Investigating the relationships between formal schooling and ethnoveterinary knowledge in Eluwai village, Tanzania

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Abstract

This dissertation investigates the current status and attitudes toward traditional knowledge of ethnoveterinary medicines in a Maasai community in rural Tanzania, and the relationships between ethnoveterinary knowledge and formal education. It concludes that ethnoveterinary medicine still plays an important role in primary livestock health care in the village of Eluwai, and that formal schooling appears to have a negative impact on young people's ethnoveterinary knowledge. It also finds that a culturally sensitive education can have a positive impact on young peoples' attitudes toward traditional knowledge and practises such as ethnoveterinary medicine, suggesting that intercultural education may be a valuable tool in biocultural conservation. Furthermore, this study highlights the importance of practical and contextual experience for learning about ethnoveterinary medicine.

The cover photograph shows a young Maasai *laiyon* herding animals near his *boma* in Eluwai Village, Tanzania.

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> *"The new knowledge the human race is acquiring does not compensate for the knowledge spread only by direct oral transmission, which, once lost, cannot be regained or retransmitted: no book can teach what can be learned only in childhood if you lend an alert ear and eye to the song and flight of birds and if you can find someone who knows how to give them a specific name."*
>
> -Italo Calvino (1983)

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Abbreviations:

BCT	Bovine cerebral theileriosis
CBPP	Contagious bovine pleuro-pneumonia
ECF	East coast fever
ESR	Education for self-reliance
EVM	Ethnoveterinary medicine
EVK	Ethnoveterinary knowledge
GBP	Great British pounds
IUCN	International Union for the Conservation of Nature
LSD	Lumpy skin disease
MMDP	Maasai Medicines Documentation Project
NGO	Non-governmental organisation
PROFIT	Property fitting analysis
TK	Traditional knowledge
TSH	Tanzanian shillings
UNCTD	United Nations Conference on Trade and Development
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
WSK	Western scientific knowledge
WWF	World Wildlife Fund

Chapter 1: Context to a case study in ethnoveterinary medicine

1.1. Introduction

The value of traditional knowledge (TK) for conservation and sustainable development increasingly draws the attention of scholars and practitioners all over the world, and a growing body of literature is emerging on the relationships between biological and cultural diversity (Maffi 2001 and 2005, Oviedo *et al* 2000, Loh and Harmon 2005). Like biological diversity, cultural diversity and the traditional knowledge that underpins it are under threat (Maffi 2005). One of the factors believed to contribute toward knowledge erosion is formal education, which may compete with time spent in cultural activities and learning (Burford and Ngila 2006, Zent 2001, Quinlan and Quinlan 2007, Nabhan 1998). One form of traditional knowledge is ethnoveterinary medicine (EVM), which is recognised as a valuable tool for grassroots rural development and cheap, accessible animal healthcare especially in the world's poorest nations, and as a safer or environmentally benign alternative to conventional medicine in both developed and developing countries (Pieroni *et al* 2004, Githiori *et al* 2006, Minja 1999, Iqbal *et al* 2005). Like other forms of traditional knowledge, ethnoveterinary knowledge (EVK) is under threat from changing attitudes, lifestyles, and values, particularly among the younger generations (Wanzala *et al* 2005). Studies of the Maasai have revealed a primary interest in sustaining their environment not just for the good of people, but also for their animals and the plants that they rely on for animal care (Minja 1999). Therefore continued use of EVM may help to ensure sustainable development, and biological as well as cultural conservation in Maasailand. Formal education may contribute to loss of Maasai EVK, but it may also be a potential remedy to its erosion.

1.1.1. Aims and objectives of the study

The main topic of this dissertation is the relationship between formal education and knowledge of EVM, focussing on a case study in rural Tanzania, which compared the EVK of Maasai students at Noonkodin Secondary School with that of their unschooled peers and elders. The aims of the study were to investigate the attitudes toward and use of EVM in Eluwai village and record the most salient

ethno-medicinal treatments used for livestock in the local community, and to compare students' knowledge of EVM with their unschooled peers' and elders'.

Information for this dissertation was collected from both primary and secondary sources, including seven weeks of field work in a Maasai community. The objectives for the fieldwork were:

- To determine the most salient livestock diseases and EVMs known to students and non-students through freelisting exercises
- To investigate attitudes toward EVM among students and non-students through questionnaires and semi-structured interviews
- To compare theoretical (lexical) knowledge of EVMs between students, unschooled youths and elders of Eluwai village through freelisting exercises
- To explore the variation in students' naming ability through a questionnaire investigating their socio-economic background and exposure to ethnoveterinary practises
- To compare substantive (practical) knowledge of a sub-set of students with that of their unschooled peers and elders through semi-structured interviews

1.1.2. Theoretical and practical significance of the study

This study follows and was in part based on previous research carried out at Noonkodin School, which evaluated student's knowledge of human ethnomedicine (Bradley 2012). It also builds upon the Maasai Medicines Documentation Project (MMDP) (2010/2011), which was developed by Noonkodin school along with local and international partners to record the ethnomedicinal knowledge of Maasai in Monduli district (Hall *et al* 2010). The MMDP was carried out by Noonkodin students and researchers from partner institutions, and resulted in the publication of a booklet documenting the uses and preparation of twenty local medicinal plant species (Burford and Ngila 2006, Hall *et al* 2010). Data collected through interviews and group discussions in this study will be used to produce a supplementary booklet detailing ethnobotanical veterinary treatments used locally. Furthermore, the assessment of students' EVK will be used to evaluate the need to include EVM in the indigenous knowledge programme at Noonkodin School.

The case study presented here will also contribute to the wider body of knowledge investigating the status of EVK among Maasai, and the relationship between formal schooling and traditional knowledge, and young peoples' attitudes toward traditional knowledge. This has implications for education, biocultural conservation and sustainable development.

1.2. Theoretical context

1.2.1. Biocultural diversity

The relationships between biological and cultural diversity increasingly draw the attention of scholars, conservationists and development agencies. The field of *biocultural diversity* studies, which encompasses research into "the total variety exhibited by the world's natural and cultural systems" (Loh and Harmon 2005), recognises the links between linguistic, cultural and biological diversity, and addresses the common threats to all three (Maffi 2005). If species richness and language richness are taken as indicators of biological and cultural diversity respectively, a striking overlap can be identified between countries with high diversity and endemism for both biological species and native languages (Oviedo *et al* 2004). An example is the United Republic of Tanzania, which is ranked 13th in the world for language endemism, 21st for vertebrate endemism, 19th for flowering plant diversity, and 14th for endemic bird areas (Oviedo *et al* 2004). In a study of sub-Saharan Africa, Moore *et al* (2002) found that both vertebrate diversity and language diversity followed a latitudinal gradient, and that the two were very closely correlated, particularly in forests and savannas. To investigate this trend on a global scale, the WWF created the 'Global 200', a sample of 238 ecoregions that are highly representative of the 'biological distinctiveness' of the earth's 19 major biomes. Locations of indigenous peoples, distinguished as 'ethno-linguistic groups', were then mapped onto the Global 200, showing that 67% of indigenous peoples lived in one of these ecoregions, and 95% of ecoregions contained indigenous populations (Oviedo *et al* 2000). Like biological diversity, cultural diversity is under threat (Maffi 2005). As many as 90% of languages are expected to be extinct within the next one hundred years, a number that far exceeds the IUCN predictions for biological extinctions, and if language is a proxy for cultural diversity this represents the loss of the majority of the world's cultures (Oviedo *et al* 2004). Biocultural diversity conservation in practise means maintaining and restoring both biological and cultural diversity, which are interrelated and mutually

supportive, in order to maintain and restore the diversity of life as a whole (Maffi 2012:1).

While the Maasai have fought to maintain their culture since colonial times, they have lost land to rival tribes, environmental changes, privatisation, and conservation efforts, and traditional pastoralism has declined (Maundu *et al* 2001, Homewood *et al* 2009:1). Contemporary scientists view pastoralism as an ecologically sustainable way to utilise arid and semi-arid grasslands and to cope with their spatial and temporal variability, and studies with the Maasai have indicated a primary interest in responsible stewardship of their environment in order to sustain both human and animal health (Minja 1999). Through an intimate connection with the grasslands they inhabit, the Maasai have developed a huge knowledge base about the plants in their rangelands, and rely heavily on them for both nutrition and human and animal medicine (Minja 1999). Furthermore, eating wild animals is heavily tabooed in Maasai culture, as hunting is viewed as a primitive way to obtain food (Maundu *et al* 2001). Thus, the Maasai sustain a diversity of flora and fauna in their rangelands, and maintaining Maasai culture may also help to sustain biological diversity in the vast areas of Kenya and Tanzania that are Maasailand.

1.2.2. Traditional knowledge

> "(TK) refers to the knowledge base acquired by indigenous and local peoples over many hundreds of years through direct contact with the environment. It includes an intimate and detailed knowledge of plants, animals, and natural phenomena, the development and use of appropriate technologies for hunting, fishing, trapping, agriculture, and forestry, and a holistic knowledge, or 'world view' which parallels the scientific discipline of ecology" (Inglis 1993 pg6).

TK can provide a long term perspective on ecological issues and dynamics based on ancestral knowledge and interactions, and is fundamental to human adaptation to natural environments (Oviedo *et al* 2004). It is culturally and contextually embedded and linguistically encoded (Ellen and Harris 2000), thus it's continuation depends on the continuation of diverse cultures. Like western scientific knowledge (WSK), TK is empirically based, detailed and has predictive

capabilities (Kimmerer 2002). It differs in that it is generally qualitative instead of quantitative, diachronic rather than synchronic, based on trial-and-error as opposed to systematic investigation, and, rather than generating general theories, is highly contextualised to specific environments and activities (Kimmerer 2002, Berkes 1993, Ellen and Harris 2000). These differences have in the past caused scientists and governments to question the legitimacy and value of TK, and indigenous cultures all over the world have been marginalised as a result of a model of 'modernisation' that hails western science as the only valid system of knowledge, consumption as the only viable means of progress, and the state as the only legitimate authority (Alexiades 2009). As a result, the structure and livelihoods of indigenous communities have undergone profound changes, including movement from subsistence to a market economy and consumerism, formal schooling, introduction of biomedical treatments and conventional medical practitioners, loss of or reduced use of local languages, settlement and loss of land, exposure to urban culture and values, and erosion of TK (Quinlan and Quinlan 2007, Ross 2002, Nabhan 1998, Zent 2001, Zarger 2001). This is a global issue for mankind, as reduced diversity "diminishes the adaptational strength of our species because it lowers the pool of knowledge from which we can draw" (Bernard in Maffi 2005, pg603).

In the last few decades, TK has begun to be legitimised, and has come to be viewed by many as a complement to WSK. It has become increasingly important on the international agenda, with concerns over biocultural conservation, recognition of the value of TK in many people's lives, and concerns over illegal patenting and benefit sharing (Twarog 2004). Attention has been drawn in particular to its value in developing cost-effective, sustainable, socio-culturally respectful, and environmentally benign strategies to improve the livelihoods of the world's poor (Inglis 1993, Huntington 2000, Kimmerer 2002, Berkes 1993, McCorkle and Mathias-Mundy 1992).

