson's chi-square test and, when the expected counts of cells <5, then Fisher's exact test was applied. Fisher's is a statistical significance test used in the analysis of categorical data where sample sizes are small, whereas chi-square is used of N is large. Additionally, Fisher's was used because the data were slightly unbalanced. All analyses were performed in SAS (SAS Institute Inc., 2003) with the level of significance set at 5%.

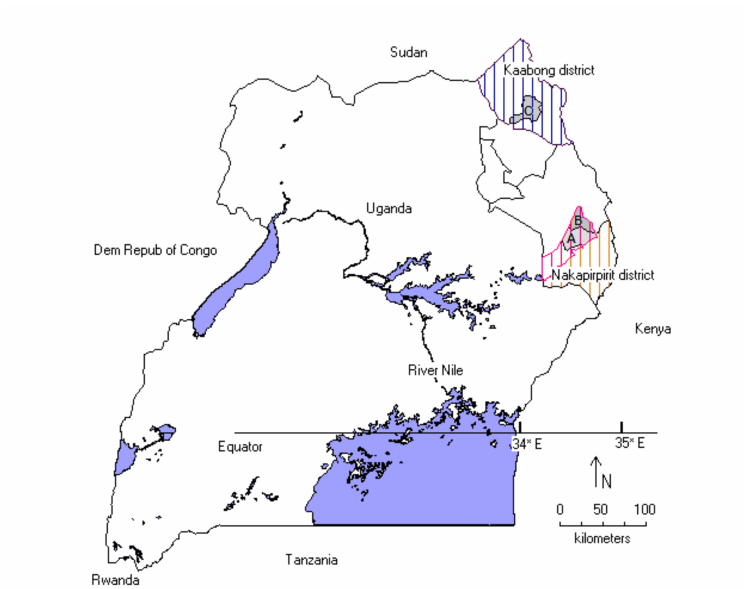

Figure 8-2 Map of study sites in Karamoja region, Uganda. Nakapiripirit district, Pian county, Nabilatuk and Lorengedwat sub-counties (A and B sites, respectively), and Kaabong district, Dodoth county, Kaabong Rural sub-county (site C). Map designed by primary author with DIVA.

8.3 Results

8.3.1 Knowledge diffusion based on total scores

We found that knowledge measured by the total score varied significantly between study sites for both "diseases" and "remedies" as their total scores were significantly higher in at least one of the sites (see Figure 8-2). For disease, the score was higher in site A than in both site B (χ^2 = 3.81, df=1, P=0.05) and site C (χ^2 = 58.07, df=1, P<0.001), and higher in site B than in site C (χ^2 = 32.20, df=1, P<0.001). Similar results were obtained for remedies, i.e. the score was higher in site A than in both site B (χ^2 = 31.67, df=1, *P*<0.001) and site C (χ^2 = 95.19, df=1, *P*<0.001), and higher in site B than in site C (χ^2 = 16.52, df=1, *P*<0.001). So for both "diseases" and "remedies", total score site A > total score in site B > total score in site C (Figure 8-2).

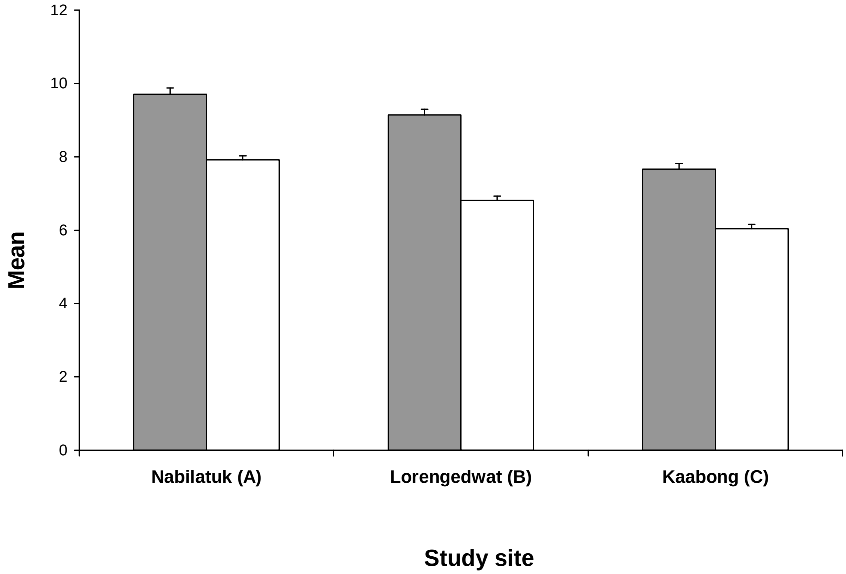

Figure 8-3 Pastoralists' indigenous knowledge levels (mean ± SE) in relation to their total disease score (dark bar) and total remedy score (open bar) for different study sites. Means are reported on normal scale for illustration purpose (analyses were performed on log scale).

8.3.2 Remedies' ethnoveterinary use versus ethnomedicine use

Table 8-1 and 8-2 display the knowledge scores of the same remedies for use in either livestock (EV, Table 8-1) or people (EM, Table 8-2). The data is pooled into binomial variables ("no knowledge" vs. "knowledge"), allowing us to compare the proportion using the test of two binomial proportions between sites, but also EV vs. EM within a site. We found that knowledge scores for remedies' use in livestock also varied with site: EV score was higher in site A than in both site B (Fisher exact test; z=-6.15, *P*<0.001) and site C (z=-16.10, *P*<0.001), and higher in site B than in site C (z=-9.28, *P*<0.001).

EM was higher in site A than in site C (z=-5.7, *P*<0.001, and in site B than in site C (z=-5.52, *P*<0.001), but was not different between site AS and site B (z=-0.1, *P*=0.9). Overall, EV in site A> EV in site B > EV in site C, while the pattern was somewhat different for EM (EM in site A= EM in B > EM in site C.

Table 8-1 Respondents' opinion or knowledge (proportion in brackets) on remedies use in animals in the three study sites

study site	no knowledge	knowledge	Total n
A	42 (8.2%)	465 (91.8%)	507
B	106 (22.2%)	372 (77.8%)	478
C	245 (49.5)	250 (50.5%)	495

Table 8-2 Respondents' opinion or knowledge (proportion in brackets) on remedies use for people in the three study sites

study site	no knowledge	knowledge	Total n
A	129 (25%)	378 (75%)	507
B	123 (25.7%)	355 (74.3%)	478
C	209 (42.2%)	286 (57.8%)	495

We also compared both EV and EM scores within study sites. We found EV score to be higher in site A than EM score (Fisher exact test; z=-7.5, *P*<0.001), EV score was lower in site C than EM score (z=2.3, *P*=0.021), whereas there was no difference between EV score and EM score in site B (z=-1.29, *P*=0.19). Our results show that the likelihood that people in site A would have no knowledge of EV is 8% more probable than an answer of knowledge, but 25% for EM. Interestingly, study site C appears to have lower EV than EM knowledge (42.2% vs. 49.5 %); however these correspondents have less overall EV and EM in comparison with other study sites. In summary, site A had far greater knowledge on remedies' use in animals than for the same plants' use in people, site B likewise had more EV than EM but not as marked as site B. However, site C informants scored higher on people's use than livestock use-knowledge for the same remedies. Thus, we have the pattern: A - EV>>EM, B - EV>EM and C - EV<EM.

8.3.3 Knowledge scores of indigenous versus introduced plant species

We compared knowledge scores within each study site for exotic plants vs. the indigenous treatments, and found there were no differences (all $P>0.05$). However, exotic plant knowledge scores alone, as well as indigenous plant knowledge varied significantly between study sites. Indeed, the exotic species score was much higher in site A than in site C (χ^2 = 95.51, df=1, $P<0.001$) and also higher than in site B (χ^2 = 0.146, df=1, $P<0.001$). Similarly, site B scored higher than site C (χ^2 = 0.134, df=1, $P<0.001$), thus score in site A> score in site B> score in site C for knowledge about exotic plant species.

On the other hand, the indigenous remedies' scores were significantly higher in site A than in both site B (χ^2 = 4.47, df=1, $P=0.035$) and site C (χ^2 = 5.60, df=1, $P=0.018$). However, there was no significant difference between site B and site C ($P>0.05$), thus, score in site A> score in site B = score in site C.

8.3.4 Long term versus recently introduced plant knowledge

Results showed that distance (a measure of the difference between sites) had no effect on the well-established and domesticated *Azadirachta indica* ($P>0.05$). Thus, knowledge score in site A= score in site B = score in site C. However, distance did have an affect upon knowledge scores of the more recently introduced *Moringa oleifera* ($P<0.001$). Study site A had significantly more knowledge than both sites B (χ^2 = 9.98, df=1, $P=0.002$) and C (χ^2 = 4.52, df=1, $P=0.033$). There were no significant differences between study site B and C's knowledge levels for *Moringa oleifera* ($P>0.05$); again, knowledge score in site A > score in site B = score in site C.

8.4 Discussion

Results of the 180 Karamojong interviewed, show that the distance from the healers' association significantly influenced overall EVK score. Indeed, we found that EVK was higher in Nabilatuk than in the other locations, whereas Lorengedwat likewise scored better than Kaabong. Distance is globally significant and distance is correlated to knowledge.

Results show that study site A, near Nabilatuk, base of the Pian TLHA, had significantly higher scores for each query on the remedy questionnaire set. This means that this site's correspondents had more knowledge related to certain aspects of the selected remedies, including: remedies' identification; knowledge of use – for both animal and human needs; plants' growth habits, availability, conservation and harvesting; and recent actual use of the remedies questioned, as well as a self-assessment of their confidence in using the remedy in question.

Furthermore, informants from site A, on a whole, consistently scored higher on each question in the disease questionnaire. Their aptitude was evidenced in disease symptomology, treatment and prevention; causality; epidemiology with both animal and zoonotic potential knowledge. They also appear to have more recently treated these diseases and therefore seem more confident and experienced in treating them. Additionally, their confidence self-assessment was higher (as part of the scores in Figure 8-2).

This goes along with the hypothesis that social variables are important in determining medicinal plant knowledge (Vandebroek *et al.*, 2004b). Specifically, the healing tradition of the extensive family, and in Nabilatuk, TLHA further stimulate exchange through THLA extensive family, similar to a healers network in Bolivia, where Andes communities tested higher knowledge than a more floristic and remote Amazonian community that did not have a semi-formal healers' network (Vandebroek *et al.*, 2004a).

Communities located close to active registered TH manyattas have higher knowledge related to exotic plant remedies than areas distant from their homes. This is evidenced in that site A scored higher than people from B and/or C (Figure 8-2). Interestingly, ethnomedical (EM) remedy use scores do not significantly differ between sites A and B. Additionally, site C, though lower than A and B, had basically the same level of knowledge on EV as on EM (table 1 and 2, 0.495 and 0.422), and actually had more EM than EV. We can use ethnomedicine knowledge scores as a baseline control. Treatment of human diseases was not the focus of the organised TH workshops; therefore the means or pipeline of diffusion –the traditional healers' relationships - has not been stimulated by the THLA to promote EM. If we assume that *before* associations were organised, the knowledge levels for local medicines of both EV and EM within sites (A, B and C) were roughly the same, we would expect EV (and overall EVK score) would increase initially at A (due to THs sharing) and then that knowledge would diffuse to B and then eventually to C. We could also assume that, since THLA primarily share about livestock disease, as opposed to human health, EM would not dramatically increase in A and subsequently B. We could further assume, since they have only been meeting for six years, their EVK diffusion has not yet reached site C so we would expect that their EM and EV would be unchanged from the base-line date and that EM and EV would basically be even (same scores). Based on these findings, we can make a preliminary conclusion in favour of these assumptions contingent on future empirical findings. That is the healers of Nabilatuk have shared their EVK effectively and encouraged its diffusion.

We could also look at the knowledge level differences between native and introduced plant remedies. In this case, there is no difference within any of the sites. However, comparing site to site, there are differences in both types of remedies, with A (still) being the most knowledgeable. For introduced remedy knowledge, A had much more knowledge than C and was also higher than B to a certain extent. For indigenous plant knowledge, B and C held no difference, although both were less than A. Similarly, when we examine knowledge levels based on the relative recently introduced moringa, B and C held no difference, although both scored less than A. Interestingly, there were no differences between the three sites for the well-established and naturalised neem tree (*Azadirachta indica*). These results could mean that the THLA have been effective in teaching their neighbours, but this knowledge has not yet effectively diffused out to B and C. It appears since neem has been around for long, and has been promoted through missions and NGOs, that pastoralists throughout the study sites have high and even knowledge levels on its uses – for both animal and human needs; plant identification; growth habits, availability, conservation and harvesting; and recent actual use of neem. We assume that, 50 years ago, when neem was first introduced to the area, planted at Christian missions and around Muslim mosques, and later in major towns (Moroto and Kotido), neem knowledge levels would have initially been extremely low. From the missions to district headquarters, where today we can see well-established trees, neem has thrived in Karamoja's dry environment. However, because it must be planted, watered and cared for (except for saplings under a well-established mother tree), it is extremely rare to see this tree in the manyattas. Interestingly, we did see a number of young neem trees growing at a few manyattas in and near study site A – the work of TLHA hands.

Total knowledge score clearly shows that A>B. This indicates that THs, through their workshops and personal contacts, have been effective at locally sharing and this knowledge has diffused to B. This suggestion is confirmed (or strengthened) in that C's knowledge scored much less. Community members from A and B can interact with one another – but these opportunities are somewhat limited. Perhaps the most common face-to-face scenario would be at the kraals (migratory cattle camps) and some rare market interactions. Much of the diffusion probably occurred through close interpersonal contacts which has been the way that news has and continues to filter through this oral (pre-literate) culture.

Partnerships with local NGOs and TLHA in documenting Karamojong EVK introduce additional ways to help keep EVK alive and to spread it farther. Furthermore, facilitating and encouraging regular TLHA meetings value-adds to an endogenous way to stimulate EVK promotion. Community members from C and A will not interact in the current socio-culture framework, indeed, they probably will not interact until a few generations after 'development covers Karamoja' but there is a danger that this EVK will be lost. If they no longer actively use EVK, it falls into disuse, or becomes adulterated with mixtures of other knowledge systems. Currently, if A and C community members interact

–it is outside of the indigenous pastoral Karamojong culture and therefore, extremely rare. It would be, for example, politicians or school boys – who most probably would already have shunned their ancestral knowledge or culture for ‘modern-western’ ways and therefore would not be the conduits of EVK dissemination.

If the pipelines work – information should not only pass through it, there should be some adopters, that is, people should be knowledgeable and actively using the knowledge that has been shared in different areas. Because B>C – we can assume that the indigenous pipeline is working – and it is through this conduit that the information passed from A to B, and eventually could carry it to C. Furthermore – the endogenous pipeline of TLHAs and local NGOs could help to carry it, together with as the recently available written documentation.

8.5 Conclusions

All these results indicate that the healers of Nabilatuk have shared their EVK effectively and encouraged its diffusion in the studied areas. These results support the working hypothesis that knowledge will not disappear if it is used and communicated (orally, practically and written) through all available networks - indigenous, endogenous and exogenous. This may help spare the Karamojong pastoralists from a future ‘cultural limbo’ stage, that many cultures have experienced as modernity disrupts both people and land, thus enabling a more smooth transition into the next cultural identity era in which Karamoja reaches a sustainable independent way of living in conjunction to the modern context. Written EVK documentation should be locally available to be appropriately used in school, and by THLA, NGO and GO networks.

9.

9 General conclusions and recommendations

9.1 General conclusions

This written body of research has both detailed Karamoja's oral history and veterinary knowledge and also validated the pastoralists' knowledge through scientific research. It has both substantiated and strengthened this knowledge and has opened more avenues for further validation through publication in international peer-reviewed journals and symposiums.

The central hypothesis of this thesis is that if Karamoja's oral history and veterinary knowledge is written down, validated through scientific field trials and used in community development work, it will not disappear. It could even be used to strengthen their society, to prevent them from entering a cultural limbo and help them with their cross-cultural transition as the world around them dramatically changes.

The first two chapters of this work surveyed current knowledge on the existing ethnoveterinary knowledge in a marginalized pastoral area in northeastern Uganda. There has never been a published report on EVK in the study area, in Karamoja or the entire (socio-cultural) Karamojong cluster which extends into southeast Sudan, northwest Kenya, and southwest Ethiopia. Further, there were no published ethnobotanical records for the 11 tribes in Karamoja at the time of this writing. The most recent vegetation surveys whose data were available at the beginning of this study are those of Thomas (1943) and Wilson (1962).