1.2.3. Ethnoveterinary medicine

Ethnoveterinary medicine (EVM) can be defined as:

> "a holistic tradition or local/native system of livestock health management rooted in the people's cultures, customs, taboos and traditions and adopted by livestock raisers... in their respective

> environmental conditions to keep their animals healthy and productive, and to treat and control diseases and livestock-related problems by use of medicines, management practices, information about diseases, animal production and breeding methods, tools and technologies, and magico-religious beliefs..." (adapted from Wanzala *et al* 2005).

Ethnoveterinary knowledge (EVK) therefore encompasses, but is not limited to; breeding, nutrition, epidemiological knowledge of disease vectors, pests and pathogens, spiritualism, herbalism and a deep knowledge of the ecological setting in which this knowledge exists and is used (Wanzala *et al* 2005). The case study presented in this dissertation investigated knowledge of traditional livestock medicines, in particular but not limited to ethnobotanical remedies. Breeding, nutrition and other forms of EVK were not investigated, as the purpose was to compare knowledge rather than to gain a comprehensive understanding of EVM in the study area.

As with human ethnomedicine, plants are highly important in EVM, and a growing body of literature has reported the pharmacological activity of ethnobotanical remedies in EVM across the globe (McCorkle and Mathias-Mundy 1992, McGaw *et al* 2007, Pieroni *et al* 2004, Lans *et al* 2007, Iqbal *et al* 2006). Other important *materia medica* include ashes, salt, clay, and urine, and procedures including cauterisation, crude forms of immunisation, surgery, and obstetrics (McCorkle and Mathias-Mundy 1992).

EVM is recognised as a valuable tool for grassroots rural development and cheap, accessible animal healthcare, especially in the world's poorest nations where conventional veterinary medicine is often out of reach due to economic reasons, lack of infrastructure, and cultural incompatibility (Iqbal *et al* 2005, Wanzala *et al* 2005). Ethnoveterinary practices have proven particularly effective for primary livestock healthcare, and to treat general afflictions such as skin diseases, wounds and birth complications (McCorkle and Mathias-Mundy 1992, Nfi *et al* 2001). On the African continent ethnoveterinary practises remain important among the many tribes who rely on livestock for their livelihoods (Minja 1999, McCorkle and Mathias-Mundy 1992) and, where conventional veterinary medicines are available, is often used complementarily (Minja 1999, Jacob *et al*

2004). In 1977, the 30th World Health Assembly urged governments to integrate and utilise their traditional healthcare systems (Nfi *et al* 2001), and advantages of combining both conventional and traditional strategies for coping with livestock diseases have been described (Minja 1999, Wood 1987). EVM is also seeing a resurgence in the developed world, as consumers increasingly favour organic production of quality food, free from artificial chemicals (Pieroni *et al* 2004, 2006, Lans *et al* 2007, Minja 1999). Contamination emergencies in the meat and dairy industry such as BSE in the UK, and increasing drug resistance, particularly of gastrointestinal parasites in small ruminants, has stimulated debates about animal healthcare policies; in this climate EVM has been recognised as a potential way forward to deal with these issues (Pieroni *et al* 2004, Githiori *et al* 2006).

Like other forms of TK, the continued use and transmission of EVK is threatened by a number of factors associated with socio-economic, technological, and environmental change (Wanzala *et al* 2005). Exposure to external cultures' values and attitudes through television and other media, non-native institutions such as churches, and formal education, can have profound effects on the lifestyles that young people choose, and the attitude they take toward the knowledge and practises of their elders; traditional knowledge and practitioners rarely receive external recognition of their value (Wanzala *et al* 2005, Shikongo 2005). Additionally, schooling and wage labour can remove young people from their cultural setting, reducing their exposure to traditional practises and their interaction with community members who hold TK (Zarger 2001, Zent 2001, Nabhan 2008). Among Maasai, the *ilterito* age set (elders) are the most experienced custodians of EVK, and continuation of this knowledge relies on oral transmission from them to younger generations (Jacob *et al* 2004).

1.2.4. Formal education and traditional knowledge

Studies have shown that TK is generally learnt in the home or other cultural environments through informal teaching during work, play and community activities (Zarger 2011). Formal schooling is widely recognised as a factor in the development of a 'generation gap' in knowledge transmission (Burford and Ngila 2006, Zent 2001, Quinlan and Quinlan 2007, Nabhan 1998), as it takes a great amount of children's time, removing them from the settings in which they would learn TK and reducing contact with 'teachers' (Zarger 2011, Reyes-García *et al* 2010). Maffi (2001:7) coined the term 'extinction of experience', referring to "the

radical loss of direct contact and hands-on interaction with the surrounding environment that traditionally comes through subsistence and other daily life activities", which she suggests is a major factor in TK loss. Furthermore, formal schooling can break down the 'learning networks' through which TK is transmitted (Zarger 2001), especially where wage labour further reduces time spent in informal education with parents and other members of the local community (Nabhan 1998).

Often, students must travel to the nearest city to attend school, and board there because the distance is too far to commute every day. This not only removes youths from their community for long time periods, but also exposes them to urban culture and values; many migrate permanently to cities to work in wage labour jobs, and abandon their traditional lifestyles (Burford and Ngila 2006, Ruiz-Mallén and Barraza 2007). Even where local schools exist to serve rural or indigenous communities, teachers often come from different ethnic groups, use material developed in a different ecological and social context, and remain for a short time only (Reyes-García *et al* 2010). Often lessons are taught in a dominant national language rather than the local tongue, a common problem in Central and South America (Reyes-García *et al* 2010) and in African countries such as Tanzania (Semali 1999). Thus, formal education can contribute to the erosion of local languages, and the TK which they encode (Maffi 2005), and children may have difficulty learning knowledge that cannot be applied in a locally relevant context (Reyes -García *et al* 2010, Cruz-García 2006). The subversion of TK to WSK and pervasive elitist values since the colonial era is apparent in formal education systems the world over; TK is often considered to be rudimentary and naive, with local institutions and innovations gaining little recognition (Alexiades 2009, Ellen and Harris 2000, Shikongo 2005, Semali 1999).

In 1968, post-independence, the first president of Tanzania Julius Nyerere said:

> "At present, our students learn to despise even their own parents because they are old-fashioned and ignorant; there is nothing in our existing educational system which suggests to the pupil that he can learn important things about farming from his elders. The result is that he absorbs beliefs about witchcraft before

> he goes to school but does not learn the properties of local grasses; he absorbs taboos from his family but does not learn the methods of making traditional foods. And from school he acquires knowledge unrelated to agricultural life. He gets the worst of both systems!" (From Semali 1999, pg. 307)

Decades later, locally relevant TK has still not been successfully incorporated into African school systems, although Tanzania's 'Education for self-reliance' (ESR) programme is largely hailed as the best attempt that has yet been made in Africa to integrate cultural knowledge into formal education (Semali 1999). ESR aimed to localise school currricula and create a practical programme of learning that would be more appropriate to the activities of Tanzania's rural communities (Semali 1999). In fact, although it was written into some subject syllabi that students should be taught local customs and knowledge, in reality this was not linked to local activities. Rather than gaining practical skills, students were required to regurgitate the information for exams, a similar situation to attempted education reforms in Kenya (Semali 1999).

1.2.5. Intercultural education

While formal education is largely considered to be a threat to TK, it is also a possible remedy to TK erosion (Reyes-García *et al* 2010). One of the key measures for conserving indigenous knowledge and biocultural diversity recommended by Oviedo *et al* (2004) in a UNCTAD publication, is a focus on children and education. The authors state that:

> "It is fundamentally important to work with the school system. Increasingly, children from indigenous and traditional communities go to school, and almost certainly in a couple of decades the school will become a universal system for transmission of knowledge.... Working with the school system from the start is very important for managing cultural change in a way that benefits traditional communities. The school can and should be a vehicle for the transmission of TK together with other knowledge systems."

Intercultural education has arisen out of indigenous peoples' frustration with formal education systems that repress cultural diversity and aim to assimilate their children into a dominant national society (Aikman 1999 pg2, Arratia 1997). It

is based on principles of equality, democracy, and respect for diversity, and on the understanding that indigenous peoples have the right to a culturally appropriate education (Aikman 1997). This is outlined in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), which states that:

> "Indigenous peoples have the right to establish and control their educational systems and institutions providing education in their own languages, in a manner appropriate to their cultural methods of teaching and learning" (UNDRIP Article 14:1).

For indigenous communities, intercultural education can be a tool in the fight to maintain cultural identity, values, traditional knowledge and livelihoods, and to facilitate free and full participation in wider society (Aikman 1999 pg1).

1.3. Background to the study

1.3.1. Cultural context

Traditionally a nomadic people, the Maasai occupy the southern part of Kenya and northern districts of Tanzania, an area of about 150,000 km^2 of arid and semi-arid land (Maundu *et al* 2001, Homewood *et al* 2009:1). The term 'Maasai' refers to speakers of the Eastern Sudanic language called Maa, of the Nilo-Saharan language family, who are believed to have originated from northern central Africa (Maundu *et al* 2001). As livestock keepers, the Maasai traditionally subsisted on milk, blood and meat products from their cows, sheep and goats, although some now keep poultry as well; wild foods such as berries are also important particularly when herding, but meat hunted from the wild is heavily tabooed (Maundu *et al* 2001). Much of the Maasai's original land has been lost to their agricultural rivals, or as a result of land tenure changes, privatisation, set-aside for conservation efforts, and environmental changes, and specialised pastoralism has declined and been driven to the drier plains (Maundu *et al* 2001, Homewood *et al* 2009:1). Although the Maasai still rely predominantly on livestock, many have diversified to agro-pastoral systems of subsistence, or have drifted to urban centres and now participate in a monetary economy (Homewood *et al* 2009:1, Lovett *et al* 2001). In Tanzania the Maasai were largely sedentarised in villages during the 1960s and 70s under the socialist regime, which aimed to create proximate settlements in order to provide services to all of its citizens (Ndagana 1982, Goldman and Riosmena 2013). Monduli Juu, where fieldwork for this

dissertation took place, was created during the resettlement programme 'Operation Imparnati' in 1974 (Ndagana 1982).

Maasai social organisation is gender streamlined, with males passing through three distinct stages (boyhood, junior and senior warriorhood, and elderhood) marked by rituals and ceremonies. Approximately every 15 years a new age set is created, with boys around the age of 15 circumcised, marking their passage to junior warriorhood (Maeda-Machung'u *et al* 2001). Elders are responsible for training *morans* (warriors) in how to be tough, how to handle and treat animals, how to prepare herbal concoctions for stimulating libido, and traditional ethics (Maeda-Machung'u *et al* 2001). Young boys, called *laiyons*, are given chores such as herding near the homestead, and play games which become increasingly rough as they age (Maeda-Machung'u *et al* 2001). Junior warriors are considered old enough to take care of themselves, and are often sent on *ronjo*, which involves moving with livestock to temporary settlements in order to find fresh pastures during the dry season or droughts (Goldman and Riosmena 2013). On *ronjo*, *morans* rely on wild plant resources for food, medicine and EVM (Maundu *et al* 2001).

Girls aged 9-12 associate with junior *morans* rather than boys, and can take lovers (Maeda-Machung'u *et al* 2001). Traditionally, girls are circumcised when they reach puberty and are then eligible for marriage, although in Monduli district, where the fieldwork took place, female circumcision is now outlawed. As they become older girls learn female chores from their mothers, such as milking, fetching water, building houses, cooking, sewing, and taking care of children (Maundu *et al* 2001, Maeda-Machung'u *et al* 2001). Further knowledge such as herbalism and EVM is learnt from observation and exposure to household activities such as gathering firewood and construction materials, and husbands also teach their new wives about EVM (Maundu *et al* 2001, Maeda-Machung'u *et al* 2001).

Marriage is exogamous and descent is patrilineal; polygamy is typical (Maundu *et al* 2001, Maeda-Machung'u *et al* 2001). A traditional homestead, called a *boma* in Swahili or *engang* in Maa, is a circular arrangement of mud and grass-thatch huts typically housing a polygamous family unit, with a hut for each wife

and her children, and a communal enclosure for the family's livestock (Goldman and Riosmena 2013).

Research has shown that Maasai have a vast amount of TK in relation to both human health care and EVM (Minja 1999, Maeda-Machang'u *et al* 2001). However, livestock disease is commonly reported as a major cause of livestock loss and reduced production in pastoral systems in Tanzania, and an array of other factors pose further threats to both pastoral livelihoods and TK (Maeda-Machang'u *et al* 2001). Notable changes facing pastoralists in Tanzania include reduced mobility, reduced subsidies for veterinary services, diversified livelihoods resulting in disrupted social organisation, out migration particularly of young men from rural communities, environmental degradation and loss of plant species, and changes in government economic and land policies (Maeda-Machang'u *et al* 2001). These are similar to changes facing pastoralists across Africa and globally (Galvin 2009, Fratkin 2001, Shikongo 2005).

1.3.2. Demographic context

The field work for this dissertation was carried out in Monduli District, in the Arusha region of northern Tanzania, 50km north-west of the city of Arusha. About 86% of households in Monduli district are rural, the rest are classed as peri-urban (EDI 2005). There is a high level of poverty in this region, particularly in rural areas where over 50% of the population lives below the Basic Needs Poverty Line (EDI 2005). Literacy is low, particularly in rural areas where the rate is as low as 38% (and worse among females), with poor access to schools; as few as 6% of secondary school age children in rural areas live within 30 minutes of a secondary school, although around two thirds of children attend primary school across the whole district (EDI 2005).

1.3.3. Geographical context

Monduli Juu, which means Monduli 'in the sky' referring to the high altitude (1600-2500m), consists of four villages in Monduli District; Emairete, Enguiki, Mfereji and Eluwai. Monduli Juu has a population of 15,914 according to the 2012 National Census (National Bureau of Statistics 2013). The study was conducted in the village of Eluwai, which includes the Eluwai plains and Tarsero peak (Ndagala 1982). Of the four villages that make up Monduli Juu, Emairete, Mfereji and Enguiki are linked by the Monduli-Loliondo road to Monduli Mjini, the nearest town, and

via Monduli Mjini to the city of Arusha. Eluwai remains relatively isolated, and can only be accessed by foot, motorcycle taxi or with a four-by-four vehicle. Access during the rainy season is particularly difficult due to the black cotton soil which retains water poorly and prevents any vehicular access during heavy rains. The only water source in the plains and valleys where Emairete and Eluwai are located is the Monduli Juu dam, built in the early 1980s.

Figure 1. Photograph of mature and immature forms of *Eluwai* (*Acacia drepanolobium*), taken from the yard at Noonkodin Secondary School. Eluwai can be recognised by its dark galls.

Monduli is one of the districts which falls within the "Maasai Steppe-proper" of Tanzania, characterised by arid land and tree savannah dominated by *Acacia* and *Commiphora* species (Kshatriya *et al* 2007). The village of Eluwai is named for the gall acacia (*Acacia drepanolobium*) which forms a shrubby land cover across much of the landscape. Rainfall in Monduli is bi-modal, with short rains falling between November and December, and heavier, longer rains in March to May, with dry periods in between (Kshatriya *et al* 2007). Mean temperatures reach a maximum of 27°C and a minimum of 16°C, although these vary depending on the altitude; Eluwai sits at relatively high altitude and so receives heavy rainfall and the more extreme temperatures. Eluwai's vegetation consists of wooded grassland of varying composition and diversity depending on the rains, including many species of Poaceae as well as annual and diminutive perennial shrubs and flowers (Bradley 2012), and dry montane forest with stands of *Olea europaea ssp. africana*, as well as *Carissa edulis*, *Juniperus procera*, *Cordia ovalis*, and other *Acacia* species (Burford 2002, Bradley 2012).

1.3.4. Social organisation in the study area

The traditional land use pattern in Eluwai was transhumance but this has changed to an agro-pastoral system, with many households growing maize and beans in their *shambas* (farms). Typically in Monduli, the highlands (*osupuko*) are grazed during the dry season as well as being used for crop cultivation, and the hot plains (*orpukel*) are grazed during the wet season (Mapinduzi *et al* 2003). As well as smallstock and cattle it is common to keep chickens for egg production, donkeys as pack animals, and guard dogs for protection from wild animals. Cows are usually used to produce milk for the family, with fermented milk traditionally being the staple food source, and surplus may be sold for around 5,000 TSH a litre (about 2GBP). Cows may also be sold for meat, and are used as social currency; a man must pay a bride price in cows to the parents of his prospective wife. Small stock are also milked but usually for subsistence only, as they rarely give enough milk to have surplus (Mollel, pers. comm. 2013). Small stock are also eaten at feasts and may be sold for meat at market. At market women can also be found selling maize, beans and other fruits and vegetables grown locally or brought from Arusha and elsewhere, as well as handicrafts, eggs, and other groceries brought from the city.

Figure 2. A Maasai herder with his cows passes a field of maize in Eluwai village, demonstrating the diversified livelihood of Maasai in this region. *Katani* (*Agave sisalana*) can be seen planted along the edge of the field to reduce soil erosion, and is also a popular EVM.

1.3.5. Noonkodin School

Noonkodin Secondary School is a non-government school in the village of Eluwai, run by UK-based NGO Serian UK. Noonkodin implements an indigenous knowledge programme alongside the national curriculum, which teaches local knowledge such as traditional medicine, as well as ethnobiological research methods designed to equip students with the skills to research and document TK in their own communities through self-lead projects (Burford and Ngila 2006, Burford *et al* 2012). The broad aims of the school are to develop self-esteem, cultural identity and practical skills relevant to local community activities, and to reduce out migration of young people to go to school or join the workforce in cities (Burford and Ngila 2006). The intercultural curriculum involves local community members in teaching TK as well as the histories, oral literatures and cultural practises of their ethnic groups, helping to bridge the gap between elders and young people and restore informal learning networks. The school boasts a number of positive impacts including preservation of traditional knowledge through participatory learning and knowledge documentation, an education that equips

young people to deal with the challenges in their own communities and local environment, as well as high standards of discipline and intercultural awareness between students (Burford *et al* 2012).

Figure 3. Students of Noonkodin Secondary and the local primary school playing a game of football on the sports field shared by the two schools. Younger children from the primary school regularly mix with Noonkodin students, and teachers also join in.

Chapter 2: Methodology

Qualitative and quantitative methods were used for primary data collection during field research in Tanzania. The aims of the fieldwork were two-fold: first to investigate the attitudes toward and use of EVM in Eluwai village, and record the most salient ethno-medicinal treatments used for livestock in the local community, and second to compare students' knowledge of EVM to their unschooled peers' and elders'. The objectives, and the methods used to investigate each objective are summarised in the following table.

Figure 4. Table summarising the methods and analysis used to achieve each of the five objectives of this study.

Objectives	Methods	Sample	Analysis
1. Determine most salient diseases and ethnoveterinary medicines known to students and non-students	Freelisting	Students n=80 Non-students n=20 (10 young, 10 elders)	Quantitative: Anthropac- frequency and Smith's salience
2. Investigate attitudes toward EVM among students and non-students	Questionnaires	Students n=79	Qualitative
	Semi-structured interviews	Students n=10 Non-students n=20 (10 young, 10 elders)	Qualitative
	Informal discussions	Not measured- opportunistic	
3. Compare lexical knowledge of students and non-students	Freelisting	Students n=80 Non-students n=20 (10 young, 10 elders)	Quantitative: SPSS- *t*-tests/ Mann-Whitney tests
4. Explore variation in naming ability among students	Questionnaires	Students n=79	Quantitative: SPSS- *t*-tests on freelists of groups
5. Compare substantive knowledge of students and non-students	Semi-structured interviews- knowledge scored	Students n=80 Non-students n=20 (10 young, 10 elders)	Quantitative: SPSS- *t*-tests/ Mann-Whitney tests

2.1. Fieldwork

2.1.1. Location and organisation

Fieldwork was carried out over seven weeks in April-June 2013, and was based at Noonkodin Secondary School in Eluwai village; formal research was carried out both at the school and in the village. Research was carried out in Swahili and Maa, with the aid of a trilingual interpreter competent in Swahili, Maa, and English. The interpreter, Samwel Mollel, was a teacher and a former student of

Noonkodin School, grew up in a nearby village, and knew many people in Eluwai; he therefore acted as a cultural facilitator as well as an interpreter. The same interpreter was used throughout the research. Interpretation was instant, so that the primary researcher was able to lead interviews and freelisting sessions. Transcription was from the English translations in the voice recordings. While living in the village there were many opportunities for informal discussions as well as the structured research methods described below, and these allowed further insight into the issues surrounding EVK in Eluwai.

2.1.2. Ethical considerations

The research adhered to the code of ethics of the International Society for Ethnobiology (International Society for Ethnobiology 2006). Prior, written, and informed consent was obtained from the Second Master of the school on behalf of the students who participated. Verbal consent was obtained from all non-student participants prior to interviews and was recorded on a voice recorder as part of the interview, as most were illiterate. Names are not used in this dissertation although they were recorded so that informants could be revisited if further questioning was deemed appropriate. To the best of my knowledge, no sensitive information will be divulged in this or any other report resulting from this research, and all information relating to EVM is considered the intellectual property of the participating community.

2.1.3. Indicators of EVK

Knowledge is complex and measuring EVK in its full complexity was beyond the scope of this study given the time limitations. It was decided that theoretical and practical knowledge must be measured, as intellectual ability and practical ability are not necessarily gained at the same time, with theoretical knowledge often learnt in childhood while practical skills may be learnt later (Reyes-García *et al* 2007, Hunn 2002, Reyes-García *et al* 2009, Zarger 2002, Hewlett and Cavalli-Sforza 1986, Zent 2001). Indicators of individual knowledge used in this study were:

- Lexical knowledge/naming ability- freelist length
- Substantive knowledge- uses and preparations known to the informant (self reported in interviews)

To quantitatively analyse students' theoretical knowledge, the length of freelists were compared, as freelisting is a simple but powerful technique for investigating theoretical knowledge (Bernard 2004), and was easy to perform with a large group of students in a short time allocation. Furthermore, comparing freelist length did not rely on cultural consensus to measure individual knowledge, allowing for variation in individual knowledge between students for example who were from different districts or ethnic groups. However, salience of items listed was analysed to identify differences in knowledge between groups of informants.

Practical knowledge was measured by asking informants to self-report their skills in interview, i.e. they were asked the uses and preparations of plants in their freelists. Although it is more common in ethnobotanical studies for researchers to observe informants in order to evaluate their skills (Reyes-García *et al* 2007), it was not possible to do this with the students as they were in boarding school and did not have regular responsibilities in livestock care. Therefore, practical or substantive knowledge was assessed by scoring informants' interview responses when asked about the use and preparation of ethnoveterinary medicines, with points awarded for knowing a) at least one use, and b) at least one method of preparation for each EVM listed.