Chapters three and six showed that this ethnoveterinary study, in a previously unstudied area and with a little documented population still living in a traditional way, has helped add to the growing body of knowledge about useful plants in Uganda. More specifically, it has added useful plant knowledge about the Karamoja cluster, where other closely-related ethnic groups still practice a transhumant lifestyle. The pastoralists of south and central Karamoja have a great quantity of knowledge and a variety of plants to choose from to satisfy their subsistence needs and to cater for their livestock healthcare needs. Many of the plants in this inventory have not been documented before at all and/or for the uses recorded here. The results of these studies were published as original research articles (Gradé *et al.*, 2008a; Gradé *et al.*, submitted) and will be highlighted below and detailed within the content of this thesis.

Chapter four illustrated a case study on a field trial that tested a traditional medicine, i.e. *Albizia anthelmintica* Brongn., against an allopathic dewormer under field conditions. The EVK treatment proved to be effective at levels that are consistent with the veterinary pharmaceutical standards for novel treatment. Therefore, Karamojong EVK holds potential for developing sustainable local resource-based and integrated livestock management plans not only in the study area, but also in other developing countries. The results of these studies were published in Gradé *et al.* (2007, 2008b).

The wisdom of not only the pastoralists, but also the 'intuition' of their livestock was assessed in chapters four and five, where the hypothesis that animals self-medicate was investigated, by using a combination of veterinary, ethnobotanical and indigenous techniques. As a result, we showed that livestock and more in particular goats indeed self-medicate. It was also shown there is reason to suggest that some ethnomedicine knowledge has originated from careful animal observation. To our knowledge, this was the first time these techniques were combined in zoopharmacognosy, and one of the few studies ever to investigate livestock self-medication. The results of these studies were published as original research articles in Gradé *et al.* (2007, 2008c).

Chapter six brought in details of ethnographic action research and aspects of local capacity development we did in Karamoja. The results show that with growth of a viable EVK network in Karamoja, local attention to nature conservation has increased. Furthermore, it was shown that encouraging EVK and increasing medicinal plant availability benefits not just the livestock, but also the people who depend on them. The sharing has stimulated dialogue between antagonistic groups, within families, clans and tribes and even across borders. Strengthening local institutions that address EVK and natural resource management may thus produce peace as a by-product. Further analysis could increase understanding of how bringing people together to share EVK can lead to increased trust and security (Gradé *et al.*, 2008a).

Furthermore, chapter seven, concerning IK diffusion, indicates EVK is more commonly known and used in community groups where healers have actively shared it. These results indicate the healers of Nabilatuk have shared their EVK effectively and have encouraged its diffusion in the studied areas. These results support the working hypothesis that knowledge will not disappear if it is used and communicated (orally, practically and written) through all available networks - indigenous, endogenous and exogenous. This may help spare the Karamojong pastoralists from a future 'cultural limbo' stage that many cultures have experienced as modernity disrupts both the people and land. Further, it may enable a smoother transition into the next cultural identity era in which Karamoja reaches a sustainable independent way of living in conjunction to the modern context. Written EVK documentation should be locally available for appropriate use in schools and by THLA, NGO and GO networks (Gradé *et al.* in prep).

9.2 Recommendations for further research

There are several gaps in our understanding of the ethnoveterinary knowledge of Karamoja, and of the Karimojong ethnic group specifically. Research, therefore is needed for different linguistic aspects of the remedies used, traditional medicine product development, indigenous organization capacity building and also on sustainable and appropriate ways for local involvement in protection of biodiversity.

We recommend that every community development program should have an EVK survey as initial and integral part of its core methodology and approach. Furthermore, EVK should be integrated into community animal health care worker (CAHW) programs, into school curricula – both ABEK (alternative based education Karamoja) and conventional schools, NGOs and GOs should be not only sensitive to EVK, but should also promote, preserve and protect the unique Karamojong aspects of it. Formats should be created to bring together local and external techniques and their experts in order to cross-pollinate and strengthen animal health in the region. This might be used as a model for the rest of the Karamojong cluster and other pastoral areas. In fact, this EVK research should be copied and expanded to other parts of Karamoja.

Further research should focus on more validation and standardization of EVK revealed in this thesis. Specifically, we recommend that dewormer and external parasitic treatments be positively exploited. Market potential of *Albizia anthelmintica* should be investigated; this should be followed with research to put this product into a saleable reproducible form for promotion within Karamoja and neighbouring communities.

Additionally, new vegetation studies should be undertaken in Karamoja as well as the first human ethnobotanical studies, specifically on diseases and also on hunger foods. A pre-literate EVK book should be produced, based on this dissertation for community, CAHW and local NGO use.

Further investigations into appropriate sustainability and practical conservation of the remedies should be undertaken. This will aid in the endeavour to preserve, promote and protect the EVK of Karamoja. This will also aid endeavours in peace-making and building bridges across periods of cultural limbo. Both these last deserve investigations of their own. EVK is at the heart of Karamojong culture. Efforts to preserve, promote and protect it will benefit the entire culture.

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APPENDIX

APPENDICES I - IV

Appendix I - Plants EVK date base

See legend at the end of table

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
Abrus precatorius L., Fabaceae, JTG-371	**ESIDONGOROR**	H; W, I	ear ache, **AYEYE**	S	powder in ears	T
Abutilon hirtum (Lam.) Sweet, Malvaceae, JTG-021	**EKWANGA**	H; W, I	retained placenta, **ANGASEP**	B	water extract	T
Acacia abyssinica Hochst. ex Benth., Fabaceae	**EMINIT**	S; W, I	lumpy skin disease, **LONARU**	B	water extract	B, P
				B, R	water extract with *Tagetes minuta* whole plant, topically	P
				B	water extract with *Steganotaenia araliacea* leaves and roots	P
			snake bite, **AKONYET KE EMUN**	B	water extract; water extract with *Steganotaenia araliacea* leaves and roots and EKEREYE (ni010) roots; water extract with *Capparis fascicularis* bark and roots	B
				B	water extract with *Steganotaenia araliacea* bark	B, P
Acacia albida Del., Fabaceae, JTG-372	**EDUROKOIT**	T; W, I	fodder, **AKIMUJ NGIBAREN**	F	direct	B
Acacia brevispica Harms, Fabaceae, JTG-282	**EKUNGARIT**	T; W, I	fodder, **AKIMUJ NGIBAREN**	wp	direct	P
Acacia drepanolobium B.Y. Sjöstedt, Fabaceae, JTG-051, JTG-461	**EYELEL**	S; W, I	diarrhoea, **AKIURUT**	R	water extract	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			lumpy skin disease, **LONARU**	B, L	water extract	B
			rinderpest, **LOLEO**	B	water extract	B
			snake bite, **AKONYET KE EMUN**	B, L	water extract	B, P
Acacia gerrardii Benth., Fabaceae, JTG-310	**EKIPELIMAN**	T; W, I	cough, **ARAKUM**	B	water extract	B
Acacia macrothyrsa Harms, Fabaceae, JTG-464	**ARATOM**	T; W, I	Lokilala tetany, **EYALIYAL**	B, L	water extract	P
			lumpy skin disease, **LONARU**	B, L	water extract	T
			skin disease with intestinal adhesions, **LONGOLESIKE**	B, L	water extract	T
Acacia mellifera (Vahl) Benth. ssp. *mellifera*, Fabaceae	**EREGAE**	S; W, I	otitis secondary to biting ticks, **EKONYIT**	B	water extract	T
Acacia mellifera (Vahl) Benth., Fabaceae, JTG-039	**EREGAE**	S; W, I	rinderpest, **LOLEO**	B	water extract	B
Acacia nilotica (L.) Delile, Fabaceae, JTG-365	**EKAPELIMAN**	T; W, I	pneumonia, **AWALA**	B	water extract	T
			fodder, **AKIMUJ NGIBAREN**	F, L	direct	B
Acacia oerfota (Forssk.) Schweinf., Fabaceae, JTG-019, JTG--030	**EPETET**	S; W, I	pneumonia, **AWALA**	B	water extract	T
			rinderpest, **LOLEO**	B	water extract	B
			trypanosomiases, **EDIIT**	R	water extract	B
Acacia senegal (L.) Willd., Fabaceae, JTG-366, JTG-408	**EKODIOKODOI**	T; W, I	delivery pain, **ASIYEC**	B	water extract	B
			fodder, **AKIMUJ NGIBAREN**	F, L	direct	B
			post partum pain, **AKIYEC**	B, R	water extract	B, M, P
Acacia seyal Delile. Fabaceae, JTG-402, JTG-403	**EYELEL**	S; W, I	diarrhoea, **AKIURUT**	R	water extract	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			lumpy skin disease, **LONARU**	B, L	water extract	P
Acacia spirocarpa Hochst. ex A. Rich., Fabaceae	**ETIRIR**	T; W, I	abscess, **ABUS**	L	water extract	B, M, P
Acacia tortilis (Forssk.) Hayne, Fabaceae, JTG-367, JTG-368	**ETIR or EWOI**	T; W, I	fodder, **AKIMUJ NGIBAREN**	F, L	direct	B
			abscess, **ABUS**	L	decoction, topically; poultice with butter	B
			fodder, **AKIMUJ NGIBAREN**	F	direct	B
Acacia sp., Fabaceae, JTG-002	**EWALONGOR**	T; W, I	goat pox, **ETOM**	F	water extract with *Ocimum basilicum* whole plant & cow's manure	B
			low milk production, **EURICIANA**	F, L	water extract	B
			retained placenta, **ANGASEP**	B	water extract	B
Acacia sp. f. *A. elatior* Brenan, Fabaceae, JTG-052	**EMINIT**	T; W, I	rinderpest, **LOLEO**	B	water extract	B
Acalypha fruticosa Forssk., Euphorbiaceae	**ETETELEIT**	S; W, I	pneumonia, **AWALA**	R	water extract	T
			bloody calf diarrhoea, **AREMOR KA NGAKOT**	R	water extract with *Kigelia africana* roots	P
Achyranthes aspera L., Amaranthaceae, JTG-330	**LOKIRIKETA**	H; W, I	ceremony, **ITIC AKIRIKET**	wp	ritual	P
Acmella caulirhiza Delile, Asteraceae, JTG-441	**ESAA**	H; W, I	pneumonia, **AWALA**	R	water extract	B, M, P
Adenium obesum (Forssk.) Roem. & Schult., Apocynaceae, JTG-364	**ELEMU**	S; W, I	mange, **EMITINA**	B	poultice	T
Agave sp., Agavaceae, JTG-272	**AMOJO**	H; W, I	ropes, **AUNO**	L	pound leaf fiber, separate and form into braided rope	B
Agave sisalana Perrine ex Engelm., Agavaceae	**AMOJOI**	H; W, I	self-med	L	animal self-medicate orally	P

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
Albizia amara (Roxb.) Boivin. ssp. *sericocephala* (Benth.) Brenan, Fabaceae	**EKWAKWA**	T; W, I	**abscess, ABUS**	L	poultice	B
			chronic wound, **ETOKU**	L	oil poultice	P, T
			mange, **EMITINA**	L	oil extraction, topically	B, P
			hoof disease, if severe - the digits may fall off, **LOMOKERE**	L	oil poultice	P
			maggots, **NGIKUR KE KWAN**	L	water extract with *Leonitis nepetifolia* leaves	B
			otitis with pus, often ticks, **LOMID**	L	oil poultice	B
			ticks, **NGIMADANG**	L	oil poultice	B
			wounds, **AJOME**	L	oil extraction	B
Albizia anthelmintica Brongn., Fabaceae, JTG-019	**EKAPANGITENG**	T; W, I	bloat and cough, **EKITUBON KA AWALA**	B	water extract	B, P
			intestinal parasites, **NGIKUR**	B	water extract	B
				L	direct	P
				R	water extract	P
			rinderpest, **LOLEO**	B, R	water extract	B, P
Albizia coriaria Welw. ex Oliv., Fabaceae, JTG-447	**ECAILAIT**	T; W, I	barren cow, **ATENGINA EKOLUPANA**	B	water extract	B
			pneumonia, **AWALA**	B	water extract	P
			increase fertility, **AKIDORE**	B	water extract	T
			fever, **IYALAARA**	B	water extract	B
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	B	water extract	P
Albizia zygia (DC) J.F. Macbr., Fabaceae, JTG-437	**ETARAMATOKIE NI**	T; W, I	eyes painful red, **ARIBO AKONGU**	B	powder in eye	P
			lice, **NGILAC**	B	water extract	B
			mange, **EMITINA**	B	poultice	T

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Allium cepa L., Alliaceae	**EKITUNGURU**	S; W, T	anaplasmosis, **LOPID**	R	water extract with **EUPET** (ni025), sediment rock (CaCO3), salt & ampicillin	P
Aloe dawei A.Berger, Asphodelaceae, JTG-107	**ECUCUKA**	H; W, I	anaplasmosis, **LOPID**	L	water extract	B
			fly repellent, **AKIRIT NGICUC**	exudate	poultice	B
Aloe tweediae Christian, Asphodelaceae, JTG-412	**ECUCUKA**	H; W, I	anaplasmosis, **LOPID**	exudate	water extract	B
			fever, **IYALAARA**	L	juice	T
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	exudate	water extract	T
			wounds, **AJOME**	exudate	juice topically	T
Aloe sp. 1, Asphodelaceae, JTG-059	**ECUCUKA**	H; W, I	east coast fever, **LOKIT**	L	water extract	B, M, P
			Lokilala tetany, **EYALIYAL**	L	water extract	P
Aloe sp. 2, Asphodelaceae, JTG-121	**ECUCUKA**	H; W, I	contagious bovine/caprine pleuropneumonia, **LOUKOI**	L	water extract	B
Aloe sp. 3, Asphodelaceae, JTG-139	**ECUCUKA**	H; W, I	fever, **IYALAARA**	L	water extract	B
Amaranthus spinosus L., Amarathaceae	**LOSGIRAI**	H; W, I	self-med	L	animal self-medicate orally	B, P
Anthericum subpetiolatum Bak., Agavaceae, JTG-348	**NGIKACEKIYIM**	H; W, I	fodder, **AKIMUJ NGIBAREN**	R	direct	B
Aeollanthus sp., Lamiaceae, JTG-421	**LOTUKO**	H; W, I	trypanosomiases, **EDIIT**	R	water extract	B
			diarrhoea, **AKIURUT**	R	water extract	T
Asparagus africanus Lam., Asparagaceae, JTG-316	**ESIKARAKIRU**	H; W, I	stops the rains, **AKITOWO AKIRU**	L	ritual	P
Asparagus racemosus Willd., Asparagaceae, JTG-440	**ESIKARAKIRU**	H; W, I	chases rain away, **AKIRIT AKIRU**	wp	ritual	P
			genital diseases, **ANGAC**	R	water extract	B, M, P
			hydrocoel, **AAKUYE**	R	water extract, oral and topical	T

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			swollen testis, **AKWE**	R	water extract, oral and topical	P
Aspilia mossambicensis (Oliv.) Wild, Asteraceae, JTG-015	**EKUYON**	H; W, I	anaplasmosis, **LOPID**	F, R	water extract with *Solanum* spp. fruits	B
			east coast fever, **LOKIT**	R	water extract with *Solanum incanum* fruits	B
Azadirachta indica A. Juss., Meliaceae	**EMITULAYA**	T; SW, I	chicken mites, **APINGAC**	S	poultice with seed cake	P
			eye problem, **NGAKONYEN**	B, L, R	water extract	B, P
			fever, **IYALAARA**	B, L, R	water extract	T
				B	decoction	B
			fleas, **NGIKADESIDES**	F	grind seeds to extract oil, apply topically (goat kids)	B, P
			genital diseases, **ANGAC**	B, L, R	water extract	P
			mange, **EMITINA**	F	grind seeds to extract oil, apply topically	B
			mosquito control, **AKIRETAKIN NGITHIRU**	F	grind seeds to extract oil, apply topically	N
			ringworm, **AKESIT**	F	grind seeds to extract oil, apply topically	B
			wounds, **AJOME**	F	grind seeds to extract oil, apply topically	B, P
Balanites aegyptiacus (L.) Del., Zygophyllaceae, JTG-014, JTG-034, JTG-369	**EKORETE**	T; W, I	blind, eye turns blue, **EMUDURU**	exudate	powdered sap, in eye	B
			diarrhoea, **AKIURUT**	B, R	water extract	B
			eye problem, **NGAKONYEN**	exudate	powdered sap, in eye	B
				F	fruits mixed with ashes of *Kigelia africana* leaves, in eye	B
			eyes painful red, **ARIBO AKONGU**	exudate	powdered sap, in eye	B