2.2. Freelists

2.2.1. Freelisting as a tool in ethnobotany

Freelisting is used to reveal cultural salience as well as individuals' knowledge of a domain such as medicinal plants (Quinlan 2005, Puri and Vogl 2005, Ryan *et al* 2000). This method in ethnographic/ethnobotanical research is based on several assumptions; first, that informants will list those items with which they are most familiar first, and those they scarcely come into contact with last, second that those with greater knowledge of a domain will list more items than those with less knowledge, and third that items commonly mentioned are locally prominent (Quinlan 2005, Gatewood 1983). In this study freelists were used to explore the domains of 'disease' and 'medicine' in the population studied, to discern the most salient items in these domains, and whether they differed between groups in the sample. They were also used as an indicator of informants' individual knowledge about ethnoveterinary medicines, simply by totalling the

number of items mentioned and comparing 'knowledge', using naming ability as an indicator, between groups.

2.2.2. Sampling

80 students from Noonkodin Secondary School took part in the freelisting exercise, including 48 from form three and 32 from form four. The ages were similar in both forms, and ranged from 16 to 24 years old; most had been in formal education for approximately ten years. Of these, 37 were female and 41 were male. 49 students were Maasai, the remaining 29 being of twelve other indigenous groups, the most common of which were Chagga, Meru and Iraqw.

Ten unschooled youths produced freelists. Unschooled young males were all currently *morans* (junior or senior) and were considered to be the students' peers according to my interpreter; females were of similar ages. Six males and four females were interviewed, with ages ranging from 16 to 32 (although most people in this sample guessed, as the Maasai don't traditionally keep track of their exact age). None of these informants had higher than a primary school education. Six of these informants were married and therefore carrying out adult roles to maintain their own household, rather than living at their parents' homes. These informants were recruited opportunistically by walking in the village and talking to people on the paths, in their fields, or at their *bomas* to ask if they would be willing to participate in the research, if they met the required demographic characteristics.

Elders were of the 'elder' age set in the case of males, meaning that they had graduated through warriorhood; women were of similar ages as there is no official set for them. Informants were estimated to be aged 40- to 100-years-old, although most people made an estimate of their age. Seven males and three females were interviewed (see section 2.5.3. Sampling limitations). Elder participants were recruited opportunistically; they were met during walks around the village either by approaching *bomas*, or talking to people in the fields and on paths who met the demographic requirements of the sample. None of these informants had higher than a primary school education, and all participated in a traditional lifestyle and predominantly subsisted from animal husbandry and in some cases crop cultivation also.

2.2.3. Freelisting exercises

Informants were asked to make two freelists; one of all of the diseases that they knew for domestic animals, and one of all of the medicines that they knew for domestic animals. There was no time limit, in order to prevent the exercise from feeling like a test, and all finished within half an hour, some earlier than others. Students were asked not to compare lists, and were encouraged to think of the different domestic animals that they knew to help them to recall livestock diseases and medicines.

Non-student informants produced freelists as part of a semi-structured interview. They were first asked which animals they keep, and then to list all of the diseases they know for domestic animals, then all of the medicines that they know for domestic animals. Some informants, particularly elders, asked to refer back to their list of diseases in order to remember medicines, and this was allowed. Informants were encouraged to add more to their list before moving forward in the interview.

2.2.4. Analysis

Students' freelists were written in Swahili, Maa, and English, and were translated by my interpreter. Synonyms were combined. The term *'mti shamba'* was discounted, as it is the generic Swahili term for traditional medicines. A number of conventional medicines were also omitted from analysis, since the freelists were intended to explore knowledge of EVM; these were *'olturumaesi'*, *'rangi mbili'*, *'beren'* and *'mseto'*. General names of plant parts where specific plants were not named were also excluded from the analysis. Translation of vernacular names to biomedical terms and Latin binomials was difficult in some instances; some items were not translated although all of the common items were. Some of these vernacular names were translated by the interpreter and cross-checked against existing literature and online resources, others were translated by the researcher using literature and online resources. This was very time consuming, in part due to the large number of synonyms, and also because there is a huge degree of variation in spellings in the literature, as Maa is not traditionally a written language. Furthermore, students made many spelling mistakes in both Maa and Swahili. Resources used to translate vernacular names of diseases and medicinal plants are listed under separate headings in the bibliography.

Univariate analysis using Anthropac© was used to determine the frequency of naming and salience of items named by students and non-students, as described in Puri and Vogl (2005). To compare naming ability between students and non-students, the mean length of freelists were compared using independent samples *t*-tests in SPSS©. Levene's test for equality of variance was first carried out to determine the appropriate statistical test; where variances were significantly different the Mann-Whitney U test for non-parametric data was used instead of *t*-test. Summary data were displayed in charts created using Excel©.

The tool PROFIT (property fitting), which uses multiple regression analysis, was used to determine whether age accounted for any of the variation in the freelists, and network regressions were performed to determine the relationships to the following non-metric variables: gender, tribe, level of schooling (primary, form 3, or form 4), occupation/family occupation ('traditional'- animal keeping and/or crop cultivation, or 'commercial'- wage labour), residence (village or town), favoured medicine (traditional, conventional, or both), whether informants were actively taught about EVM or not, and whether they had been on *ronjo* or not. Those variables that appeared to be related to EVK were investigated further within the student dataset using independent variables *t*-tests comparing mean list lengths between groups, which were performed in SPSS©. Groups compared were: Maasai/non-Maasai, male/female, form three/form four, taught/not taught about EVM, residing in a town/village, and had been on *ronjo*/had not been on *ronjo*. A significance level of 95% was accepted ($p=<0.05$). Summary data were displayed in charts created using Excel©.

2.3. Semi-structured interviews

2.3.1. Sampling

34 interviews were carried out with students, their unschooled peers (current warriors, or their female age equivalents), and elders. The interviews were recorded using an Olympus© WS-812 voice recorder, and the English translations were transcribed afterward. The sample included ten students, ten unschooled young people, and ten elders. The purpose of these interviews was to discern whether informants had substantive knowledge about the medicines that they named. Informants were not offered payment for their participation, but were given a gift at the end of the interview.

Non-student informants were those who had participated in the freelisting exercise (described in section 2.2.2.). Students were selected randomly from a subset of the informants who gave freelists. This subset consisted only of Maasai students, since all non-student informants were Maasai, and excluded those who named neither any diseases nor any medicines in their freelists, and were therefore considered to have very little or no knowledge of EVM. Form four students had exams at this time, so only form three students were able to participate. This sample consisted of eight males and two females; gender was shown to be insignificant across the complete sample of students in relation to naming ability. The age range of this sample was 18-21, and all of the students were unmarried and resided in their parental household outside of school time.

2.3.2. Structure of interviews

Interviews began by collecting basic socio-economic information. Informants were also asked to tell me which animals they kept in their household. Non-student informants were then asked to make freelists of diseases that they knew for domestic animals, and medicines that they knew for domestic animals; in the case of students the freelist they had already written was read back to them. During the interview informants were encouraged to extend their freelists using techniques discussed in Brewer (2002); non-specific prompting, such as 'do you know any diseases that affect donkeys?', by reading back over their lists, and by using free-listed items as semantic clues, for example 'are there any other medicines which can treat *ormilo*?'. Most informants added more items to their freelists during discussions, some even doubling their list. The interview technique linked the freelists of diseases and medicines; after making two separate free lists, the informant was asked to tell me the symptoms of each disease they had mentioned, then to tell me all of the EVMs that they knew of to treat it. For each medicine they were then asked where can you find it, which part to use (where applicable), and how to prepare and administer it. The informant was then asked which diseases were treated by any remaining medicines on their list that had not yet been discussed. This technique is known as successive free-listing, and is effective in eliciting more information from informants than standard freelisting (Ryan *et al* 2000). Finally, informants were asked how they had learnt about EVM, and whether they had been on *ronjo*.

2.3.3. Analysis

The extended lists obtained during interview were analysed as described above, using Anthropac© to determine the most salient and frequently mentioned items, and SPSS© to compare mean list lengths between groups. Substantive knowledge was then scored using a five point scale; one point was awarded for a name, two additional points if the informant could describe at least one disease that the medicine could treat, and a further two points for being able to describe how it is prepared/administered. Informants were also asked where to find each medicinal plant that they mentioned, but this was not a good indicator of substantive knowledge for non-botanical treatments, and would bias the analysis in favour of those who mentioned more botanical than non-botanical remedies, such as cauterisation or bleeding. Therefore, knowing the location of a medicinal plant was not used as an indicator of substantive knowledge. A maximum of two points was awarded for knowing at least one use (which disease), and at least one preparation/ administration for each treatment. Some treatments were effective for more conditions than others, and some had multiple preparations; no further points were awarded for additional answers. Two points were awarded for each measure of substantive knowledge, and only one for the name, in order to weight the scores in favour of substantive knowledge rather than theoretical. Independent samples *t*-tests were performed in SPSS© to identify significant differences in the mean scores of informants between groups, and average scores were displayed in a bar graph using Excel©.

2.4. Questionnaires

2.4.1. Sampling

79 out of the 80 students who took part in the freelisting exercise also completed questionnaires; one had returned home to his father who had fallen ill and was therefore unable to complete a questionnaire.

2.4.2. Questionnaire structure

Students were asked to complete questionnaires which investigated their socio-economic background, if or how they had been taught about EVM, and their attitudes toward learning about EVM. The response rate was generally high, although some students left answers blank. The questionnaire was written in Swahili, and was piloted on three student teachers who had all attended

Noonkodin School themselves within the last year or two. Despite having no trouble in the pilot stage, students consistently had trouble answering how many years they had been in school, perhaps because some were unsure of their exact age now or when they started school. Level of schooling was therefore measured by their form rather than years in school.

2.4.3. Analysis

Questionnaires were analysed quantitatively (responses were used to create groups which were tested against each other using *t*-tests as described in section 2.2.4.), and qualitatively (quotes were used to demonstrate typical responses to a question about values). Questionnaire responses were organised and analysed using SPSS©.

2.5. Methodological limitations

2.5.1. General limitations

This research was carried out through an interpreter, and the primary researcher was previously unknown to the informants. This may have affected informants' responses, though most informants seem generally trusting and many had participated in other ethnobotanical research including that carried out by students and associates of Noonkodin School in the past. Samwel Mollel had not worked as an interpreter before and sometimes communication was strained; he was asked repeatedly not to lead informants or help them with remembering names.

A plant trail was planned as an identification exercise, but time limitations and geographical spread of salient plants made this impossible in the time frame permitted; future research could be improved by use of additional methods to supplement the findings based on freelists. Previous research at this school (Bradley 2012) indicated that herbarium specimens were not easily identified by students, so a plant trail would be more suitable, time permitting. Alternatively, photographs could be used, or ethnobotanical *materia medica* could be collected or bought by the researcher and the identification could be carried out with fresh material *ex-situ*.

2.5.2. Limitations of freelisting

Brewer (2002) points out that when freelisting, informants may not list all the items that they know exhaustively, and may have trouble recalling items; in interviews informants were able to list more items than in their freelists, and further comparisons were made after interviews. Written freelists are preferable to verbal freelists because they are less likely to be contaminated by bystanders (Quinlan 2005), however most villagers in Eluwai have little or no literacy and therefore students gave written lists while non-students were asked to make a freelist during interview. In interviews it was at times hard to prevent bystanders from trying to participate, especially when interviews were conducted at the *bomas*, and especially with female informants who were carrying out work activities communally. Although individuals other than the informant were asked not to participate, they did occasionally offer 'help' and had to be asked again not to aid the informant.