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			fodder, **AKIMUJ NGIBAREN**	L	direct	B
			joint/bone pain, **LOKOYETA**	B, R	water extract	T
			heartwater, **LOKOU**	exudate	make slurry with powdered sap, apply topically and orally	P
			mosquito control, **AKIRETAKIN NGITHIRU**	L	leaves fall into pond, forming a soapy substance to suffocate larvae	B
			muscle pain, **NGAMORI LOKOYATA**	B	water extract	B
			spear shaft, **AMOROK AKWARA**	branch		P
			stomach pain, **AKOOK**	B	water extract, oral or enema	B
Balanites orbicularis Sprague, Zygophyllaceae, JTG-060	**EJOJOR**	T; W, I	otitis with pus, often ticks, **LOMID**	L	paste in ear	T
Balanites rotundifolius (Tiegh.) Blatt., Zygophyllaceae, JTG-061	**EBEI**	T; W, I	otitis with pus, often ticks, **LOMID**	L	paste in ear	T
Barleria acanthoides Vahl, Acanthaceae, JTG-390	**EMEKUI**	H; W, I	fattens donkey, **ITUMI NGIKOODO**	L	direct	T
Bidens pilosa L., Asteraceae, JTG-443	**LOMOSIKIN**	H; W, I	eyes painful red, **ARIBO AKONGU**	R	paste in eye	B
			fresh wounds, **AJOME**	L	poultice	B, M, P
Bothriochloa insculpta (A. Rich.) A. Camus	**AKAWOO**	H; W, I	self-med	L	animal self-medicate orally	P
Brachiaria brizantha (Hochst. ex A. Rich.) Stapf, Poaceae, JTG-381	**ELET (A)**	H; W, I	fodder, **AKIMUJ NGIBAREN**	wp	direct	B
Bridelia micriantha (Hochst.) Baill., Phyllanthaceae, JTG-325	**EBOLOBOLOT**	T; W, I	retained placenta, **ANGASEP**	B	water extract	B
Bridelia scleroneura Müll. Arg., Phyllanthiaceae, JTG-444, JTG-475	**EKWANAKALIE**	T; W, I	retained placenta, **ANGASEP**	B	water extract	B

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Bulbostylis pusilla (Hochst. ex A. Rich.) C.B. Clarke, Cyperaceae, JTG-264	**APUNA**	H; W, I	fodder, **AKIMUJ NGIBAREN**	wp	direct	P
Butyrospermum paradoxum (C.F. Gaertn) Hepper, Sapotaceae, JTG-417, JTG-448	**EKUNGARIT**	T; W, I	constipation, **EGWEE**	F	extract oil from seeds	B, P
			diarrhoea, **AKIURUT**	B	water extract	T
			mange, **EMITINA**	S	extract oil from seeds, topically	B, M, P
			stomach pain, **AKOOK**	B	water extract	B, M, P
Cadaba farinosa Forssk., Capparaceae, JTG-260	**ERERENG**	H; W, I	prevent wizard from attacking animals, **AKIRETAKIN EKAPILAN ALOBAREN**	L	ritual	B
Caesalpinia decapetala (Roth) Alston, Fabaceae, JTG-362	**EKARAO**	T; W, I	living fence, **AWAS**	wp	transplant	P
Calotropis procera (Aiton) W.T.Aiton, Apocynaceae, JTG-031, JTG-080	**EPUU**	H; W, I	east coast fever, **LOKIT**	wp	--	B
			anaplasmosis, **LOPID**	wp	--	B
Capparis fascicularis DC. var. *elaeagnoides* (Gilg) DeWolf, Capparaceae, JTG-303	**EKADOLIAE**	L; W, I	heartwater, **LOKOU**	B	water extract	B, M, P
				B	water extract with *Carissa edulis* bark	B, P
			lumpy skin disease, **LONARU**	B, R	water extract with *Steganotaenia araliacea* leaves and root, topically	T
			snake bite, **AKONYET KE EMUN**	B, R	**see *Acacia abyssinica***	B
Capparis tomentosa Lam., Capparaceae, JTG-305	**EKADOLIAE or EROGOROWETE**	L; W, I	heartwater, **LOKOU**	R	water extract	B
			anaplasmosis, **LOPID**	R	water extract	B

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Capparis sp., Capparaceae	**EROGOROWETE**	L; W, I	self-med	B	animal self-medicate orally	B
Capsicum annuum L., Solanaceae, JTG-081	**EPILIPILI**	S; W, I	anaplasmosis, **LOPID**	F	decoction, add sediment rock (CaCO3)	P
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	F	water extract with *Warburgia salutaris* bark, *Solanum incanum* fruits, sediment rock (CaCO3) and water; water extract with *Solanum incanum* fruits	B
			heartwater, **LOKOU**	F	paste, nasally	B, T
				F	pound fruit & apply to freshly branded areas	B
Capparis sp., Capparaceae	**EWONOKORI**	L; W, I	anaplasmosis, **LOPID**	B	water extract	B
			black quarter - 'speared or piercing', healthy animal dies suddenly, one leg becomes emphysematous, limps for a day and dies, **LOKECUMAN**	branch	water extract	B
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	B	water extract	T
			east coast fever goats, swollen lymph nodes, **LOKIT NGAKINE**	B	water extract	T
			fever, **IYALAARA**	B, R	water extract	B
			pain killer, **ALEMAR ARIABA**	B, R	water extract	T
			sudden death, **ATWANARE ATIPEI**	B, R	water extract	T

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Caralluma dummeri N.E.Br., Apocynaceae, JTG-322	**LOKEJUKUMA**	H; W, I	wounds, **AJOME**	F	juice topically	P
Carica papaya L., Caricaceae	**EPAIPAI**	T; W, I	intestinal parasites, **NGIKUR**	S	seeds direct	M, T
Carissa spinarum L., Apocynaceae, JTG-010, JTG-428	**EKAMURIAI**	S; W, I	anaplasmosis, **LOPID**	R	infusion	B
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	R	decoction	T
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	R	infusion	B
			chicken pox, **LONGOLESIKE**	B	water extract	B
			diarrhoea, **AKIURUT**	B	water extract with *Zanthoxylum chalybeum* roots	B, P
			east coast fever, **LOKIT**	B	water extract	B
				R	infusion	B
			general body pains, **EPILPIL AKWAN**	R	water extract	B
			heartwater, **LOKOU**	B	**see *Capparis fascicularis***	P
			lumpy skin disease, **LONARU**	B	water extract; water extract with *Zanthoxylum chalybeum* roots	B, P
			Lokilala tetany, **EYALIYAL**	B	water extract	B
			muscle pain, **NGAMORI LOKOYATA**	R	water extract	T
			rinderpest, **LOLEO**	R	Infusion	P
			skin disease with intestinal adhesions, **LONGOLESIKE**	B	water extract	T
Cassia nigricans Vahl, Fabaceae, JTG-092, JTG-112, JTG-319	**EPEERU**	S; W, I	abscess, **ABUS**	L	powder topically	B

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			dermatophilosis, **EPAARA**	L	water extract with *Piliostigma thonningii* bark, wash	B
			fever, **IYALAARA**	L	direct	T
			intestinal parasites, **NGIKUR**	L	water extract	B
			meningitis, **ETERAGEGE**	L	water extract	B, M, P
			wounds, **AJOME**	L	powder topically	B
Catha edulis (Vahl) S.Endlicher, Celastraceae	**KHAT**	H; W, I	self-med	L	animal self-medicate orally	P
Chasmanthera dependens Hochst., Menispermaceae, JTG-049, JTG-268	**LODWAR**	L; W, I	anaplasmosis, **LOPID**	R	water extract	B
				B, R	water extract	B, P
			diarrhoea, **AKIURUT**	B, R	water extract	P
			east coast fever, **LOKIT**	B, R	water extract	B, P
				R	water extract	B
			fever, **IYALAARA**	B, R	water extract	T
			FMD prophylaxis, **AKIRIT EJOTA**	R, stem	water extract	P
			foot and mouth disease (FMD), **EJOTA**	R, stem	water extract; water extract with *Tamarindus indica* fruits	P
			Lokilala tetany, **EYALIYAL**	B, R	water extract	B
Cissus cactiformis Gilg, Vitaceae, JTG-298	**EMOROS**	S; W, I	bloat, **EKITUBON**	stem	water extract	P
Cissus quadrangularis L., Vitaceae, JTG-012, JTG-400	**EGIGITH**	L; W/SW, I	anaplasmosis, **LOPID**	L	water extract	B
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	L	water extract	B
				stem	water extract with *Warburgia salutaris* bark	B, P, T

species, family, voucher	**local name**	**habitat; status**	**indications, local name**	**part used**	**preparation and administration**	**ethnic group**
			calf diarrhoea, **AREMOR**	stem	water extract	B
			intestinal parasites, **NGIKUR**	stem	water extract	T
			low milk production, **EURICIANA**	stem	water extract	B, P
			rinderpest, **LOLEO**	stem	water extract	B
			weak calf, **ABUR**	stem	water extract, mixed with sour milk	B
Cissus rotundifolia (Forsk.) Vahl, Vitaceae, JTG-267	**ETOPOTOJO**	L; W, I	rotten wounds in mouth, **LOKITUK**	wp	water extract, wash mouth	B
			wounds, **AJOME**	L	poultice with oil or water	P
Cissus sp., Vitaceae,	**ELIGOI**	L; W, I	self-med	L	animal self-medicate orally	
Cissus sp., Vitaceae	**LONGARWE**	L; W, I	self-med	L	animal self-medicate orally	
Citrus sp., Rutaceae	**EMACUNGA**	T; C, I	rinderpest, **LOLEO**	R	paste enema	P
Clausena anisata (Willd.) Benth., Rutaceae, JTG-410	**NAWAWAYO**	S; W, I	calf diarrhoea, **AREMOR**	R	water extract	B
			fever, **IYALAARA**	R	water extract	T
Cleome gynandra L., Cleomaceae	**AKEO**	H; W, I	trachoma, **AKIRUMIT AKONYEN**	Fl	squeeze liquid from flower	B, M, P
Coccinia adoensis (A. Rich.) Cogn., Cucurbitaceae, JTG-339	**EDALDALAKISIN**	H; W, I	anaplasmosis, **LOPID**	R	infusion	B
Coffea eugenioides S. Moore, Rubiaceae, JTG-354	**EBISALUMACH**	T; W, I	fodder, **AKIMUJ NGIBAREN**	L	goats take direct	B
Commelina simplex Vahl, Commelinaceae	no name	H; W, I	human food	L	cooked	P
Commiphora africana (A. Rich.) Engl., Burseraceae, JTG-279	**EKADELI**	T; W, I	fly and maggot control, **AKIRETAKIN NGICUC KA NGIKUR**	exudate	powdered sap, topically	B
			living fence, **AWAS**	branch	transplant	B
			fresh wounds, **AJOME**	exudate	powdered sap, topically	B, M, P
			wounds, **AJOME**	exudate	powdered sap, topically	B

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Commiphora habessinica (O.Berg) Engl., Burseraceae, JTG-023	**EKADELI**	T; W, I	eyes painful red, **ARIBO AKONGU**	exudate	powdered sap, in eye	B, P
			mange, **EMITINA**	exudate	powdered sap, topically	B, P
Crabbea velutina S. Moore, Acanthaceae, JTG-343	**LOTIDAE**	S; W, I	compaction, **ETID**	F	knick hide at level of spleen, press in fruit	B
Cratolaria sp. 2, Fabaceae, JTG-285	**MATADO**	H; W, I	poisonous - gives cattle foot rot, **INAK EMAARA**	F	cattle walk on mature pods in pasture	B
Cucumis sp., Cucurbitaceae	**EKALERUK**	V; W, I	anaplasmosis, **LOPID**	F	water extract with *Warburgia salutaris* & sediment rock (CaCO3)	B, P, T
			bloat, **EKITUBON**	F	mix juice in water	B, P
			east coast fever, **LOKIT**	F	water extract with *Warburgia salutaris* & sediment rock (CaCO3)	P
			fodder, **AKIMUJ NGIBAREN**	F, L	donkeys eat direct	P
			rinderpest, **LOLEO**	F	water extract with fruits, *Warburgia salutaris* bark and sediment rock (CaCO3)	B
			wounds, **AJOME**	F	*Cucumis* sp. and *Momordica foetida* fruit juices & salt, topically	B
Cucurbita maxima Duchesne, Cucurbitaceae	**AKAIDEIT**	L; W, T	acute eye syndrome, **ADEIKIN**	S	paste in eye	B
Cymbopogon giganteus Chiov., Poaceae	**AKAWOO**	H; W, I	self-med	L	animal self-medicate orally	P
Cyperus fischerianus A. Rich., Cyperaceae, JTG-424	**EKIKIRAUT**	H; W, I	snake bite, **AKONYET KE EMUN**	R	water extract	T
				R	powder topically	P

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Cyphostemma serpens (Hochst.) Desc., Vitaceae, JTG-314	**AMANA AKURI ASANGISANG**	H; W, I	edible insects collection, **AKIYOR NGIKONG**	wp	trap insects in web of plants around anthill	P
Cyphostemma ukerewense (Gilg) Desc., Vitaceae, JTG-434	**AMANA-AKURI**	H; W, I	absess with maggots, **AKIMADYA**	wp	poultice	T
			fly repellent, **AKIRIT NGICUC**	R	powder topically	B
			intestinal parasites, **NGIKUR**	wp	water extract	B, P
			maggots, **NGIKUR KE KWAN**	R	powder topically	T
				wp	poultice	B
			ticks, **NGIMADANG**	R	powder topically	P
Dactyloctenium aegyptium (L.) Willd., Poaceae, JTG-383	**EKOWDA**	H; W, I	fodder, **AKIMUJ NGIBAREN**	F	direct	B
Digitaria sp., Poaceae, JTG-388	**DEDE**	H; W, I	fodder, **AKIMUJ NGIBAREN**	wp	direct	B
Dracaena sp. cf. *deremensis* Engl., Rutaceae, JTG-418	**EMOGOLIT**	S; W, I	diarrhoea, **AKIURUT**	R	water extract	T
Dregea rubicunda K. Schum., Apocynaceae, JTG-345	**LOKAKWAN**	T; W, I	sore mouth in kids, **LOKITUK**	L	gently crush leaves	T
Elaeodendron buchananii (Loes.) Loes., Celastraceae, JTG-358	**MIIRA**	T; W, I	stimulent, **AKISIBURAKIN**	L	direct	B
Eragrostis pilosa (L.) P. Beauv., Poaceae	**LOLETIO**	H; W, I	self-med	L	animal self-medicate orally	P
Erythrococca bongensis Pax, Euphorbiaceae, JTG-093, JTG-450	**EDIPIDIPI**	S; W, I	intestinal parasites, **NGIKUR**	L	water extract	B
				L, R	water extract	T
Euphorbia bongensis Kotschy & Peyr., Euphorbiaceae	**JERIMAN**	H; W, I	anaplasmosis, **LOPID**	wp	water extract	P
			bloat, **EKITUBON**	wp	water extract	B
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	wp	water extract	B, M, P
			east coast fever, **LOKIT**	wp	water extract, oral or topical	B
			heartwater, **LOKOU**	R	water extract, oral or topical	B

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			Lokilala tetany, **EYALIYAL**	wp	water extract	P
			panacea, **NGIDEKESIO DADANG**	wp	water extract, oral or topical	B
			rinderpest, **LOLEO**	wp	water extract, oral or topical	P
			ticks, **NGIMADANG**	wp	water extract, topically	P
Euphorbia candelabrum Kotschy, Euphorbiaceae	**EPOPONG**	T; W, I	anaplasmosis, **LOPID**	stem	water extract with sediment rock ($CaCO_3$)	B
				exudate	knick hide at lymph node, drip in latex	B
			east coast fever, **LOKIT**	exudate	water extract, into lymph node	T
Euphorbia cooperi N.E.Br., Euphorbiaceae	**EPONG**	T; W, I	contagious bovine/caprine pleuropneumonia, **LOUKOI**	stem	singe stem	B
Euphorbia tirucalli L., Euphorbiaceae	**ELIGOI**	S; W, I	enlarged lymph nodes, **NGAGAWEI**	exudate	latex on lymph node	B
Fagaropsis angolensis (Engl.) H.M. Gardner, Rutaceae	**EKAKIRET**	T; W, I	anaplasmosis**, LOPID**	B	water extract	T
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	B	water extract	T
			lice, **NGILAC**	B	water extract	T
			snake bite, **AKONYET KE EMUN**	B, R	water extract	T
Gardenia jovis-tonantis (Welw.) Hiern, Rubiaceae, JTG-431, JTG-467	**EKORE**	T; W, I	bloat, **EKITUBON**	B	water extract	B
			heartwater, **LOKOU**	B	water extract	B
			snake bite, **AKONYET KE EMUN**	R	water extract with *Steganotaenia araliacea* roots	T
			snake spit, **AKONYAT EMUN**	R	water extract with *Steganotaenia araliacea* bark and stem, bathe eye	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			stick for spinning milk, **EGEC**	B		P
Gloriosa superba L., Colchicaceae, JTG-336	**LOKIRITIN**	H; W, I	clots milk, **AKISIDIK NGAKILE**	L	add leaf to milk filled gourd, gently shake to clot, may then be eaten immediately or preserved	B
Gnaphalium purpureum L., Asteraceae, JTG-392	**EKOUTAPEM**	H; W, I	eyes painful red, **ARIBO AKONGU**	L	paste in eye	B, M, P
Gomphocarpus fruticosa (L.) W.T. Aiton, Apocynaceae, JTG-411, JTG-420	**EPUURU**	S; W, I	back pain, **ACIR**	R	water extract	T
			diarrhoea, **AKIURUT**	R	water extract	T
Grewia bicolor Juss., Malvaceae, JTG-289	**EKALIYE**	T; W, I	retained placenta, **ANGASEP**	B	water extract	B
			spear shaft, **AMOROK AKWARA**	B		B
			sticks for guiding livestock, **EBALA**	B		T
Grewia mollis Juss., Malvaceae, JTG-445	**EKABOLOBOLOT or EKALIE**	T; W, I	retained placenta, **ANGASEP**	B	water extract	B, T
			constipation, **EGWEE**	B	water extract, oral or enema	B
Grewia villosa Willd., Malvaceae, JTG-101, JTG-458	**EPONGAE**	S; W, I	lice, **NGILAC**	B	water extract, topically	B
			retained placenta, **ANGASEP**	stem	water extract	B, M, P
Gutenbergia cordifolia Benth. ex Oliv., Asteraceae	**EKOUTAPEM**	H; W, I	pneumonia, **AWALA**	L	direct	B
Habenaria lindblomii Schltr., Orchidaceae, JTG-432	**EDAPAL**	H; W, I	guard dog becomes very 'tough' and alert, **ADEDING INGOK**	R	water extract	T
Harrisonia abyssinica Oliv., Rutaceae, JTG-018, JTG-297	**EKERE**	S; W, I	contagious bovine/caprine pleuropneumonia, **LOUKOI**	R	water extract	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			chronic neck/back wound with maggots, **EPAARA KA NGIKUR**	L, R	poultice with amphibolitic asbestos & cooking oil	B, P
			dermatophilosis, **EPAARA**	L, R	poultice with oil or water	B
			fly and maggot control, **AKIRETAKIN NGICUC KA NGIKUR**	F, L	poultice	B, P
			fly repellent, **AKIRIT NGICUC**	L	poultice	P
			mange, **EMITINA**	L, R	poultice	B
			heartwater, **LOKOU**	R	water extract	B
			maggots, **NGIKUR KE KWAN**	R	water extract, topically	P
				B, R	urine extract and butter, topically	P
			rectal wound, **AJOME AKIMOJONG**	L, R	poultice	P
			wounds, **AJOME**	L, R	poultice	B, P
				R	water extract	B
				R	powder topically	B, P
				L	water extract, topically	P
Hibiscus trionum L., Malvaceae, JTG-292	**ETOKE**	H; W, I	fodder, **AKIMUJ NGIBAREN**	S	direct	P
Homoglossum sp. (=*Gladiolus*) Iridaceae, JTG-438	**LOSARICHO**	H; W, I	low milk production, **EURICIANA**	R	water extract	T
Hoslundia opposita Vahl, Lamiaceae, JTG-301	**EPWOK**	S; W, I	eyes painful red, **ARIBO AKONGU**	L	powder in eye	T
			fodder, **AKIMUJ NGIBAREN**	L	direct	P
Hyparrhenia spp., Poaceae	**JOKPOLON**	H; W, I	self-med	L	animal self-medicate orally	B
Indigofera spicata Forssk., Fabaceae, JTG-077	**ETERUMAN**	H; W, I	appetite stimulant, **AKISUBURAKIN AKIMUJ**	R	yoghurt paste	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			calf diarrhoea, **AREMOR**	R	yoghurt paste	B
			diarrhoea, **AKIURUT**	wp	water extract	B
			trypanosomiases, **EDIIT**	R	water extract	B
Ipomoea longituba Hallier, Convolvulaceae, JTG-429	**EKOLAWAS**	H; W, I	low milk production, **EURICIANA**	R	water extract	B
	EMATWAE	H; W, I	constipation of goat kids, **EGWEE**	R	water extract, enema	T
			ticks, **NGIMADANG**	R	poultice	B
Jatropha curcas L., Euphorbiaceae, JTG-333	**EJULUNGA**	S; SW, T	inflammation, **ECOR**	F	juice topically	P
			living fence, **AWAS**	branch	transplant	T
			wounds, **AJOME**	F	juice topically	B
Kalanchoe citrina Schweinf., Crassulaceae, JTG-403	**ETABAAKWE**	H; W, I	wounds, **AJOME**	L	water extract, topically	B
Kigelia africana (Lam.) Benth., Bignoniaceae, JTG-009	**EDODOI**	T; W, I	bloody calf diarrhoea, **AREMOR KA NGAKOT**	R	**see *Acalypha fruticosa***	B
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	R	paste from ashes	B
			eye problem, **NGAKONYEN**	L	**see *Balanites aegyptiaca***	B
			heartwater, **LOKOU**	B, F	water extract	P
			pinkeye, **LOKIYO**	L	paste with leaf ash and animal butter, in eye	B
Kleinia odora (Forssk.) DC., Asteraceae, JTG-265	**ELIGOI**	H; W, I	strengthen sick calf, **AKITOGOGONG NGITAK**	stem	water extract	P
Lannea humilis (Oliv.) Engl., Anacardiaceae, JTG-276	**ETOPOJO**	T; W, I	calf diarrhoea, **AREMOR**	B	water extract	B
			switches, **AKITWARITWARET**	branch		P
Leonotis nepetifolia (L.) R.Br., Lamiaceae, JTG-328	**LOLEMO**	H; W, I	intestinal parasites, **NGIKUR**	wp	water extract	B
			maggots, **NGIKUR KE KWAN**	L	**see *Albizia amara***	B
				wp	poultice	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
Loudetia superba De Not., Poaceae	**EKOSIMABU**	H; W, I	self-med	L	animal self-medicate orally	P
Maerua edulis (Gilg. & Gilg-Ben.) DeWolf, Capparaceae, JTG-462	**ERUT**	H; W, I	abscess, **ABUS**	R	water extract	B
Maerua parvifolia Pax, Capparaceae, JTG-032, JTG-398	**EURUKANYIM**	S; W, I	acute eye syndrome, **ADEIKIN**	L	paste in eye	B
			eyes painful red, **ARIBO AKONGU**	L	masticate leaves and spit into affected eye	T
			pinkeye, **LOKIYO**	L	masticate leaves and spit into affected eye	B
Mammea africana Sabine, Clusiaceae, JTG-415	**ETUNGANAN**	T; W, I	diarrhoea, **AKIURUT**	B	water extract	T
			fodder, **AKIMUJ NGIBAREN**	F	direct	T
			lice, **NGILAC**	B	water extract, topically	T
Manihot esculenta Crantz, Euphorbiaceae	**EMOOGO**	H; C, int	self-med	L	animal self-medicate orally	B
Melia azedarach L., Meliaceae, JTG-026	**ELIRA**	T; W, I	contagious bovine/caprine pleuropneumonia, **LOUKOI**	R	water extract	B, P
			measles, **PUURU**	R	water extract	P
			rinderpest, **LOLEO**	B	water extract	P
Momordica foetida Schumach., Cucurbitaceae, JTG-332	**EYOME**	V; W, I	bloat, **EKITUBON**	F, stem	water extract	P
			lice, **NGILAC**	F	water extract, topically	T
				F	urine extract with *M. foetida* juice, *Nicotiana tabacum* leaves and old ashes, wash; *M. foetida* juice mixed with urine or water and old ashes, wash	B
			maggots, **NGIKUR KE KWAN**	F	juice topically	B, T
			pinkeye, **LOKIYO**	F	juice in eye	P

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			wounds, **AJOME**	F	juice topically; **see *Cucumis* sp.**	B
Neorautanenia mitis (A. Rich.) Verdc., Fabaceae, JTG-040	**EBUTO**	V; W, I	fleas, **NGIKADESIDES**	R	water extract, topically	B
			lice, **NGILAC**	R	ibid; urine extract, topically	B
			ticks, **NGIMADANG**	R	water extract	B
Nicotiana tabacum L., Solanaceae, JTG-474	**EPELADEK**	H; C, T	fleas, **NGIKADESIDES**	L	urine extract, add ash and wash	T
			lice, **NGILAC**	L	ibid; urine extract, topically; **see *Momordica foetida***	B
			mosquito control, **AKIRETAKIN NGITHIRU**	L	urine extract, add ash and wash	B
Nicotiana tabacum L., Solanaceae, fermented snuff	**ETABA**	H; C/B, T	acute eye syndrome, **ADEIKIN**	L	pinch of snuff placed directly in the eye, 3 days later a drop of cassava alcohol and sprinkle tetracycline powder	
			ticks, **NGIMADANG**	L	dissolve snuff in water, add urine, wash	P
ni001, Amaryllidaceae, JTG-118	**ABUKUT**	S; W, I	metritis - uterus infection, **ANGASEP**	R	water extract	B
			pyometra- uterus infection with pus, **ANGASEP KA ABUTH**	R	water extract	B, P
			retained placenta, **ANGASEP**	R	water extract	B
ni002	**AKWI-EKADETEWA**	H; W, I	seizures, **KIPAPA**	L	water extract	B
ni003, Vitaceae	**ARIGITH**	S; W, I	diarrhoea, **AKIURUT**	stem	water extract	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
ni004	**EBOLITIS**	T; W, I	goat pox, **ETOM**	B	panga heated red-hot; brand skin in circumferential pattern starting just above the eyes to below the ears extending along the middle of the ribs on both sides & paralumbar fossae	B
ni005, Fabaceae, JTG-454	**ECOKE**	T; W, I	diarrhoea, **AKIURUT**	wp	water extract	B
			low milk production, **EURICIANA**	B	water extract	B
			maggots, **NGIKUR KE KWAN**	R	water extract, topically	T
ni006, Liliaceae, JTG-338	**ECOMOCOMO**	H; W, I	yoke wounds, **APOTOSIT**	R	poultice	B, M, P
ni007	**EKALETETE**	S; W, I	poultry coccidiosis, **AKIURUT ANGIKOKOROI**	R	water extract	B, M, P
ni008, Fabaceae, JTG-478	**EKARO**	T; W/SW, I	living fence, **AWAS**	branch	transplant	B
ni009, Fabaceae, JTG-470	**EKARO**	T; W/SW, I	living fence, **AWAS**	branch	transplant	B
ni010, Araceae, JTG-281	**EKEREYE**	H; W, I	old people used for medicine, **NGKASIKOT KA AKIMAK**	N/A	--	B
			snake bite, **AKONYET KE EMUN**	R	**see *Acacia abyssinica***	B
ni011	**EKOROSOT (EKAUTII)**	T; W, I	bloody diarrhoea, **LOOKOT**	B, R	water extract	P
ni012	**EKOTI**	T; W, I	anaplasmosis, **LOPID**	B, R	water extract	B
			diarrhoea, **AKIURUT**	B, R	water extract	P

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
ni013, Sapotaceae, JTG-344	**EKUNGARIT**	T; W, I	retained placenta - smelly, **ANGASEP**	B, L	water extract	B
ni013, Sapotaceae, JTG-344	**EKUNGARIT**	T; W, I	retained placenta, **ANGASEP**	B	water extract	P
ni014, Liliaceae, JTG-270	**ELEDA**	H; W, I	yoke wounds, **APOTOSIT**	R	poultice	B
ni015, Poaceae, JTG-382	**ELET (B)**	H; W, I	fodder, **AKIMUJ NGIBAREN**	wp	direct	B
ni016	**ELIGOI**	S; W, I	pneumonia, **AWALA**	exudate	water extract	P
ni017	**ELILIYOI**	V; W, I	anaplasmosis, **LOPID**	stem	water extract	T
ni018	**ELILIYOI**	V; W, I	mange, **EMITINA**	stem	water extract	B, P
ni019	**EMITGAZEA**	T; W, I	rotten wounds in mouth, **LOKITUK**	B, R	water extract	B
ni020, JTG-025	**EMPORA**	H; W, I	fly repellent, **AKIRIT NGICUC**	L	powder topically	D
ni021	**ENGETHO**	L; W, I	quick delivery, **AKIDOUNIO ANGNIBERU**	branch	ritual	B, P
ni022	**EPERU**	H; W, I	retained placenta, **ANGASEP**	wp	water extract	B
ni023	**ESILANG**	H; W, I	stomach pain, **AKOOK**	B	water extract	B
ni024	**ETETELE**	S; W, I	fever with lower back pain, **ACIR KA IYALAARA**	R	water extract	P
ni025	**EUPET or ELILOI**	S; W, I	anaplasmosis, **LOPID**	R	water extract	B
				R	**see *Allium cepa***	P
			calf diarrhoea, **AREMOR**	B	water extract with sediment rock (CaCO3)	P
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	R	water extract	B
			rinderpest, **LOLEO**	R	decoction, add sediment rock (CaCO3)	B
ni026	**KLOROKWIN**	T; W, I	contagious bovine/caprine pleuropneumonia, **LOUKOI**	B, R	water extract	B, P
ni027	**LOKAPILAN**	S; W, I	disease prevention, **LOKIPILAK**	L, stem	powder sprinkled over body	P
ni028	**LOKILE**	H; W, I	low milk production, **EURICIANA**	L	direct	B

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ni029	**LOKITELIYOI**	S; W, I	anaplasmosis, **LOPID**	R	distill roots, inject intramuscular (IM)	B, P
			genital diseases, **ANGAC**	R	water extract	T
				R	distill roots, inject IM	B
			intestinal parasites, **NGIKUR**	R	water extract, oral or IM	B
ni030, JTG-469	**LOKOCIL**	H; W, I	fodder, **AKIMUJ NGIBAREN**	L	direct	T
			low milk production, **EURICIANA**	L	direct	P
			pneumonia, **AWALA**	L	direct	B, M, P
ni031, Orchidaceae, JTG-425	**LOKWARAS**	H; W, I	ear ache, **AYEYE**	L	grind leaf, drop in ear	B
ni032	**LOMANANG**	S; W, I	bloody calf diarrhoea, **AREMOR KA NGAKOT**	R	water extract	P
			calf diarrhoea, **AREMOR**	R	water extract	B
			calf manure brown/black can have either diarrhoea or constipation, **LOGORICINO**	R	water extract	B
ni033, Meliaceae, JTG-426	**LOMARAN**	T; W, I	contagious bovine/caprine pleuropneumonia, **LOUKOI**	B	water extract	P
			fever, **IYALAARA**	B	water extract	B, M, P
			tetanus, **ETEREGEGE**	B	water extract	P
ni034, Lamiaceae, JTG-379	**LOSIRU**	H; W, I	mosquito control, **AKIRETAKIN NGITHIRU**	wp	smudge in fire, and/or hang near kraal	B
ni035, Fabaceae	**LOSISI**	H; W, I	lumpy skin disease, **LONARU**	B, L	water extract	B, P
ni036, Crassulaceae, JTG-422	**LOTUBAE**	H; W, I	eyes painful red, **ARIBO AKONGU**	L	paste in eye	T
			joint/bone pain, **LOKOYETA**	L	poultice	B, M, P