It is important to note that prior to freelisting EVMs, informants were asked to freelist animal diseases, in order to make them think about animal health, and to aid their memory of medicines. These freelists were both done in the same session/interview, and some informants used their freelist for diseases as a direct prompt for naming medicines. Thus, the order in which medicines/treatments were named, and therefore their salience, may be related to the order in which diseases were named. This may also account for why non-botanical treatments or procedures such as bleeding or burning, were frequently mentioned as 'medicines', as these are often the only treatment available for certain diseases. However, it is likely that medicines used to treat locally prominent diseases were locally prominent also and, thus, would have been named first regardless.

Students were asked not to copy each other or to discuss their freelists with their classmates and were told that it was OK if they weren't able to answer. However, as the exercises were carried out during class time some of the students felt that they were being tested, and due to small, cramped classrooms, some 'cheating' cannot be ruled out. Ideally, all of the students would have been questioned individually about their freelists to clarify meanings and prompt further responses, but the students' heavy schedules did not permit this.

2.5.3. Sampling limitations

The sample sizes of students and non-students who participated in the freelisting activity were unequal in this study, due to the convenience of asking a large number of students to freelist in a classroom, compared to visiting non-students at their homes. However, it was useful to have a comparison between students and non-students rather than investigating the knowledge of students without a baseline, and non-parametric testing allowed for this comparison to be made despite the sample sizes.

There was a gender bias in the sample of non-students due to the sampling method, which was opportunistic; males were generally easier to access as they could be found relaxing close their *bomas* during the day, while females were generally cooking, gathering wood, tending crops or carrying out other jobs which keep them busy and often out of the home. This could possibly be avoided in future research by visiting *bomas* in the evening and pre-arranging interviews, although it was noted during fieldwork that time-keeping is not considered important in this community.

Chapter 3: Results

3.1. Cultural salience

The first objective of this research was to determine the most salient livestock diseases and EVMs known to students and non-students through freelisting exercises.

3.1.1. Livestock diseases

The most culturally salient diseases overall were *kideri*, *orltikana* and *ormilo*, though salience differed between students and non-students, and students named a greater range of diseases than non-students (42 compared to 35). Students named diseases such as bird flu and swine flu, which they may have learnt about in school or from popular media, as well as some diseases that are more common in humans but can affect animals also, such as epilepsy, and the nutritional disorder *beriberi*. These may have been learnt in the traditional medicine course of the school's indigenous knowledge programme. In both groups there were a large proportion of diseases named only once or twice, although consensus was greater among non-students. 54 diseases or other health-related conditions were mentioned in total in the domain of 'disease'; other health-related issues commonly mentioned included vectors such as ticks, lice or fleas, worms, and retained placenta. The most salient items named in freelists of 'diseases', by non- students and students, are listed below.

Figure 5. Table showing the most salient diseases that were mentioned by non-students (both elders and young people), synonyms listed were all mentioned by non-student informants; M= Maa S=Swahili.

Disease	Local names	Smith's salience
East coast fever (ECF)	*Orltikana* (M)	0.541
Bovine cerebral theileriosis (BCT)	*Ormilo* (M)	0.524
Fever	*Olokirikir* (M)	0.515
Contagious bovine pleuro-pneumonia (CBPP)	*Orkipioy* (M)	0.496
Foot and mouth disease	*Oloirobi* (M)	0.392
Anthrax	*Engeeya nairowa, Engirowaj* (M)	0.292
A disease similar to mange or lumpy skin disease	*Eneririi* (M) *Eririi* (S)	0.287
Babesiosis	*Olodokulak* (M)	0.263
Mange	*Emukuji* (M)	0.260
ECF/ CBPP?	*Lipisi* (M)	0.252
Ephemeral fever	*Nunuk* (S) *Enunwai* (S)	0.248

Figure 6. Table showing the most salient diseases mentioned by students. In local names M= Maas S= Swahili, includes all synonyms mentioned by students.

Disease	Local names	Smith's salience
Newcastle disease	*Kideri* (M) *Mdondo* (S)	0.501
East coast fever (ECF)	*Orltikana* (M) *Ndigana/ Ndigana moto* (S)	0.334
Bovine cerebral theileriosis (BCT)	*Ormilo* (M) *Kizunguzungu* (S)	0.218
Trypanosomosis	*Endorobo* (M) *Ndorobo/ Malale* (S)	0.198
Foot and mouth disease	*Oloirobi* (M) *Homa ya mifugo/n'gombe* (S)	0.116
Mange	*Emukuji* (M)	0.108

3.1.2 Ethnoveterinary medicines

78 medicines or treatments were named in total in freelists; these included ethnobotanical remedies, mineral products such as *magadi* (a rock salt) and clay, animal products such as urine and faeces, and procedures such as cauterisation, bloodletting, and even blood transfusions. 40 of the 78 medicines or treatments named (51%) were only mentioned once, indicating a low level of consensus across the entire sample; among non-students this figure was 32 out of 57 (56%), and among students 30 out 49 (61%) were mentioned just once. *Osukuroi* is the only medicine that was salient and frequently mentioned in both groups, perhaps because it had a range of uses and is widely available. The most salient medicines/treatments named by students and non-students are listed below (Smith's salience greater than 0.1), as well as the most frequently mentioned (mentioned by 25% or more of the informants in the sample).

Figure 7. Table showing the most salient and frequently named medicines or treatments among students and non-students.

Students		Non-students	
Most Salient (Smith's S)	Frequently named (%)	Most salient (Smith's S)	Frequently named (%)
Osukuroi (0.632)	*Osukuroi* (55)	*Olorien* (0.434)	*Olorien* (55)
Ormabait (0.229)		Hot iron (0.225)	*Osukuroi* (45)
Salt or *magadi* (0.128)		*Org'ilai* (0.178)	Hot iron (30)
		Osukuroi (0.170)	Ashes (30)
		Orbukoi (0.147)	*Eluwai* (25)
		Eluwai (0.141)	*Orng'oswa* (25)
		Ashes (0.135)	*Org'ilai* (25)
		Esenyi (0.125)	
		Oltarakwai (0.120)	
		Withhold water (0.118)	
		Orng'oswa (0.115)	
		Ormatasya (0.114)	

Non-students all lived in Eluwai although some of the women had moved to the village from other parts of Monduli district or other near-by regions. Of the students, 56% were from Monduli district while the rest came from other districts as far as Dar es Salaam; this is likely to influence the knowledge that they have of medicinal plants, as some of the medicinal plant species found in other regions are likely to differ due to environmental factors, as are prominent diseases.

There was also variation in the uses of those medicines that were salient, for example *osukuroi* was named by many informants as a treatment for chickens with *kideri*, and by others as a treatment for goats with *ormilo*. Similarly, multiple treatments were mentioned for many diseases, for example *kideri* could be treated not only with *osukuroi*, but also *katani*, *pilipili*, and *engurwon* (ashes). Almost all informants said that they treated their animals themselves, or called the neighbour for help with larger animals; few said that they called a medical practitioner such as a traditional healer or a conventionally trained vet. Only one informant, an elder male, mentioned using a witch doctor. The most salient medicines named by students and non-students are discussed later in this chapter, and a full list of treatments with explanations of their uses and preparation can be found in appendices one and two.

Twenty five plant families were mentioned, the most common of which were Fabaceae, with 7 species named across the sample, 4 of which were in the genus *Acacia*, and Solanaceae with 5 species named. The most salient ethnobotanical treatment overall was *osukuroi*, mentioned by 53% of informants, which appears to refer to *Aloe secundiflora* as well as another *Aloe* species; informants stated that one species had big roots that could be used for making beer but was not found close by, and the other had smaller roots and was used for medicine (*Aloe secundiflora*). Ethnobotanical preparations were most commonly made by boiling bark, roots or leaves and giving the decoction to animals to drink, although some medicines were administered nasally, anally, inhaled as smoke, injected, were rubbed onto the skin, or used as a wash.

3.1.3. Pathways of knowledge transmission

The most commonly mentioned pathway of transmission of EVK was vertical (older relatives to children), mentioned in interview by 80% of non-student informants, and 92% of student informants. Other 'teachers' mentioned by

students and non-students were husbands, professional vets or traditional healers, peers or neighbours, and other non-parent members of older generations such as people that *morans* met on *ronjo*. Non-student informants commonly mentioned personal experimentation as a further way of learning (30% of informants), and many stated that they 'observed' parents and other 'teachers' using EVM, rather than being actively taught.

3.2. Attitudes toward EVM

The second objective of the research was to investigate attitudes toward EVM among students and non-students through questionnaires and semi-structured interviews.

3.2.1. Use of and attitudes toward EVM in Eluwai

Interviews, questionnaires, and informal conversations revealed an overwhelmingly positive attitude toward EVM among the students at Noonkodin, and the community of Eluwai village. Informants stated that traditional medicines were effective, safe (rarely had any side effects), and were cheap. Conventional medicines were known to be effective, but also expensive, and to cause side-effects ranging from mild to deadly if you couldn't read the package in order to know the correct dosage to use. Generally, informants had a strong belief that EVM was useful and effective.

88% of informants stated that they still use EVM, though 93% of that majority stated that they also use conventional medicines bought from a conventional veterinary practitioner or shop. Only 6% of informants, two elders from Eluwai and three students, claimed that they or their family use EVM exclusively, while 12% stated that they used conventional medicines exclusively (these were all students). This shows that, although conventional medicines have become popular in this area, EVM is still valued and the two are used complementarily.

The most common reasons stated for use of conventional medicines were that they are easier to obtain than some of the traditional medicines, and there are 'new diseases' such as *olokirikir* (CBPP), which can only be treated with conventional medicines. One informant, a male elder, explained that some people have tried using various traditional medicines to treat these 'new diseases', but sometimes nothing but the conventional medicines work.

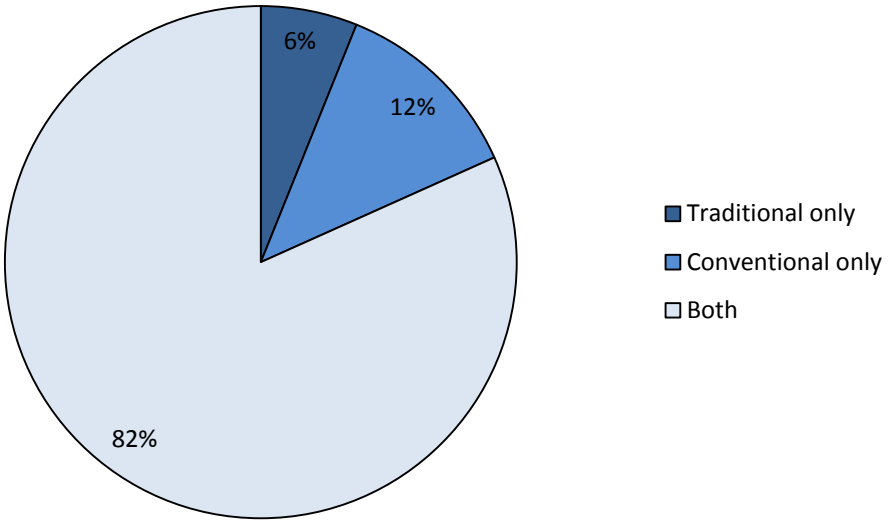

Figure 8. Pie chart showing use of traditional and conventional medicines among students at Noonkodin school and their families, and residents of the village of Eluwai.

3.2.2. Students' attitudes toward EVM

In the student questionnaire, informants were asked if they were interested in learning about EVM. 93% of the 76 students who responded to this question answered in the affirmative. 5% said that they were not interested, and one student said he was unsure. The following quotes illustrate the range of responses written by students when asked why they feel that it is important to learn about EVM (translated from Swahili):

" I need to learn because animals are our tradition"

"I would like to learn and to know more how to treat animals, and it will help me to avoid the cost of artificial medicine"

" I would like to be a vet for our animals, for the whole community"

3.3. Theoretical knowledge

The third objective of the research was to compare the theoretical (lexical) knowledge of EVM between students, unschooled youths and elders of Eluwai village, using freelist length (naming ability) as an indicator of knowledge.

80 students and 20 non-students completed freelists of the medicines that they know for treating animals. Across the entire sample of students and non-students, there was no significant difference between the mean freelist lengths of

males and females (*t*-test p=0.157), indicating that gender did not influence naming ability, although females commonly reported taking care of infant animals and smallstock, but said they required the help of their husband/ father/ neighbours to treat large cattle. PROFIT analysis showed that age did not significantly account for variation in the freelists, although there was a strong bias in the sample toward young people (only ten informants out of 100 were older than 40, the rest were aged between 15 and 32). The two most knowledgeable informants were 30- and 32-year-old senior *morans*, who were married and headed their own households in which they raised cattle. Six out of ten of the unschooled youths interviewed were married and had left their parental household, and were therefore responsible for taking care of their own, or in the case of women, their husbands' livestock. This suggests that they would have more experience than many of the students, none of whom were married or had left their parental household. Some schooled youths had however been involved in animal care at their parents' homesteads and some had taken their families' cattle on *ronjo*, thereby gaining some practical experience of EVM. The mean list lengths of students, their unschooled peers and elders are presented in figure 9.

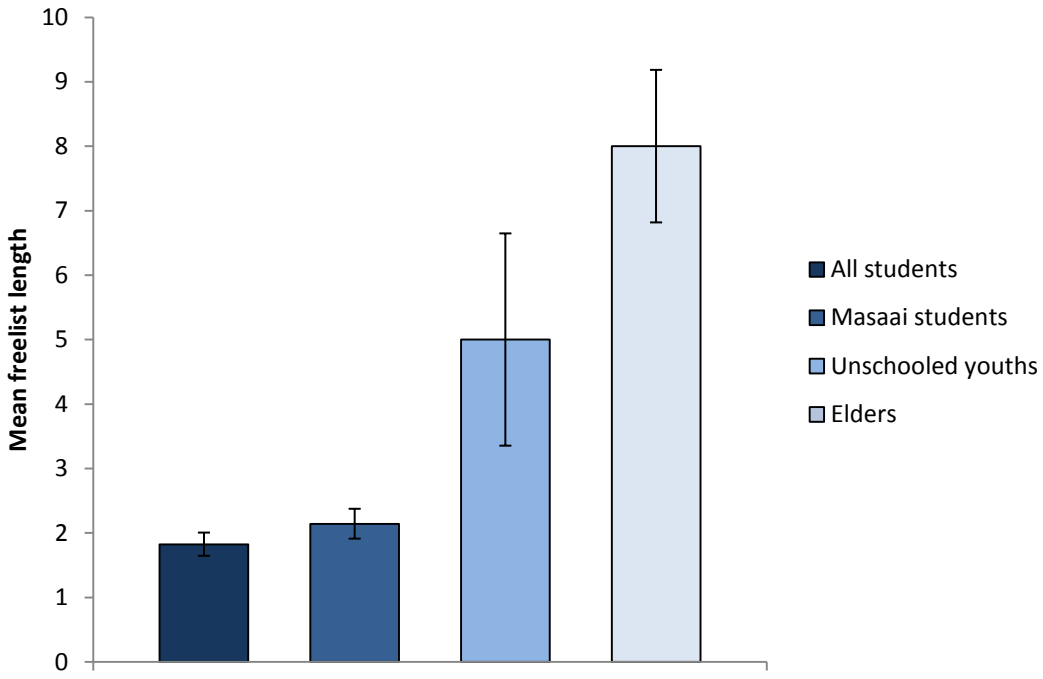

Figure 9. Bar chart showing mean lengths of freelists of ethnoveterinary medicines produced by students and non-students, with standard error.

The freelist data showed that, overall, students were able to name significantly fewer ethnoveterinary medicines than non-students (Mann-Whitney

p=0.000). A total of 78 medicines or treatments were named overall, with the mean list length being 2.8. On average, students were able to name 1.8 medicines, though Maasai students' lists were slightly longer than non-Maasai students' lists, with an average of 2.14, which was still significantly fewer than their unschooled peers (Mann-Whitney p=0.017), and elders (Mann-Whitney p=0.000). There was no significant difference between the naming abilities of unschooled youths and elders (*t*-test p=0.156).

Students' freelists ranged in length from 0 to 6 items; among their unschooled peers the range was 1 to 19, and among elders the range was 3 to 14. These figures indicate that there was a great deal of variation in naming ability among the different groups, as well as between them, as shown in the box-and-whisker plots below in figure 6.

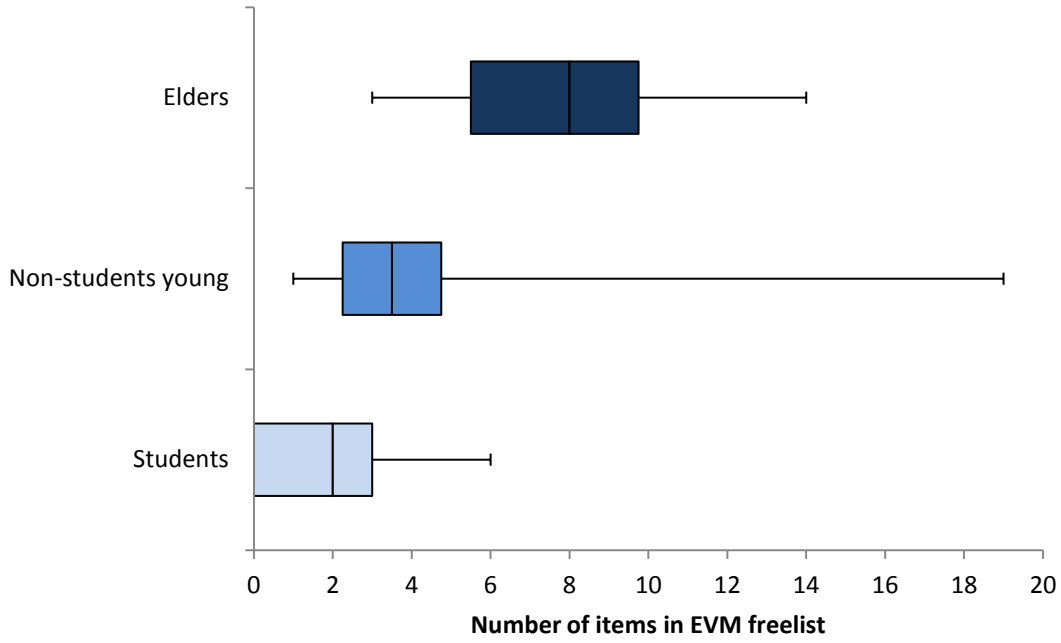

Figure 10. Box and whisker plots showing the variation in the means and the variance in freelist lengths within and between groups.

The longest freelist over all (19 items) was produced by a warrior who stated his age as 30, was married, kept his own animals, had two years of formal schooling at the primary level, and had been on *ronjo* for as much as one to two years at a time. This informant could be considered an expert, given that other informants in this group named a maximum of 7 medicines. When this informant was removed from the analysis, the average freelist for young unschooled Maasai was 3.4, still significantly greater than students' freelists, but by a far smaller

degree (p=0.034 in a *t*-test comparing young unschooled informants to Maasai students).

3.4. Variability in students' theoretical knowledge

The fourth objective was to explore the variation in students' naming ability through a questionnaire investigating their socio-economic background and exposure to ethnoveterinary practises in order to determine other factors that impacted students' informal learning of EVK, besides schooling.

The longest freelist length among students was 6 medicines/treatments, while 22 students out of 80 (18%) listed no EVMs at all. The longest lists (6 items), were produced by two 20-year-old Maasai males, both in form 3, both of whom were from villages and had parents practising traditional occupations (animal husbandry and/or crop cultivation). Analysis using Anthropac© and SPSS© showed that a number of attributes were significantly related to theoretical EVK.

PROFIT analysis determined that age did not significantly account for any of the variation in the freelists of students, and *t*-tests showed no significant difference between the mean list lengths of form 3 versus form 4 students, nor between male and female students. There was no significant difference in the mean list lengths of students from villages or towns (*t*-test p=0.275), although the category of 'city' was not recognised by informants that were spoken to in this community, and people in towns (peri-urban) often keep animals. As many students answered simply 'town' or 'village', rather than naming their home settlement, it was not possible to work out which students were from the cities as opposed to peri-urban towns.

However, further *t*-tests showed that Maasai students produced significantly longer freelists on average than non-Maasai students (2.1 compared to 1.3, p=0.036). There was also a significant difference in the mean list lengths of students whose parents had 'traditional' (animal husbandry and/or crop cultivation), versus commercial (wage labour) occupations (average list length 2.2 vs 1.3, p=0.023). Students who had been on *ronjo* produced significantly longer lists than those who hadn't (3.1 compared to 1.2, p=0.001). Unsurprisingly, those who stated that they had been actively taught about EVM by parents or other informal teachers outside of school, were able to name significantly more medicines than those who hadn't (2.3 compared to 1.3, p=0.013). 92% of those

students who stated that they had been taught EVM at home said that they were taught by parents or grandparents. Other 'teachers' were professionals (conventional vets or traditional healers), siblings, and non-parent elder community members such as neighbours.