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
ni037, Cucurbitaceae	**NGAKAYIER**	V; W, I	intestinal parasites, **NGIKUR**	S	water extract of inner seed	T
ni038, JTG-419	**SHAMCOK**	T; W, I	diarrhoea, **AKIURUT**	R	water extract	T
ni SM1	**ECORGORUM**	H; W, I	self-med	L	animal self-medicate orally	P
ni SM1	**EKARA**	H; W, I	self-med	L	animal self-medicate orally	B,P
Ocimum basilicum L., Lamiaceae, JTG-349	**LOSIRU**	H; W, I	goat pox, **ETOM**	wp	**see *Acacia* sp.**	B
			mosquito control, **AKIRETAKIN NGITHIRU**	wp	smudge in fire, and/or hang near kraal	B
Ocimum suave Willd., Lamiaceae, JTG-423	**LOSIRU**	H; W, I	calf diarrhoea, **AREMOR**	R	water extract	T
			mosquito control, **AKIRETAKIN NGITHIRU**	wp	smudge in fire, and/or hang near kraal	B
Olea africana Mill., Oleaceae, JTG-435	**EURUPEPE**	T; W, I	intestinal parasites**, NGIKUR**	L	water extract	P
Olea europaea (L.) spp. *africana* (nukk) P G, Oleaceae, JTG-114 *Olea europaea* L. subsp. *africana* (Mill.) P.S. Green, Oleaceae	**EUREPEPE**	S; W, I	intestinal parasites**, NGIKUR**	L	water extract	B
Opuntia cochenillifera (L.) Mill., Cactaceae, JTG-122	**EDAPAL**	T; W, I	compaction, **ETID**	F	water extract	B
			low milk production, **EURICIANA**	F, stem	water extract	B
			retained placenta, **ANGASEP**	stem	decoction	T
Ormocarpum trichocarpum (Taub.) Engl., Fabaceae, JTG-370, JTG-457	**ESEPERUAI**	S; W, I	clots milk, **AKISIDIK NGAKILE**	R	**see *Gloriosa superba***	B
			living fence, **AWAS**	wp	transplant	B
Ozoroa insignis Delile, Anacardiaceae, JTG-413, JTG-466, JTG-468	**EMUTORIN**	T; W, I	diarrhoea, **AKIURUT**	B	water extract	B, T

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			eyes painful red, **ARIBO AKONGU**	R	powder in eye	T
				B	powder in eye	B, T
Papaver somniferum L., Papaveraceae	**BANGI**	H; W, I	heartwater, **LOKOU**	L	crushed leaves nasally	P
Pavetta gardeniifolia A.Rich. var. *gardeniifolia*, Rubiaceae, JTG-275	**EPWATADERE**	T; W, I	stem used for making arrows, **EDUPARE NGIKALEYE**	branch	transplant	B
Phyllanthus sp., Phyllanthaceae, JTG-396	**LOMUNO**	H; W, I	snake bite, **AKONYET KE EMUN**	wp	water extract	B
Piliostigma thonningii (Schumach.) Milne-Redh., Fabaceae, JTG-359, JTG-446	**EPAPAI**	T; W, I	dermatophilosis, **EPAARA**	B	poultice; poultice with amphibolitic asbestos; **see *Cassia nigrans***	B
			bloody diarrhoea, **LOOKOT**	B, F	water extract	P
			diarrhoea, **AKIURUT**	B, F	water extract	B
				B	water extract	T
			trypanosomiases, **EDIIT**	F	water extract	B
Plumbago zeylanica L., Plumbaginaceae, JTG-040	**ETETILEIT**	S; W, I	contagious bovine/caprine pleuropneumonia, **LOUKOI**	R	water extract	B
			pneumonia, **AWALA**	R	water extract	B
Protea gaguedi J.F. Gmel., Protaceae, JTG-409	**LOLAC**	T; W, I	anthrax, **LOTIDAE**	B, L	water extract	B, T
			lice, **NGILAC**	B, L	water extract, topically	B, T
Psorospermum febrigum Spach, Clusiaceae, JTG-439	**EMOCOC**	T; W, I	mange, **EMITINA**	F	juice topically	B
Rhus vulgaris Meikle, Anacardiaceae, JTG-274, JTG-433	**ETOPOJO or LOKOCHIL or AKADETEWA**	S; W, I	diarrhoea, **AKIURUT**	R	water extract	T
			fever, **IYALAARA**	B	water extract	B, M, P
			fodder, **AKIMUJ NGIBAREN**	F	direct	P
			lumpy skin disease, **LONARU**	F, L	water extract	T
Saba comorensis (Bojer) Pichon, Apocynaceae, JTG-452	**EKUMUNE**	T; W, I	back pain, **ACIR**	F	juice and fruit flesh	T

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
Sansevieria robusta N.E.Br., Ruscaceae, JTG-351	**AMOJO**	H; W, I	ropes, **AUNO**	L	pound leaf fiber, separate and form into braided rope	P
Sansevieria suffruticosa N.E.Br., Ruscaceae, JTG-271	**ECOKILET**	H; W, I	ropes, **AUNO**	L	ibid - for small ruminant	P
Sarcostemma viminale (L.) R.Br., Apocynaceae, JTG-273	**ELIGOI or ELIGOI LODIM**	H; W, I	bloat, **EKITUBON**	wp	water extract	B
			intestinal parasites, **NGIKUR**	stem	water extract	B
			thirst, **AKURE**	L, R	direct	T
Senna obtusifolia (L.) H.S.Irwin & Barneby, Fabaceae, JTG-376	**ETIATIA**	H; W, I	fodder, **AKIMUJ NGIBAREN**	wp	direct	B
Senna occidentalis (L.) Link, Fabaceae, JTG-290	**ETIATIA**	H; W, I	constipation, **EGWEE**	R	water extract, oral or enema	P
			heart problems, **ETAU**	R	water extract	B
			rotten wounds in mouth, **LOKITUK**	F, L	water extract, wash mouth	B
Senna sp., Fabaceae	**ETIATIA**	H; W, I	fever, **IYALAARA**	R	water extract	B, M, P
			rotten wounds in mouth, **LOKITUK**	F, L	water infusion with salt, wash mouth	P
			pneumonia, **AWALA**	R	water extract	B, M, P, T
Sesamum angustifolium Engl., Pedaliaceae, JTG-374	**LOMAIDAE**	H; W, I	tuberculosis, **LOKUDI**	R	water extract	B
Sesamum sp., Pedaliaceae, JTG-378	**LOMAIDAE**	H; W, I	retained placenta, **ANGASEP**	R	water extract	P
			tuberculosis, **LOKUDI**	R	water extract	B
Sida ovata Forssk., Malvaceae, JTG-299	**IKWANGA**	H; W, I	fodder, **AKIMUJ NGIBAREN**	L	direct	P
			retained placenta, **ANGASEP**	L	water extract	B
Solanum aculeatissimum Jacq., Solanaceae, JTG-473	**ETULELO**	S; W, I	anaplasmosis, **LOPID**	F	water extract	B
Solanum cyaneopurpureum De Wild., Solanaceae, JTG-286	**ESIDIKELELE**	H; W, I	clots milk, **AKISIDIK NGAKILE**	F	**see *Gloriosa superba***	P
Solanum dasyphyllum Schumach. & Thonn., Solanaceae, JTG-451	**ETULELO**	H; W, I	contagious bovine/caprine pleuropneumonia, **LOUKOI**	F	water extract	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			heartwater, **LOKOU**	F	water extract	B
			poultry respiratory infection, **AWALA ANGIKOKOROI**	F	juice	T
Solanum giganteum Jacq., Solanaceae, JTG-337	**ETERAE**	H; W, I	back pain, **ACIR**	F	flesh around seeds consumed direct	B
Solanum incanum L., Solanaceae, JTG-001, JTG-024, JTG-287	**ETULELO**	H; W, I	abscess, **ABUS**	F	juice topically	P
			anaplasmosis, **LOPID**	F	water extract	B
			anthrax, **LOTIDAE**	F, R	water extract	B
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	F	water extract	B
				F	**see *Capsicum annuum* decoction**	B
				F	**see *Capsicum annuum* extraction**	B
			diarrhoea, **AKIURUT**	R	water extract	B, T
			east coast fever, **LOKIT**	F	**see *Aspilia mossambicensis***	B
			heartwater, **LOKOU**	F	juice in eye	B
			mange, **EMITINA**	F	juice topically	T
			otitis with pus, often ticks, **LOMID**	F	juice in ear	B
Solanum sp., Solanaceae	**ETULELO**	H; W, I	anaplasmosis, **LOPID**	F	water extract with sediment rock (CaCO3), *Warburgia salutaris* bark	P
				F	water extract with sediment rock (CaCO3)	B
			east coast fever, **LOKIT**	F	water extract	P
				F	water extract with sediment rock (CaCO3), *Warburgia salutaris* bark	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			heartwater, **LOKOU**	F	water extract with sediment rock ($CaCO_3$)	T
			liver flukes, **LOKURUT**	F	ibid	B
			rinderpest, **LOLEO**	F	water extract with sediment rock ($CaCO_3$), *Warburgia salutaris* bark	B
Sorghum bicolor (L.) Moench, Poaceae	**MUMWA**	H; W, I	self-med	L	animal self-medicate orally	B, P
Sphaeranthus suaveolens DC., Asteraceae, JTG-472	**ABIR**	H; W, I	fleas, **NGIKADESIDES**	wp	water extract, topically	B, T
			lice, **NGILAC**	wp	water extract, topically	B, T
Sphaeranthus ukambensis Vatke & O.Hoffm., Asteraceae, JTG-327, JTG-373	**ABIR**	H; W, I	bloat, **EKITUBON**	wp	water extract	B, P
			measles, **PUURU**	wp	water extract, oral and topical	P
Steganotaenia araliacea Hochst., Apiaceae, JTG-317	**ELAMORU**	T; W, I	lumpy skin disease, **LONARU**	B, R	water extract	B, P
				L, R	**see *Acacia abyssinica*; see *Capparis fascicularis***	T
			snake bite, **AKONYET KE EMUN**	B	water extract	B
				L, R	water extract	B, P
				R	**see *Gardenia jovis-tonantis***	B
				B	**see *Acacia abyssinica***	B
				L, R	**see *Acacia abyssinica***	B
			snake bite with head trouble, **AKONYET KE EMUN AKOU**	B, R	water extract	P
			snake spit, **AKONYAT EMUN**	B, stem	**see *Gardenia jovis-tonantis***	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
Synadenium grantii Hook f., Euphorbiaceae, JTG-013, JTG-329	**LOTOME or LONGARWE**	S; W, I	east coast fever, **LOKIT**	exudate	touch red-hot metal at lymph node (LN), smear latex topically and inside LN	B
				exudate	knick hide at LN, smear latex	P
			living fence, **AWAS**	stem	transplant	B
			spearhead gum, **AKWARA**	exudate	fresh sap as glue	T
Tagetes minuta L., Asteraceae, JTG-361, JTG-442	**ABIR or LOSISI**	H; W, I	lumpy skin disease, **LONARU**	wp	**see *Acacia abyssinica***; water extract	P, T
			lice, **NGILAC**	wp	water extract	P, T
			mange, **EMITINA**	wp	poultice	P
			poultry respiratory infection, **AWALA ANGIKOKOROI**	wp	water extract	B, T
Talinum caffrum (Thunb.) Eckl. & Zeyh., Portulacaceae, JTG-341	**EKURI**	H; W, I	low milk production, **EURICIANA**	R	water extract	T
Tamarindus indica L., Fabaceae	**EPERDURU**	T; W, I	calves that have lost appetite with diarrhoea, **LOLEO**	F (if none, use L)	Infusion	P
			foot and mouth disease (FMD), **EJOTA**	F	**see *Chasmanthera dependens***	P
			rotten wounds in mouth, **LOKITUK**	F (if none, use L)	water extract	P
Tephrosia sp. 1, Fabaceae, JTG-397	**EDODO**	H; W, I	poisonous - gives cattle foot rot, **INAK EMAARA**	F	cattle walk on mature pods in pasture	P
Tephrosia sp. 2, Fabaceae, JTG-092	**EPEERU**	H; W, I	abscess, **ABUS**	L	poultice	B
			anaplasmosis, **LOPID**	wp	water extract	T
			fever, **IYALAARA**	L	paste	B
			intestinal parasites, **NGIKUR**	L	water extract	B
Tephrosia vogelii Hook.f., Fabaceae	**FISHBIN**	S; C, I	ticks, **NGIMADANG**	L	water extract	P
Terminalia brownii Fresen., Combretaceae, JTG-269, JTG-436	**EPIE or EKUYON**	T; W, I	anaplasmosis, **LOPID**	B	paste	P
			east coast fever, **LOKIT**	B	paste	B
			kidney disease, **ENGALURA**	B	water extract	B

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			liver disease, **LOLIBAKONYEN**	B	water extract	T
				B	paste	B
			pneumonia, **AWALA**	B	water extract	B, M, P
Tinospora caffra (Miers) Troupin, Menispermaceae, JTG-016	**ELIGOG**	T; W, I	anaplasmosis, **LOPID**	R	water extract	B
Trichilia prieureana A. Juss, Meliaceae, JTG-355	**LOMARAN**	T; W, I	chest pain, **EKORE**	B	water extract	B
			east coast fever, **LOKIT**	B	water extract	B
Trichilia prieuriana A. Juss. subsp. *vermoesenii* J.J.de Wilde, Meliaceae, JTG-426	**LOMARAN**	T; W, I	anaplasmosis, **LOPID**	B	water extract	B
				B	paste	P
			east coast fever, **LOKIT**	B	paste	B
			heartwater, **LOKOU**	B	water extract	B
Turraea floribunda Hochst., Meliaceae, JTG-353	**DOKTOR**	T; W, I	panacea, **NGIDEKESIO DADANG**	B	water extract	B, M, P
Urena lobata L., Malvaceae, JTG-385	**ACEKDIPONG**	H; W, I	fodder, **AKIMUJ NGIBAREN**	L	direct	B
Warburgia salutaris (Bertol.f.) Chiov., Canellaceae, JTG-037, JTG-416	**ABWACH or EMUKWA**	T; W/B, I	anaplasmosis, **LOPID**	B	decoction; **see *Cucumis* sp.**; decoction, add sediment rock (CaCO3); **see *Solanum* sp.**	B
			black feces, greenish urine, **EDIT**	B	water extract	B
			contagious bovine/caprine pleuropneumonia, **LOUKOI**	B, R	water extract	T
				B	water extract; decoction, add sediment rock (CaCO3); **see *Capsicum annuum***	B
			compaction, **ETID**	B	water extract	T

species, family, voucher	local name	habitat; status	indications, local name	part used	preparation and administration	ethnic group
			constipation, **EGWEE**	B	water extract	T
			east coast fever, **LOKIT**	B	**see *Cucumis* sp.; see *Solanum* sp.**	B
			fever, **IYALAARA**	B	water extract	P
			heartwater, **LOKOU**	B	water extract	B
			Lokilala tetany, **EYALIYAL**	B	water extract	B, P
			rinderpest, **LOLEO**	B	**see *Cucumis* sp.; see *Solanum* sp.**	B
Withania somnifera (L.) Dunal, Solanaceae	**LOPISERU**	H; W, I	contagious bovine/caprine pleuropneumonia, **LOUKOI**	wp	**see *Cissus quadrangularis***	B, P, T
Ximenia americana L., Olacaceae, JTG-300	**ELAMAI**	T; W, I	cures leather, **AKIMANYIMANY EJAMU**	F	crush fruits and seeds, scrape fresh hide clean and stretch out	P
Zanthoxylum chalybeum Engl., Rutaceae, JTG-003, JTG-347	**EUSUGU**	T; W, I	anaplasmosis, **LOPID**	B, R	water extract	B
			calf diarrhoea, **AREMOR**	R	sour milk extract	P
			diarrhoea, **AKIURUT**	R	water extract	B
				R	**see *Carissa edulis***	P
			fever, **IYALAARA**	B	water extract	P
			headache, **LOKOU**	B	water extract	P
			liver disease, **LOLIBAKONYEN**	B, R	water extract	B, M, P
			lumpy skin disease, **LONARU**	R	**see *Carissa edulis***	P
Zizipuhus mauritiana Lam., Rhamnaceae, JTG-005	**EKALE**	T; W, I	constipation, **EGWEE**	B	water extract	P
			vomiting, nausea with salivation, **LOJELJEL**	B	water extract	P

ni – not fully identified

Habitat: L – liana; H – herb; S – shrub; T – tree; V – vine or creeper

Status collected: B - available at market; C - cultivated; SW - semi-wild; W - wild

Status origin: I - indigenous; int – introduced

Part used: B – bark; F – fruit; Fl –flower; R – root; S – seed; branch – straight woody branch 1-3 cm diameter; exudate – latex, sap; stem – herbaceous branch; whole plant – any and all parts of herb without the roots;

Preparation: decoction – hot water extraction, boiled in water; direct – no preparation needed; extract - soaked in water (or other mentioned liquid); infusion - warm water extraction, steeped without boiling; poultice – ingredients with a small amount of water (or other mentioned liquid) to form a suspension, used topically; paste – same as poultice, but not used topically; ritual – use with ceremony; -- not given. Specific preparations detailed on first mention, thereafter noted ***see botanical spp.*** where initially mentioned. Semicolons used to separate multiple preparations if same disease, same plant part and same ethnic group

Ethnic group: B – Bokora; D –Dodoth; M – Matheniko; P – Pian; T – Tepeth

Local names **in bold CAPITOL LETTERS**

For more on local disease terminology, see appendix III

For details on additional other uses of these plants and areas utilised, see Prélude Medicinal Plants Data Base (www.metafro.be/prelude)

Figure 1 (appendix) Goat branded to treat goat pox, ETOM. See description in APPENDIX II for this and other non-plant EVK treatments.

Appendix II - Non-plant EVK materials used in Karamoja

See legend at the end of table

english equivalent, ID	**Local name**	**indications, local name**	**preparation and administration**	**ethnic group**
Coral reef ($CaCO_3$) formed by deposition of material over time (Sediment Rock)[1], potash, soda ash, native salt; NP01	**ABALANGIT**	Anaplasmosis, gall sickness (Lopid can mean any disease that affects the Gall Bladder. Apid translates to gall bladder. Lopid could, therefore be confused with East Coast Fever or Babesiosis, based on post mortem signs); **LOPID**	water extract from *Warburgia salutaris* stem bark, *Cucumis* sp.fruits and **ABALANGIT**	P
			water extract from *Warburgia salutaris* stem bark, *Solanum* sp. fruits and **ABALANGIT**	P
			water extract from *Solanum* sp. fruits and **ABALANGIT**	B
			water infusion with ampicillin and **ABALANGIT**; given intravenously	B
			water infusion with **EUPET** (ni025), salt, ampicillin and ABALANGIT	B
			decoction made from *Warburgia salutaris* stem bark and **ABALANGIT**	B
			decoction made from *Euphorbia candelabrum* stem bark and **ABALANGIT**	B
		pneumonia, respiratory infection, Contagious Bovine/Caprine Pleuropneumonia (CBPP, CCPP); **LOUKOI**	water extract with *Warburgia salutaris* bark, *Solanum incanum* fruits and **ABALANGIT**	B
		East Coast Fever; **LOKIT**	water extract from *Warburgia salutaris* stem bark, *Cucumis* sp.fruits and **ABALANGIT**	B, P
			water extract from *Warburgia salutaris* stem bark, *Solanum* sp. fruits and **ABALANGIT**	B, P

[1] Sample identified at Makerere University

english equivalent, ID	Local name	indications, local name	preparation and administration	ethnic group
		pneumonia; **LOUKOI**	decoction from *Warburgia salutaris* stem bark and **ABALANGIT**	B
		Rinderpest, diarrhoea usually with blood; **LOLEO**	water extract from *Warburgia salutaris* stem bark, *Cucumis* sp.fruits and **ABALANGIT**	B
			water extract from *Warburgia salutaris* stem bark, *Solanum* sp. fruits and **ABALANGIT**	B
singe; NP02	**AKICUNY**	ticks; **NGIMADANG**	fire or a heated iron pressed on tick	P
pierce ticks; NP03	**AKIDOT KIWAK NAKIM**		pluck ticks from skin, carefully to remove mouth parts, throw tick into fire or crush it until blood comes out	B
brand; NP04	**AKIMAD**	wounds; **AJOME**	heated machete pressed on wound	B
freshly churned cow's butter; NP05	**AKIMIET ANGATUK**	eye problems, pinkeye; **LOKIYO**	*Kigelia africana* leaf powder paste with butter in eyes	P
		orf, mouth infection on goats; **NGITUBUKAI**	topically	B
honey; NP06	**AKIMIET KA AOO**	Heartwater; **LOKOU**	oral	B, P
kerosene; NP07	**AKIMIET KE ETAA**	scabies; **EMITINA**	topically	B, P
soil; NP08	**AKINUWI**	bloody diarrhoea; **LOOKOT**	paste	T
hand-pick; NP09	**ALEMANAR**	ticks; **NGIMADANG**	remove by hand, throw down, pierce tick with thorn or throw into fire	B
brand; NP10	**AMACAR**	Heartwater; **LOKOU**	Hot iron used to make a brand line on head, across ears. Then dab squeezed *Capsicum annuum* fruit juice on top	B, M, P
		East Coast Fever; **LOKIT**	metal in hot fire and then press against swollen parotid gland	B
		goat pox; **ETOM**	panga heated red-hot in fire, brand skin in circumferential pattern starting just above the eyes to below the ears extending along the middle of the ribs on both sides & paralumbar fossae	B

english equivalent, ID	Local name	indications, local name	preparation and administration	ethnic group
rabbit soup; NP11	**APOO**	Lokilala tetany or Karamojong immunosuppression syndrome (KIS) listlessness, lethargy, dizzy, fatigue, feeling feverish, losing condition; **LOCEKE**	skin live rabbit, boil in water, remove meat for people to eat. Add 1kilo sugar to soup and more water	B, P
cooking oil; NP12	**AUTO**	chronic neck/back wound back secondary to mites, injury or dermatophilosis; **EPAARA**	oil and kerosene extraction from **ELUPE** (NP15); topically	B, P
local clam shell; NP13	**EKAME**	eye problems, squinting, lacrimation, blindness, pinkeye, small blue spot starting; **ADEIKIN**	paste with inner layer of clamshell powder; ocular	B
ashes; NP14	**EKURON**	lice; **NGILAC**	sun infusion with cattle urine and ashes; topically	B, P
			sun infusion with cattle urine, *Nicotiana tabacum* leaves and old ashes; topically	B
asbestos talc, amphibolitic asbestos[2]; NP15	**ELUPE**	Anaplasmosis; **LOPID**	paste	B
		chronic neck/back wound; **EPAARA**	oil extraction from **ELUPE**; topically	B
			powdered **ELUPE**; topically	B
		chronic neck/back wound back with maggots, **EPAARA KA NGIKUR**;	poultice with *Harrisonia abyssinica* roots/leaves & cooking oil	B, P
		East Coast Fever; **LOKIT**	paste	B
		wounds; **AJOME**	powdered *Piliostigma thonningii* bark and **ELUPE**; topically	B
			poultice from butter and **ELUPE**	B
white soil mixed with water; NP16	**EMUNYEN**	prevent disease, protects from wizzards; **IWURIARIO NGIDEKESIO**	poultice	B

[2] Splintery, orangey mineral used to make cooking and water pots, see Wilson, 1973

english equivalent, ID	Local name	indications, local name	preparation and administration	ethnic group
		Prevent wizard from attacking animals, general disease prevention; **AKIRETAKIN EKAPILAN ALOBAREN**	poultice	B
pin fire; NP17	**EPIPIOT**	East Coast Fever; **LOKIT**	panga or hot iron placed in fire to heat to red-hot	B
cattle urine; NP18	**NGACOTO**	lice; **NGILAC**	extract in urine; topically	B
			water extract or urine; topically	B
			sun infusion with cattle urine and ashes; topically	B
			sun infusion with cattle urine, *Nicotiana tabacum* leaves and ashes; topically	B
		ticks**; NGIMADANG**	dissolve fermented *Nicotiana tabacum* (**ETABA**) leaves in water, add urine; topically	P
yoghurt; NP19	**NGAKIBUK**	diarrhoea of small calves; **AKIURUT ANGITAK** or **AREMO**	**ETURUMAN** roots, water and **NGAKIBUK**	B
		increase appetite; **AKISUBURAKIN AKIMUJ**	**ETURUMAN** roots, water and **NGAKIBUK**	B
		intestinal parasites, worms; **NGIKUR**	**ETURUMAN** roots, water and **NGAKIBUK**	P
fresh blood; NP20	**NGAKOT**	orf, mouth infection on goats; **NGITUBUKAI**	topically	B
salty soil; NP21	**EDOOT**	salt craving; **EKICUYON**	animal self-medicates directly	
cut muscle belly; NP22	**AKIDUNG**	tight, hard muscle, white muscle disease or compartmentalization; **AKESIT, NGAKESETA**	use sharp knife directly into affected muscle	B
anthill; NP23	**AKOUMA**	self-med;	animal self-medicates directly	
salty river water; NP24	**ARI ANGOLOL**	self-med;	animal self-medicates directly	
bad water; NP25	**NGAKIPI NGUNA AMUNARA**	self-med;	animal self-medicates directly	
water; NP26	**NGAKAPI**	self-med;	animal self-medicates directly	
burnt grass; NP27	**ANOMOT**	self-med;	animal self-medicates directly	

english equivalent, ID	Local name	indications, local name	preparation and administration	ethnic group
rain; NP28	**AKIRU**	external parasites (lice, ticks or fleas)	animal self-medicates by standing in rain	
rocky field; NP29	**AMANA NGINA ANGATABAB**	foot and mouth disease;	animal self-medicates directly by walking on rocky field	
fence rubbing; NP30	**AKIRING ANAWAS/ ALOKITOE**	external parasites (lice, ticks or fleas);	animal self-medicates directly by rubbing	

Preparation: decoction – hot water extraction, boiled in water; direct – no preparation needed; extract - soaked in water (or other mentioned liquid); infusion - warm water extraction, steeped without boiling; poultice – ingredients with a small amount of water (or other mentioned liquid) to form a suspension, used topically; paste – same as poultice, but not used topically; ritual – use with ceremony; -- not given. Semicolons used to separate multiple preparations if same disease, same plant part and same ethnic group

Ethnic group: B – Bokora; P – Pian; T – Tepeth

Local names **in bold CAPITOL LETTERS**

For more on local disease terminology, see appendix III

Figure 2 (appendix) Above, goats, brown one has orf, NGITUBUKAI. Below, cow with retained placenta, ANGESEP

APPENDIX III

Local Disease Terminology

Appendix III - Livestock disease terminology

ngakarimojong	animal species	english	description
AAKUYE	all	hydrocoel	
ABUR	cattle	trypanosomiasis	chronic form of **EDIIT**
ABUR	calves	weak calf	
ABUS	all	abscess	
ACIR	all	back pain	
ACIR KA IYALAARA	all	fever with lower back pain	
ADEDING INGOK	dog	guard dog becomes very 'tough' and alert	
ADEIKIN	all	acute eye syndrome	
ADONGE	all	sterility	inability to get pregnant
AGULE	all	hernia	swelling on the body which may contain intestines
AJOME	all	fresh wounds	
AJOME	all	wounds	
AJOME AKIMOJONG	all	rectal wound	
AKESIT	cattle	white muscle disease or compartmentilisation?	
AKESIT	all	ringworm	round patches of hair loss, usually on the head and face of younger animals. Seen on children's heads and arms
AKICWE	ruminants, dogs	heartburn	or **EKICUYAN,** culturally bound syndrome can refer to disease of animal or people, described as ‘salt-craving’ or meat deficiency
AKIDONG	all	castration	two stones are used to crush the testicular cords to cause sterility. In goats, one testicle is preserved.
AKIDORE	all	increase fertility	
AKIDOUNIO ANGNIBERU	all	quick delivery	
AKIMADYA	all	abscess with maggots	
AKIMANYIMANY EJAMU	all	cures leather	
AKIMUJ NGIBAREN	all	fodder	

ngakarimojong	**animal species**	**english**	**description**
AKIRETAKIN EKAPILAN ALOBAREN	all	prevent wizard from attacking animals	
AKIRETAKIN NGICUC KA NGIKUR	all	fly and maggot control	
AKIRETAKIN NGITHIRU	all	mosquito control	
AKIRIT AKIRU	all	chases rain away	
AKIRIT EJOTA	cattle	FMD prophylaxis	
AKIRIT NGICUC	all	fly repellent	
AKIRUMIT AKONYEN	all	trachoma	
AKISIBURAKIN	all	stimulent	
AKISIDIK NGAKILE	all	clots milk	
AKISORIT	all	ringworm	round patches of hair loss, usually on the head and face of younger animals. Seen on children's heads and arms
AKISUBURAKIN AKIMUJ	all	appetite stimulant	
AKITHECON	all	abortion	early delivery of a small, premature animal
AKITOGOGONG NGITAK	cattle	strengthen sick calf	
AKITOWO AKIRU	all	stops the rains	
AKITWARITWARET	all	switches	
AKIURUT	all	diarrhoea	
AKIURUT ANGIKOKOROI	poultry	coccidiosis in domestic birds	
AKIYEC	all	post partum pain	
AKIYOR NGIKONG		helps to collect **NGIKONG** (edible insects)	
AKONYAT EMUN	all	snake spit	
AKONYET KE EMUN	all	snake bite	
AKONYET KE EMUN AKOU	all	snake bite with head trouble	
AKOOK	all	stomach pain	
AKURE	all	thirst	

ngakarimojong	animal species	english	description
AKUTAM	all	bloat, impaction	or **ETID,** enlargement of the rumen following ingestion of soil or other materials that block digestive tract and lead to compaction.
AKWARA		spearhead gum	
AKWE	all	swollen testis	
ALEMAR ARIABA	all	pain killer	
AMIILA	poultry	chicken mites	see **ANYINI**
AMOROK AKWARA	all	spear shaft	
ANGAC	all	genital diseases	
ANGASEP	all	metritis - uterus infection	
ANGASEP	all	retained placenta - smelly	
ANGASEP	all	retained placenta	
ANGASEP KA ABUTH	all	pyometra- uterus infection with pus	
APINGAC	poultry	chicken mites	
APOTOSIT	cattle, donkeys	yoke wounds	
ARAKUM	all	cough	
AREMOR	cattle	calf diarrhoea	
AREMOR KA NGAKOT	cattle	bloody calf diarrhoea	
ARIBO AKONGU	all	eyes painful red	
ARONIKIN	all	dystocia	difficult delivery
ASIYEC	all	delivery pain	
ATENGINA EKOLUPANA	all	barren cow	
ATOMA		pox, acute	acute swelling of the body, eventually gets **ETOM**
ATWANARE ATIPEI	all	sudden death	
AUNO	all	ropes	
AWALA	all	pneumonia, coughing	
AWALA ANGIKOKOROI	poultry	poultry respiratory infection	
AWAS		living fence	
AYEYE	all	ear ache	

ngakarimojong	animal species	english	description
BOROTOKISIM	goats	diarrhoea, chronic	chronic diarrhoea in goats, soiled tails
CHIRAI	cattle, shoats	spirit possession, tick paralysis	hind leg paralysis in cattle and goats. Ghost enters leg. Cure by sacrificing a small animal and tie piece of hide onto affected leg.
EBAIBAI	all, but donkeys	foot rot	occurs during the rains. Animal gets wound between claws and swellings around the hoof top. It may start with a tick bite. Smells bad and limps.
EBAIBAI (Bokora)	cattle	foot and mouth disease (FMD)	
EBALA	all	sticks for guiding livestock	
EBULOLO	poultry	chicken lice	
EBUTELEK	ruminant	sudden death from worm on plant	sudden death during any season after ruminant animal grazes a plant that has 'ebutelek' worm
ECOR	all	inflammation	
ECORO	poultry	newcastle's disease	
EDIIT	cattle	trypanosomiasis, acute	standing hair, thin animal that stays in shade. Eyes -squint, tears, might become cloudy. Tail eventually falls off from disease or if vaccinated
EDIIT	all	trypanosomiases	
EDIT	all	black faeces, greenish urine	
EDUPARE NGIKALEYE	all	stem used for making arrows	
EETO	all	swelling or cellulitis	localised swelling following injury.
EETO	all	mastitis	udder swelling with abnormal milk and might be tender
EDEKEAINGOKWO	all	rabies	'disease of dogs'
EDEKE KE ENGOK ANGIKEREP	all	rabies	
EGEC	all	stick for spinning milk	
EGWE	all	bloating, overeating	enlargement of the rumen following overeating, excess volatile fatty acids and burping
EGWEE	goats	constipation of goat kids	
EGWEE	all	constipation	