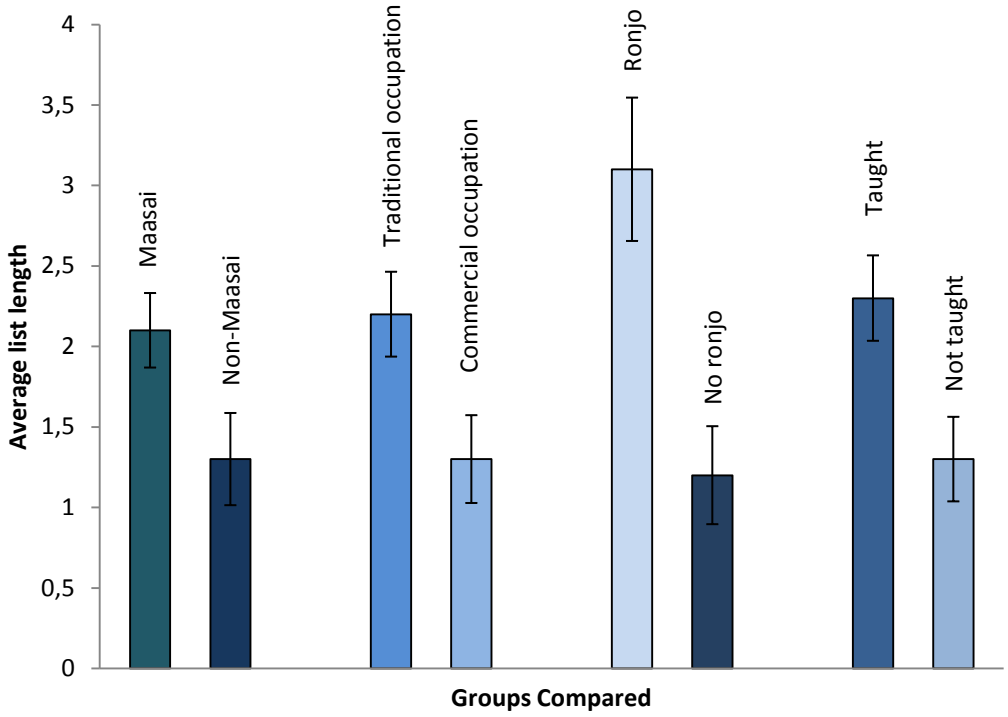

Figure 11. Bar chart showing attributes which bore a significant relationship to students' medicine naming ability.

3.5. Substantive knowledge

The fifth objective was to compare the substantive (practical) knowledge of a sub-set of students with that of their unschooled peers and elders through semi-structured interviews. In interviews, most informants produced longer lists than their original freelists. The list lengths produced in interviews were first compared, and then substantive knowledge was scored and compared.

3.5.1. Lists of EVMs produced in interviews

Generally, informants were able to expand their freelists during interview; two students were able to name as many as 12 medicines or treatments in interview (longest freelist length was 6). The average number of medicines/ treatments named in interviews (including the freelist) was 8.1. A total of 83 medicines or treatments were named in a total of 30 interviews.

Students were able to name an average of 6.2 medicines or treatments, non-student young people (including the informant who appeared to be an expert, who

mentioned 24 medicines in total) were able to name an average of 8.5, and elders an average of 9.6. No significant differences were indicated by *t*-tests between the means of any of the groups, suggesting that naming ability was similar in this subset of students compared to non-students, and across the age groups. PROFIT analysis did, however, indicate that age accounted for 27% of the variation in the lists in this sample (p=0.039), but the trend was unclear.

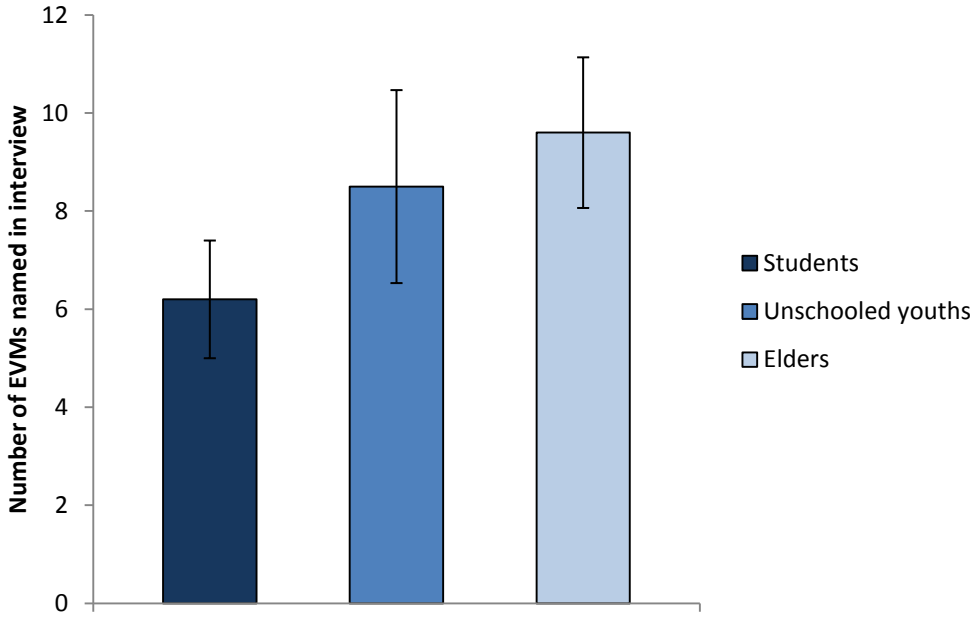

Figure 12. Bar chart showing the mean number of medicines mentioned in interview by students, their unschooled peers, and elders, with standard error.

Medicines/treatments mentioned varied within and between groups, as evidenced by the great number of treatments mentioned in total (83). The table shows the top treatments (mentioned by at least 25% of the sample) in each group, ranked according to frequency mentioned. *Osukuroi*, salt/*magadi*, and hot iron were frequently mentioned in all three groups.

Figure 13. Table showing the medicines named most frequently in interviews by students, their unschooled peers, and elders.

Students (%)	Young people non-students (%)	Elders (%)
Osukuroi (80)	*Olorien* (60)	*Osukuroi* (70)
Salt/*magadi* (40)	*Ndulele* (50)	Hot iron (70)
Pilipili (30)	*Orng'oswa* (50)	*Olorien* (60)
Eluwai (30)	Salt/*magadi* (50)	Ashes (60)
Hot iron (30)	Hot iron (40)	Withhold water (50)
	Ashes (40)	Salt/*magadi* (40)
	Oloisuki (40)	*Pilipili* (40)
	Org'ilai (30)	*Orbukoi* (40)
	Osukuroi (30)	*Oltarakwai* (30)
	Urine (30)	*Eng'arooji* (30)

3.5.2. Comparisons of substantive knowledge

Substantive knowledge was not validated against any consensus, as many informants across the whole sample named the same treatments but for different diseases and with varying methods of preparation. Therefore, it was not possible to confidently discern whether information given by informants about uses or preparation was 'correct'. Furthermore, some of the informants named treatments that were not mentioned by anyone else. Thus, informants were considered to have substantive knowledge if they stated at least one use, and one method of preparation/administration, for each treatment they named.

Non-students were able state at least one use of each treatment that they named, as well as the method(s) of preparation, with one exception; a 28-year-old male named the medicine *oremit* but only knew it's use for human medicine. For the most part, students were also able to name uses and preparation of the treatments on their freelists, with two exceptions. An 18-year-old male, was unable to give specific uses for two of the medicines he named, *orkiloriti* and *emukutan*, although he did profess to know that they can be used for both human and animal medicine. A 19-year-old female was unable to name the disease that can be treated with the tree, *olchani engashe*, although she was able to describe it's preparation, and stated that it was used to treat a disease affecting cows.

When substantive knowledge was assessed using a scoring system, elders scored an average of 48, while the average score of students was 29.6, and their unschooled peers 43.6; it appeared that elders and unschooled youths had greater substantive knowledge than students. However, when scores were compared using *t*-tests, there were no significant differences between the mean scores of students and non-students ($p=0.116$), nor between elders and students ($p=0.067$), students and their unschooled peers ($p=0.283$), nor elders and unschooled youths ($p=0.643$). This suggests that in this sample, students had roughly the same level of substantive knowledge about EVMs, as well as similar naming ability, to their unschooled peers, and elders did not have significantly greater knowledge than young people.

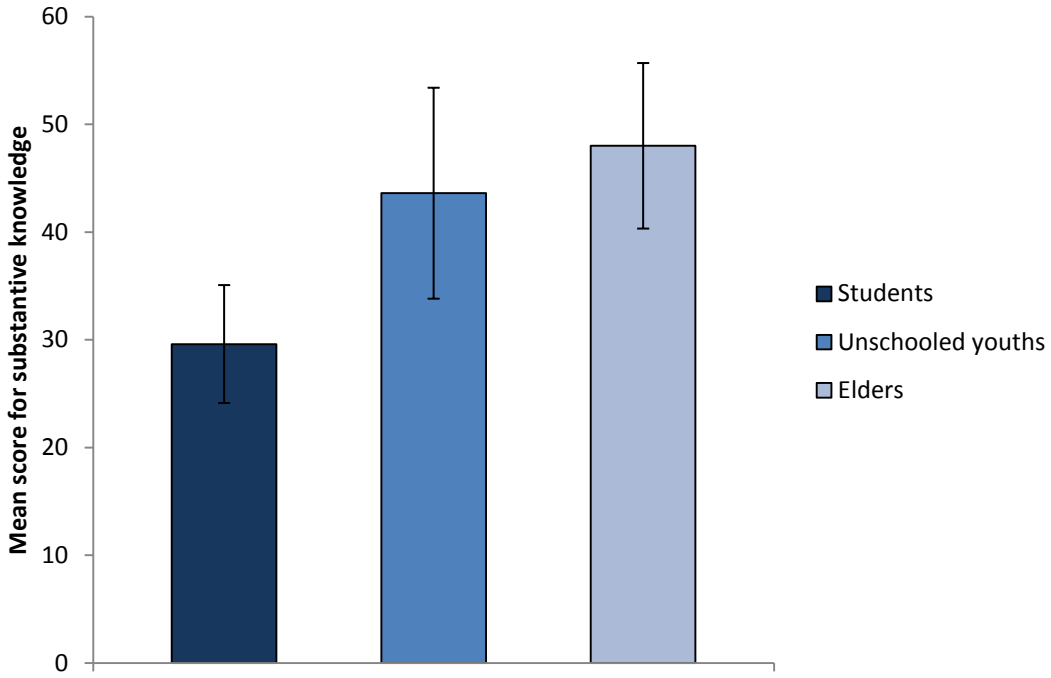

Figure 14. Bar chart showing the mean scores for substantive knowledge of students, their unschooled peers, and elders, with standard error.

3.6. Summary of results

These results show that EVM is still very important in Eluwai and is valued by both students and non-students. It also shows a high degree of variation in EVM both in terms of *materia medica* used and the uses of stated *materia medica*, not only between students and non-students, but also generally across the sample.

Although on average students appeared to be less knowledgeable about EVM compared to their elders and unschooled peers, a sample of those who had acquired some knowledge in this area were able to achieve a similar level of ability, both in naming and practical aptitude, as their unschooled peers and elders. Students' naming ability depended on the interplay of a number of factors including parents' occupation and experience, and those students who had learnt EVM outside of school appeared to have a practical understanding rather than simply theoretical knowledge.

Chapter 4: Discussion

4.1. Cultural salience

4.1.1. Vernacular names

In some instances it was difficult to translate vernacular names to their biomedical terms or in the case of plants their Latin names, given the common challenges of understanding folk taxonomies (Berlin 1992, Conklin 1962, Hunn and Brown 2012). Most plant names could be found in the literature, albeit with minor spelling variations, though some names referred to more than one species. For example *osukuroi* referred to at least two species of *Aloe*. Diseases were harder to translate due to the Maasai's complex diagnostic system which is based on symptoms, vectors of diseases, season of outbreak and livestock species affected, and does not consistently agree with conventional veterinary diagnostics (Jacob *et al* 2004). This was further complicated in fieldwork by the fact that informants often referred to all livestock as *engishu*, the word which literally means 'cattle', and they had to be asked to name affected animals specifically. In the local diagnostic system ECF and anaplasmosis were both classified as *orltikana* by most informants, although there was also idosyncratic variation in disease naming; *lipisi* was named as a distinct disease by some informants, while others said that *lipisi* was a form of *orltikana*. Other informants mentioned what may be comparable to folk binomials (Conklin 1962) *ngdigana baridi* and *ndigana moto* (Swahili words for *orltikana* 'hot' and 'cold'), suggesting that two pathologies were recognised but were considered to be forms of one disease. Previous literature has noted that anaplasmosis, ECF and cowdriasis are often lumped together in Maasai diagnosis (Jacob *et al* 2004). Skin conditions were also difficult to identify with biomedical names, as variations in folk names depended on which part of the body was affected, even though all other symptoms may be the same, for example *ormaromui* is potentially the same as *emukuji* or e*neririi* (mange or LSD), but was differentiated because it only affects the mouth and legs.