ngakarimojong	animal species	english	description
EJAA	cattle	foot and mouth disease (FMD)	
EJOTA	cattle	foot and mouth disease (FMD)	
EKICODON	shoats	foot rot	shoats limping during rain season, secondary to tick bite or grass awn. Begins with swelling, stops grazing and drinking and becomes thin.
EKICUMET	cattle	black quarter	'pierced', blood makes a black area under the skin (subcutis), more common along chest and front legs. Appears the animal has been speared. Meat tastes bitter.
EKICUYAN	ruminants, dogs	heartburn	or **AKICWE,** culturally bound syndrome can refer to disease of animal or people, described as 'salt-craving' or meat deficiency
EKITUBON	all	bloat	
EKITUBON KA AWALA	all	bloat and cough	
EKONYIT	all	otitis secondary to biting ticks	
EKORE	all	chest pain	
ELOMUN	cattle and sheep, fat	grass tetany	lies down and won't get up, acts confused. Called morning malaria - happens in the morning when there is still dew. Usually seen in swampy places, but may occur in dry areas during the rains. Not a common disease and will usually recover without treatment.
EMAM NGAKILE	all	lack of milk	
EMARA	all	foot rot, chronic	hoof wall separates, walks poorly. Hooves are long and make a hollow noise when walking.
EMITENA	goats	demodectic mange	itchy spots, raised hair, brittle and may fall out. Skin is hard and dry with small scabs.
EMITINA	all	mange	
EMUDUKO	all	blind	
EMUDURU	all	blind, eye turns blue	
ENARU	cattle, shoats	lumpy skin disease	or **LONARU,** small swellings on skin, they may burst with pus. Body feels warm and goes off feed.
ENGALURA	all	kidney disease	

ngakarimojong	animal species	english	description
ENGATUN	all	cleft palate	upper lip is split, can even affect the hard palate. Difficult to nurse and probably will not live.
EPAARA	cattle	scabies, mange mite, dermatophilosis	Itchy chronic back wounds. May begin with yoke wound, then spreads over back. Hairs come out; area gets raw or can be scab covered. Yellow exudate when rubbed.
EPAARA	all	dermatophilosis	
EPAARA KA NGIKUR	all	chronic neck/back wound with maggots	
EPAKA	all	foot rot	
EPARA (Pokot)	sheep	sheep foot rot (Pian)	
EPILPIL AKWAN	all	general body pains	
ERIMIRIM	cattle	heartwater, circling, cowdriasis	or **LOKOU,** Tick-borne disease. Animal often moves in a circle while trying to herd them, always turns in the same direction and might headpress against a tree or try to knock the shepherd if he is too close. Hair stands and teary eyes with low appetite. at slaughter fluid in chest cavity and sometimes around the heart.
ETAU	all	heart problems	
ETERAGEGE	all	meningitis	
ETEREGEGE	all	tetanus	animal gets stiff legs. Eyes look very large and fearful with rapid blinking
ETID	all	compaction or bloat	
ETOKU	all	chronic wound	
ETOM	shoats	goat/sheep pox	lesions on muzzle and other mucocutaneous junctions. At slaughter, see stony material in intestines
EURICIANA	all	agalactia, low milk production	
EWOU	bloat		
EYALA	all	ephemeral fever	called **EYALIYAL** in Bokora

ngakarimojong	animal species	english	description
EYALIYAL	all	ephemeral fever or grass tetany	1. 'malaria' caused by coldness due to grazing animals in the early morning before dew is dry. Standing back hair, stretches and yawns, starts to stagger as affected animal walks as if it has a pulled muscle. Animal recovers when sunshine warns animals, hair flattens down. can be affected for a few days. commonly seen October-April, pregnant heifers and small, fat bulls 2-4 years old. Meat at slaughter is yellow, fatty and slightly salty like dry-season bore hole water. 2. During the rainy season with fresh grass. there is a worm in the grass's dew that can bite and cause sudden death. standing hair, blood comes from nose and other orifices. If it recovers, it will limp for a while. Meat at slaughter is reddish and tasteless (like **EKICUMET**). **EYALA** in Pian.
EYALIYAL	all	Lokilala tetany	
INAK EMAARA	cattle	poisonous - gives cattle foot rot	
ITIC AKIRIKET	all	ceremony	
ITUMI NGIKOODO	donkey	fattens donkey	
IYALAARA	all	fever	
KARABU	all	osteomylitis secondary to foot rot	hole in the hoof, foul odour and swollen joint
KARABU	all	pinkeye	see **LOKIYO**
KIPAPA	all	seizures	
KOLERA	poultry	newcastle's disease	sneezing and green diarrhoea in chickens, many die. Some will twist their heads around behind themselves. Bloody stomach and veins.
LOBULUBUL	poultry	fowl cholera	chickens with swollen, pus filled eyes. Rattling sound when it breathes, if bird held upside down - fluid drains out of beak.

ngakarimojong	animal species	english	description
LOBULUBUL	cattle and poultry	hemorrhagic septicaemia	smelly diarrhoea, swollen smelly ears, eyes and neck, standing hair, swollen lymph nodes. Affected animal acts constipated, gets thin and dies within one to four weeks. Similar to **EDIT**, it can evolve into **ABUR**. The meat is watery and will immediately snuff the roasting fire out. Intestines are dark, filled with water and little faeces. Stomach is filled with water. commonly occurs in swampy places in dry season.
LOCEKE	cattle	foot and mouth - chronic stage	‘elongation of hair'. Standing hair that changes colour and grows long with rough skin. Stands in shade, breathes fast and loud, long hooves, cow grows fat (fatter than a pig). Begins with limping, but later walks fine, no mouth lesions like **EMARA**. Doesn’t die, but can be chronically sick for 2-3 years. may get lice and may become sterile. Caused by eating fresh grass and getting too fat. Meat is fat and yellow and smells nice. Intestines cover with fat.
LOCUU	cattle	malignant oedema	weight loss, watery body tissues, epidemic at times.
LOGORICINO	all	calf manure brown/black can have either diarrhoea or constipation	
LOIR	sheep	lumpy wool	scabs in wool during rains. When pulled off -skin has open wounds, all the wool may come off.
LOJELJEL	all	vomiting, nausea with salivation	
LOKAITA (Pokot)	camel	camel diarrhoea	
LOKECUMAN	cattle	black quarter	'speared or piercing'; also known as **EKICUMET**. healthy animal dies suddenly; one leg becomes emphysematous; Commonly occurs on the short green grass of **ELET**, where there is a mixture of clay and loam soils, when the animals fatten.
LOKIPILAK	all	disease prevention	
LOKIT	all	east coast fever	Tick-borne disease. swollen lymph nodes, especially on face and shoulder. Hair stands, ears droop and goes off feed. May have diarrhoea with blood. At slaughter, see blood on intestines, stomachs and in between the ribs.

ngakarimojong	animal species	english	description
LOKIT NGAKINE	goat	east coast fever (ECF) goats, it finishes/swollen lymph nodes	
LOKITUK	all	rotten wounds in mouth	
LOKITUK	shoats	sore mouth in kids	
LOKIYO	cattle	malignant oedema? MCF?	swollen, watery eyes. Joints swell with water is inside. Ears swell. Meat is watery.
LOKIYO	all	pinkeye	
LOKOT	all	babesiosis or anthrax	see **LOKULAM** or **LOTIDAE**
LOKOU	all	headache	
LOKOU	all	heartwater, circling, cowdriasis	see **ERIMIRIM**
LOKOYETA	all	joint/bone pain	
LOKUDI	all	tuberculosis	also **TIBI** or **LOUKO**I
LOKULAM	cattle	babesiosis	Tick-borne disease. 'urinary bladder disease' or **LOKOT**. Hair stands, weak animal, bloody urine. At slaughter, blood is watery, bladder is blood filled and tasteless meat.
LOKUROT	all	liver fluke	At slaughter, yellow or red worm in liver. Liver has hard, black areas with blood clots.
LOKURUT	all	liver flukes	
LOLEO	poultry	diarrhoea in poultry	
LOLEO	all	coccidiosis	bloody diarrhoea, calves get it post weaning
LOLEO	cattle	calves that have lost appetite with diarrhoea	
LOLEO	all	rinderpest	Bloody diarrhoea, some will stick to tail and legs. Draining from nose, mouth and eyes. Very smelly saliva and mouth wounds. Eyes sunken (dehydrated). Fever with slight cough and off feed. Not very common anymore.
LOLIBAKONYEN	all	liver disease	
LOMANY	sheep	anaplasmosis	liver disease, **LOPID** of sheep. Sheep get thin, weak, off feed and die. At slaughter, liver is enlarged, hard and yellow. Gall bladder is large and black.

ngakarimojong	animal species	english	description
LOMEE	goats	CCPP contagious caprine pleuropneumonia, or coughing	coughing with lots of nasal discharge. Thin. See **LOUKOI** = cattle **LOMEEI**
LOMEEI	goats	CCPP	
LOMID	all	otitis with pus often ticks	
LOMOKERE	all	hoof disease, if severe - the digits may fall off	
LOMOLOKA (Pokot)	camel	camel pox	
LONARU	all	lumpy skin disease	see **ENARU**
LONGOKWO	all	warbles	boil on the skin that is a fly larvae
LONGOLESIKE	all	chicken pox	
LONGOLESIKE	all	skin disease with intestinal adhesions	
LOOKOT	all	bloody diarrhoea or coccidiosis	bloody diarrhoea in calves at weaning time.
LOPID	cattle	anaplasmosis	Tick-borne disease. 'bile disease' in cattle. Off feed, hair stands, weak, constipated, enlarged lymph nodes, swollen stomach, reduced movement and stays in shade. Constipated with small, hard dry faeces. At slaughter - large gallbladder filled with thick, dark green bile. Enlarged liver and fat deposits are yellow. Omasum is hard and dry inside, sometimes with packed with dry material. Tasteless meat.
LOTEDUKWA	all	enterotoxemia	‘difficulty to breathe'. Sudden death in most healthy kids/lambs (1month-1year). Found dead in the morning with no warning. If they are seen just before death - they struggle to breathe, head back in opistotonus, body tremors and stumbling, even falling. Increased heart sounds. at death they cry out loudly in a painful manner with extreme head and neck shaking. Meat is fine to eat. Sometimes this happens when their mother dies and they are given cows milk to drink. More common in dry season when there is not enough good food.

ngakarimojong	animal species	english	description
LOTIDAE	all	anthrax	sudden death after evening of fever, dead in the morning. Swollen, bloated body with blood draining from every orifice. Meat tastes terrible aand is deadly. Blood is sticky and watery blood is found throughout the body, together with long, black clots in the vessels. after slaughter or eating its meat - people die.
LOUKOI	cattle	contagious bovine/caprine pleuropneumonia or coughing	coughing with head bent down (if it raises its head to cough, it will recover.) Slow moving within a group, it is always last. Lough, heavy breathing with front legs bowed out. Standing hair. At slaughter, lungs are large, splotchy and stuck to ribs as if a fried egg.
LOWAL	sheep	bottle jaw	swelling under the jaw, especially younger sheep. Standing hair and diarrhoea. Can affect entire flock, many animals die. Watery meat and intestines that snuff out roasting fire. Very white bone marrow. Usually seen at the start of the rains.
NGAGAWEI	all	enlarged lymph nodes	
NGAKIYO	all	tears	
NGAKONYEN	all	eye problem	
NGAKONYON	all	tears rolling	see **NGINIMUK**
NGAMORI LOKOYATA	all	muscle pain	
NGIBOKOR (Pian)	shoats	orf	‘toe nails' see **NGITUBUKAI**
NGIDEKESIO DADANG	all	panacea	
NGIKADESIDES	all	fleas	
NGIKUR	all	intestinal parasites, helminthosis	
NGIKUR KE KWAN	all	maggots	
NGILAC	all	lice	
NGIMADANG	all	ticks	specific tick names include **LOKUMA, NAYEYE, NGALOBU** and N**GOLOETHE**. *Amblyomma* (tropical bont), *Boophilus* and *Rhipicephalus* (brown ear tick)
NGINIMUK	all	tears rolling	
NGITUBUKAI	shoats	orf, contagious ecthyma	wounds with scabs around mouth, may also see on their mothers teats. Dried crusty mucous around nostrils.

ngakarimojong	animal species	english	description
NGKASIKOT KA AKIMAK	all	old people use for medicine	
NGURUMEN (Pokot)	camel	camel orf	
OKURUT	all	intestinal parasites, helminthosis	
PKONYUN (Pokot)	camel	camel swollen head	
PTULUNYOI (Pokot)	camel	camel polyarthritis	
PURIONGUT (Pokot)	camel	camel mastitis	
PUSIT	all	naval abscess	pus-filled pocket at naval of young animal seen shortly after birth. Animal gets sick and may develop a limp.
PUURU	all	measles	
RYOKON	all	tetanus	
SIMBURION (Pokot)	camel	camel mange	
TIBI	cattle	TB	or **LOUKOI** or **LOKIDI**. coughing, especially in a thin, old cow. Swollen lymph nodes.

Adapted from field notes and other NGO reports and manuals from Karamoja (ACTED, 2008; Gradé and Shean, 1998; Shean, 2002).

Appendix IV – Old parchment maps

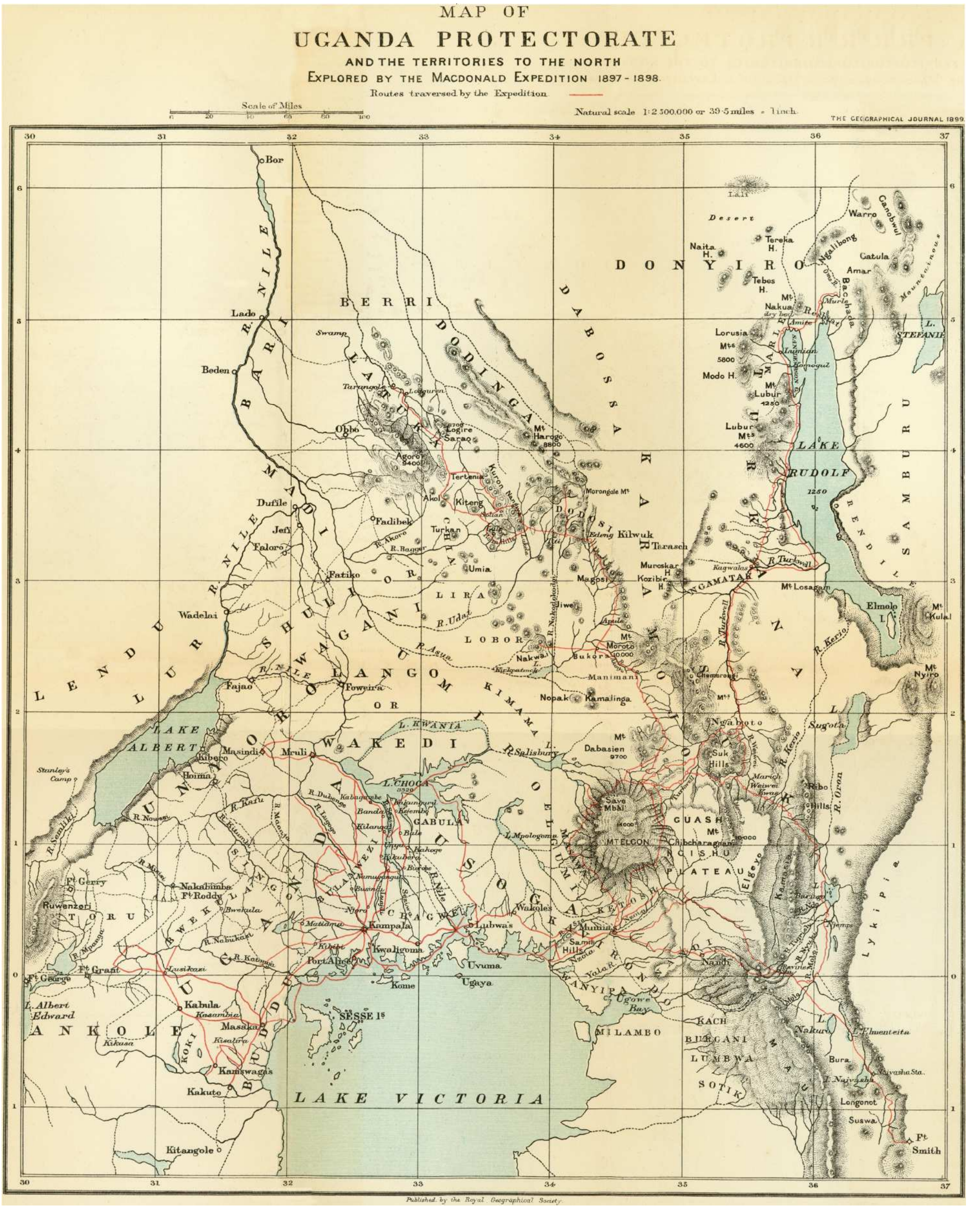


Figure 3 (appendix) MacDonald expedition sketch map through Uganda including Karamoja in 1897-98. Published by the Royal Geographical Society.

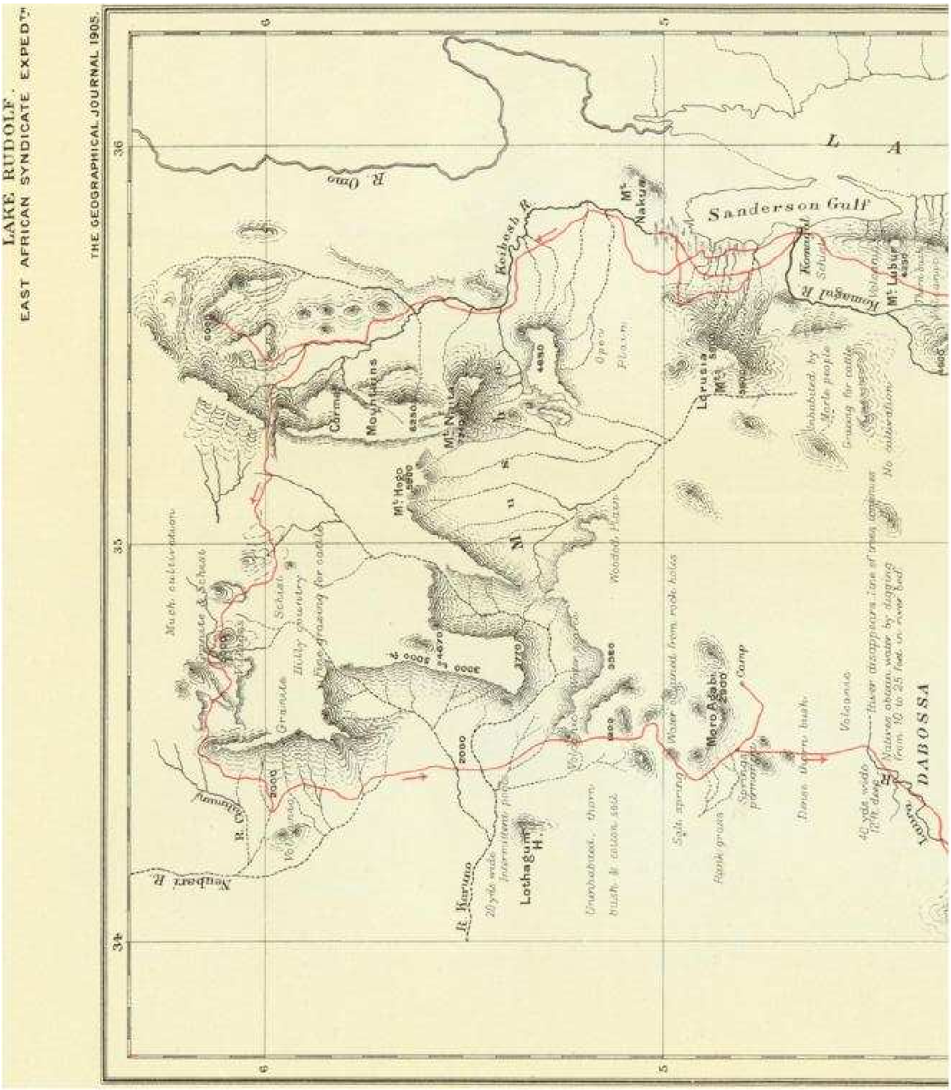
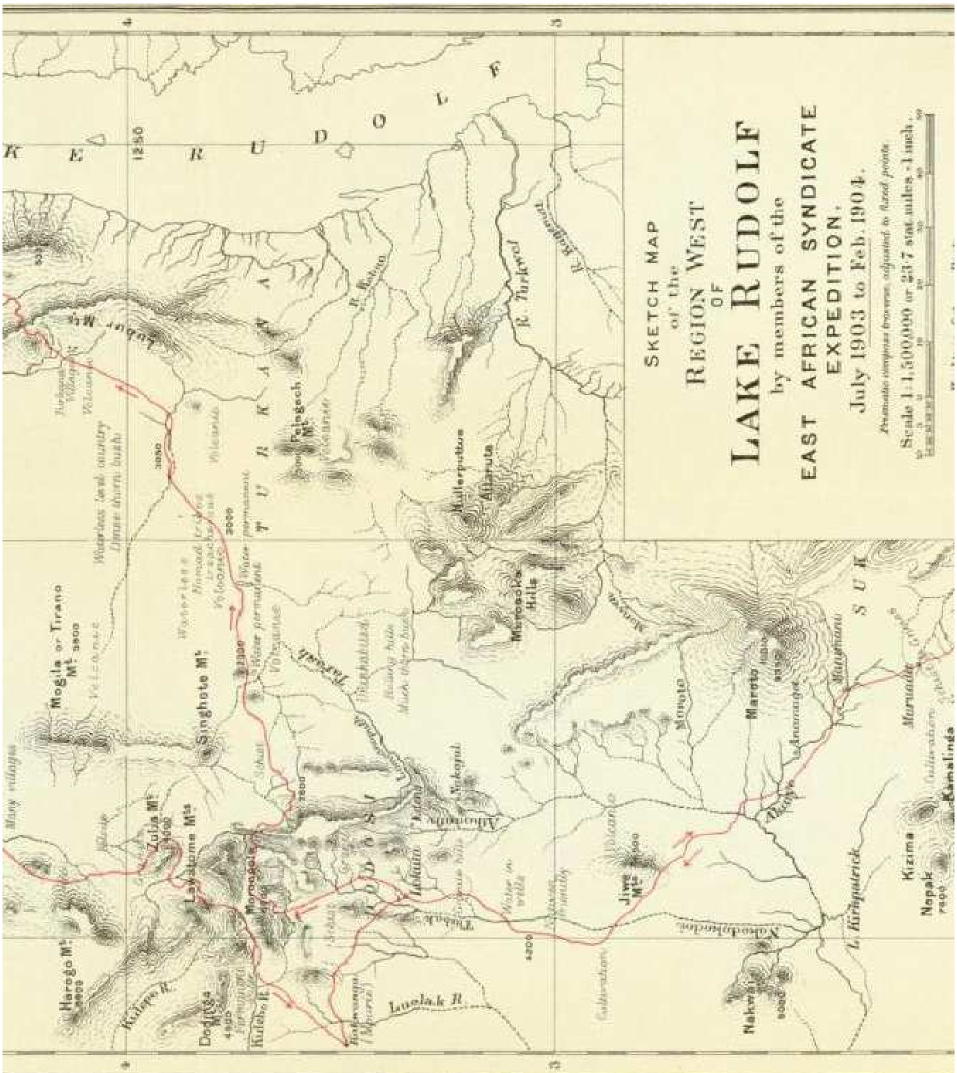


Figure 4 (appendix) Sketch map of 1903 expedition through Karamoja and the Karamoja cluster (Kenya, Ethiopia and Sudan). Published by the Royal Geographical Society.


SKETCH MAP
of the
REGION WEST
OF
LAKE RUDOLF
by members of the
EAST AFRICAN SYNDICATE
EXPEDITION,
July 1903 to Feb. 1904.
L A K E R U D O L F
T U R K A N A
S U K
R. Turkwel
Murosoka Hills
Singhote Mt.
Mogila or Tirano Mt.
Zulia Mt.
Harogo Mt.
Jiwe Mt.
Nakwai
Kizima
Napak
Moroto
Pelegech Mt.
Lubur Mts.
Luolak R.
L. Kirkpatrick
Nakodokodok

Scientific activities of the author

Papers Presented:

2008 October. Lüneburg, Germany. European awareness of Sustainability in Africa: Issues of Pastoralism International Conference at Leuphana University *Embracing ethnoveterinary knowledge diffusion in Karamoja: a strategy to strengthen*

Ibid – *panal debate for plenary session*

2007 November. Liepzig, Germany. 6th European Colloquium Ethnopharmacology. *Fourlegged pharmacists, self-medicating livestock give insights to the origins of ethnomedicines*" Travel Grant received as invited speaker

2007 September. Translational Biomedical Research Seminar. University Illinois, USA *Classroom under the Acacia Tree; Learning from Africa's Animals* Travel Grant and stipend received as invited speaker

2007 August. Ghent, Belgium. World Association for the Advancement of Veterinary Parasitologists (WAAVP) *African plant-based treatment for gastrointestinal nematodes in sheep* (poster)

2006 October. NUFU Medicinal Plants/Biodiversity Conference, at Makerere University, Uganda. *Learning from our animals, the self medicating animals of Karamoja*

2006 October. NUFU Medicinal Plants/Biodiversity Conference, at Makerere University, Uganda. *KACHEP experiences in Karamoja*

2006 November. Kampala, Uganda. Innovation Africa Symposium *IK Bridge to Innovations*. Travel Grant received as invited speaker

2005 December. Ghent University guest lecture for Biology. *Botany by instinct Self-medication of livestock in Karamoja (Uganda).*

2005 August. Istanbul, Turkey. 4th International Congress of Ethnobotany. *Goat's Self Medication in Karamoja, Uganda*. ISBN: 975-807-153-X In Proceedings of the IVth International Congress of Ethnobotany (ICEB 2005) proceedings (Ed. by Z. Füsun Ertug) Yeditepe University, Istanbul, pp 241-248.

2003 Valencia, Spain. 5th European Colloquium Ethnopharmacology. *Warriors' Backyard Pharmacies* (poster)

2002 Virginia, USA. *Integrated Approaches in Working with a Warring People*. Nine veterinary schools for Real Life Real Impact Weekend hosted by CVM

2001 Kampala, Uganda. International Scientific conference Uganda Veterinary Association *Karamojong Scientist, participatory field trails with local medicine.*

2000 Kaduna, Nigeria. International Workshop on Ethnoveterinary Practices. *Bringing Healing to the Nations through Ethnoveterinary Medicine*. In: Ethnoveterinary practices research and development. Proc. International Workshop on ethnoveterinary practices (Ed. by J.O. Gefu, P.A. Abdu and C.B. Alawa), 14-18 August, Kaduna, Nigeria. National Animal Production Research Institute, Ahmadu Bello University, Zaria, Nigeria, pp 95-106.

1999 Nairobi, Kenya. COP- 5 Conference of the Parties in conduction with the International Traditional Medicine Conference. *Bringing Healing to the Nations through Ethnoveterinary Medicine.*

1999 Kampala, Uganda. *Participatory Approach to Animal Health Trainings in Remote Uganda.* International Scientific Conference Uganda Veterinary Association

1998 Moroto, Uganda. *Investigations of Karamojong Ethnoveterinary Knowledge in Bokora County, Moroto District.* Confidential Report for Bokora Livestock Initiative BOLI

1997 Stevens Point, USA. Midwest Rotational Graziers Annual Meeting. *Practicing holistic veterinary care*

1995 – 1998 regular column six times yearly for *Pasture Talk*, North American grazier's journal

Papers Published (A1 Journals):

2008 Economic Botany. *Four Footed Pharmacists: Indications of Self-Medicating Livestock in Karamoja, Uganda*. J.T. Gradé, J.R.S. Tabuti, P. Van Damme.
DOI: 10.1007/s12231-008-9058-z

2008 Veterinary Parasitology. 157 (3-4): 267-274 *Anthelmintic efficacy and dose determination of Albizia anthelmintica against gastrointestinal nematodes in naturally infected Ugandan sheep*. J.T. Gradé, B.L. Arble, R. Weladji, P. Van Damme.
DOI 10.1007/s12231-008-9032-9

2007 Planta Medica, 73 (9): 858-859 *Antimicrobial activity of Ugandan Medicinal plants* M Kuglerova, K. Halamova, L. Kokoska, P. Van Damme, J. Grade.

2007 African Journal of Ecology 45 (3): 18-20 *Deworming Efficacy of Albizia Anthelmintica in Uganda: Preliminary Findings*. J.T. Gradé, J.R.S. Tabuti, P. Van Damme, B.L. Arble.

Papers submitted

Journal of Ethnopharmacology submitted 16 September 2008. JEP-D-08-01712. *Ethnoveterinary knowledge in pastoral Karamoja,* Uganda. J.T. Gradé, J.R.S. Tabuti, P. Van Damme.

IK Diffusion Survey. J.T. Gradé, R. Weladji, J.R.S. Tabuti, and P. Van Damme

Book Chapters

2008 October J.T. Gradé, J.R.S. Tabuti, P. Van Damme *Building institutions for endogenous development: using local knowledge as a bridge* in: P. Sanginga, A. Waters-Bayer, S. Kaaria, J. Njuki & C. Wettasinha (eds), Innovation Africa: Enriching Farmers' Livelihoods, Earthscan, London. 384 pages, ISBN: 978-1-84407-672-7

Supervising professional students:

1994-1998. Mentoring veterinary students during their clinical rotations in diary practice situations (surgery, theriogenology, clinical pathology, necropsy, epidemiology, nutrition, internal medicine, pharmacology, alternative medicine) while employed at Grassland Veterinary Service, Granton, USA from University of Wisconsin, University of Minnesota, University of Iowa and University of Illinois.

1998-present, Mentoring students in veterinary and public health during their clinical rotations in an overseas, remote, cross-cultural community development project (zoonosis, field surgery, theriogenology, necropsy, epidemiology) while employed by Christian Veterinary Mission. Students from University of Wisconsin, University of Minnesota, University of Florida, University of Illinois, Penn State, Tufts University, University of Kansas and University California.

Education:

Ph.D. Ethnobotany, Ghent University, Belgium, 2008
Faculty of Bioscience Engineering. Department of Plant Production, Laboratory Tropical & Subtropical Agriculture and Ethnobotany, Promoter: Prof. Dr. ir. Patrick Van Damme.
Co-promoter: John R.S. Tabuti (Ph.D.), Associate. Professor/Ethnobotanist, Institute of Environment and Natural Resources, Makerere University, Uganda.

Doctorate of Veterinary Medicine (DVM), College of Veterinary Medicine at the University of Wisconsin, Madison USA 1993.

Bachelors of Science in Genetics (BSc), minor in German. Agriculture and Life Sciences College at the University of Wisconsin, Madison, USA 1987.

Jean Terese Gradé, was born in the village of Elm Grove, WI on 14th of May, 1965, the youngest of ten children, full of doctors, artists and cooks. Upon receiving a Doctorate in Veterinary Medicine (DVM), she entered a rural private practice in the Great Lakes Region of North America with a dairy emphasis (1993-1998). Her clinical interests include rotational grazing and organic farming, incorporating acupuncture and homeopathy into nutritional and herd health consultations.

She left private practice in 1998 and moved to the Great Lakes Region of Africa, serving with Christian Veterinary Mission (CVM) as an Ethnoveterinary Consultant among the remote semi-nomadic Karamojong. She helped form local NGOs, Karamoja Christian Ethnoveterinary Program (KACHEP) and Karamoja Ethnoveterinary Information Network (KEVIN). They continue with ethnoveterinary research and development and local capacity building empowerment of traditional healers' activities. As a result, two traditional healers associations were registered at the national level. These are now locally staffed and managed. While in the midst of handing over the NGO to local staff to start her dissertation, she met her husband in 2004 and was married in a traditional ceremony in Bokora in her home village a handful of months later. They left Uganda to Belgium in March 2008 to finalise her dissertation with their eyes and hearts fixed on Kaabong, northern Karamoja.