4.1.2. Cultural salience

Although there was some variation in the diseases mentioned in freelists of students and non-students, the most salient diseases were similar; ECF, BCT, foot and mouth, and mange were salient in the freelists of both students and non-students. These are consistent with existing literature on EVM in Tanzania among

Maasai and other pastoral communities (Maeda-Machang'u *et al* 2001, Ogutu 2012). Both students and non-students also mentioned vectors such as ticks, parasites such as worms and fleas, and conditions such as retained placenta, which is also consistent with literature (Maeda-Machang'u *et al* 2001, Ogutu 2012).

The most common plant family named for ethnobotanical remedies was Fabaceae, with *Acacia* species being particularly common; this can be expected as Fabaceae and in particular *Acacia* species are dominant the local landscape (see section 1.3.3.). This family also contained the most human medicines (of 34 named) in a study of students' ethnomedicinal knowledge, and many of the species named for human use in the previous study were also named as EVMs in this study (Bradley 2012). For example e*luwai* is commonly used to expel the placenta after birth for both humans and cattle (Hall *et al* 2010). This is to be expected, as cultural disease concepts commonly apply to animals and humans equally, and the same treatments are used for both in many cultures (McCorkle and Mathias-Mundy 1992).

4.1.3. Variation in salience between students and non-students

There were differences in the salience of items listed by students and non-students, and this could be explained by a number of factors. It is important to note that 37% of the students interviewed were not Maasai, and some came from agriculturalist or hunter-gatherer tribes. Although many agriculturalists keep livestock also, they may keep different animals such as chickens and pigs, which are susceptible to different diseases. Similarly, students from different areas may have experienced different endemic diseases and, thus, learnt different treatments. For example, chickens are not traditionally kept by Maasai, and although many people in Eluwai keep chickens, informal discussions indicated that they were not generally considered as important as cattle which have great economic and cultural value. The most salient disease (*kideri*) and medicine (*osukuroi*) named by students were both for chickens, suggesting that chickens are more important to the families of students than non-students, or are more commonly kept. Furthermore, students who reside in towns out of school time may keep chickens but not cattle given space limitations. Additionally, students may have had more knowledge about chickens because they have been assigned to take care of them rather than other animals; it has been reported in many societies that children as

well as women are predominantly responsible for the care of chickens (Aboe *et al* 2006, Olwande *et al* 2010, White 1975).

Figure 15. Photograph of *Osukuroi* (*Aloe secundiflora*) growing on the plains (*orpukel*) of Eluwai; some of leaf tips have been harvested for medicine.

4.1.4. Variation within groups

As well as differences in salience between groups, there was also a great deal of variation within groups, in terms of both the ethnoveterinary medicines named and their uses. Two potential explanations for this can be suggested based on this research. First of all, a number of informants stated that they had 'taught themselves' some of their EVK, and said that they experiment to see which medicines may work, particularly when they encounter a new disease, suggesting that innovation is common. Furthermore, almost all informants said that they do not seek a professional such as a vet, but diagnose and treat their animals themselves. The most popular mode of transmission of EVK appears to be vertical (from older relatives to children), except where husbands reportedly taught their wives. In fact, two young wives of the same man participated in the study, and of the six and seven medicines that the two wives named in interview, only one (the common remedy ashes) was mentioned by both informants, supporting the notion that most EVK is learnt from parents in this community. Hewlett and Cavalli-Sforza (1986) suggest that vertical knowledge transmission is highly conservative, meaning that innovations will be slow to travel through the population when this mode of transmission is dominant. Therefore, a combination of experimentation

and vertical transmission may account for the large degree of variation in medicines named and their uses.

4.2. Attitudes toward EVM

4.2.1. Attitudes toward EVM in Eluwai

EVM is clearly still very important to Maasai in Eluwai village, particularly as a first line of defence and as a treatment for minor ailments such as pest infestations, while conventional medicines are used where necessary to treat more serious diseases, or those with no local cure. This is consistent with reports from other parts of Tanzania and Kenya, where conventional medicines are used complementarily to EVM (Maeda-Machang'u *et al* 2001, Ogutu 2012, Maundu *et al* 2001, Shikongo 2005, Jacob *et al* 2004). Although many informants stated that conventional medicines were easily accessible, it is unlikely that most could afford to use them primarily, given that over 50% of the rural population of Monduli lives below the basic needs poverty line (EDI 2005), and government subsidies for veterinary treatment have declined in recent years (Maeda-Machang'u *et al* 2001). Regardless of cost, many informants said that traditional medicines were highly effective and that they preferred them to conventional medicines because they are safer and they know how to use them.

4.2.2. Students' attitudes toward EVM

Secondary school students may have been expected to have negative attitudes toward learning and using EVM, given the reported detrimental impact of formal education on young people's attitudes toward TK, cultural heritage, and traditional values (Shikongo 2005, Burford and Ngila 2006, Ruiz-Mallén and Barraza 2007, Nabhan 1998), as discussed in chapter one. However in this case study the vast majority of students had positive attitudes when asked their opinions of EVM, and previous reports from Noonkodin School have also noted positive attitudes toward TK (Burford *et al* 2012). This could be explained by the culturally sensitive education that students receive at Noonkodin School, which encourages them to explore and learn the TK of their respective cultures through participatory projects for their 'Unity in Diversity' programme (Burford and Ngila 2006). Although studies of Tanzanian students' attitudes toward EVM or TK in general are lacking, intercultural education elsewhere has been shown to engender cultural pride and positive attitudes toward TK. For example, Zarger (2002)

reports that inclusion of experiential learning and TK in school curricula in Belize successfully emphasises the value of TK to children who may not be exposed to it in the same way as previous generations. Research on environmental education has also shown that positive attitudes toward environmental issues increase along with knowledge when students are exposed to environmental education programmes (Bradley *et al* 1999).

It has been reported that formal education negatively impacts TK and attitudes toward cultural heritage, not only because of the hegemony of WSK in curricula, but also because students often have to travel to cities where they are exposed to urban culture and values (Burford and Ngila 2006, Ruiz-Mallén and Barraza 2007). When asked if they thought it was important to learn EVM, students commonly referred the importance of EVM to their future livelihoods and community activities, suggesting that they wished to continue to be involved in traditional culture and activities in the local area after completing school, rather than migrating to cities as is a commonly reported consequence of formal education of indigenous youths (Burford and Ngila 2006, Ruiz-Mallén and Barraza 2007). This could be explained in part by the attention to indigenous knowledge in the curriculum, but also to the school's rural location, which reduces youths' exposure to urban culture and values.

Not only is the school in a rural location, the vast majority of the teachers at Noonkodin are local to the Arusha region of Tanzania, and speak local languages as well as Swahili and English (which are the official languages for teaching in Tanzania), particularly Maa. Out of teaching hours it is common to see both the teachers and students in traditional dress, and to hear them sing local Maasai songs while they work or socialise. This is likely to have a positive effect on students' values and attitudes toward their cultural heritage, as teachers are well respected among the students.

4.3. Theoretical EVK of students and non-students

Freelisting exercises suggested that students generally had lower naming ability than their unschooled peers when asked which animal diseases and ethnoveterinary medicines they knew. As an indicator of TK, this was expected, given that students had generally been in education for around ten years. Furthermore, there was no significant difference between the naming abilities of

elders and unschooled youths. These findings are consistent with existing literature, which suggests that most TK is learnt during childhood (Hunn 2002, Reyes-García *et al* 2009, Zarger 2002), and that, as discussed in chapter one, formal schooling competes with time spent learning TK in the home and community setting (Burford and Ngila 2006, Zent 2001, Quinlan and Quinlan 2007, Nabhan 1998, Zarger 2011, Reyes-García *et al* 2010, Cruz-García 2006, Nabhan and St Antoine 1993). Despite the attention to TK in the curriculum at Noonkodin School, there is at present no EVM module, although students may have learnt some EVMs which overlap with human medicines through the indigenous knowledge programme. One student said in interview (translated from Swahili):

> "There are so many (ethnoveterinary medicines) but I forget them because I'm learning other things at school, so I forget the names of those trees. But there are more..."

Furthermore, although Noonkodin is located in a rural area to prevent the necessity to travel to cities for education, most students board at the school due to poor transportation infrastructure which makes commuting difficult. The students are therefore removed from their families and from cultural activities for the duration of the academic year, except for occasional weekend trips home for those who live relatively close with special permission from the Second Master. This means that except for the indigenous knowledge programme which does not include EVM, for the majority of the year students are not in contact with informal teachers such as family members, who would play an integral role in their cultural learning. Zarger describes "learning networks" (Zarger 2011; pg 377) which link young people to informal teachers of TK. At least three non-mutually exclusive pathways by which TK transmission can occur have been recognised by scholars: from parents (vertical); from friends/peers (horizontal); and from non-parent members of older generations (concerted/oblique) (Hewlett&Cavalli-Sforza 1986, Reyes-García *et al* 2009). These networks may be disrupted by time spent away at school.

Moreover, youths of similar ages who do not attend school are likely to have gained more practical experience of EVM and subsequently greater knowledge as well as skills, not only from taking part in general household activities and herding, but also from attending *ronjo* for significant time periods, or from home life in the

marital home. Girls especially take on a greater role in livestock care after marriage, and are often taught further EVK by their husbands (Maeda-Machung'u *et al* 2001). Thus delaying marriage and home-making in order to attend school is likely to further delay the learning of EVK, in particular in terms of practical skills.

4.4. Variation in students' EVK

Although formal schooling does appear to be related to EVK, it is certainly not the sole reason for students' lack of knowledge; a number of other factors were also linked to students' naming ability, and it is likely that these factors interact along with formal schooling, as suggested by other authors on this subject (Quinlan and Quinlan 2007, Nabhan 1998, Zent 2001, Zarger 2011).

4.4.1. Gender

Gender was not related to naming ability, which is consistent with research on Maasai EVK in nearby Simanjaro district, which also reported that males and females had equal knowledge of EVK or ethnobotanical knowledge (Maeda-Machung'u *et al* 2001, Ibrahim 1997). This suggests that although men and women may have different roles in veterinary care, such as men taking care of larger animals and women generally taking care of infant animals and smallstock, they still come into contact with a similar number of EVMs, and likely the same EVMs with varying dosages or administration.

4.4.2. Ethnicity

Unsurprisingly, students' ethnicity was related to EVK, with Maasai students recalling significantly more medicines than non-Maasai students. Given the heavy dependence on their animals in traditional Maasai culture, it can be expected that they, and other pastoralists, will have a greater wealth of EVK compared to agro-pastoralist, agriculturist, and hunter-gatherer tribes (Jacob *et al* 2004).

4.4.3. Parents' occupation

Parents' occupation was also linked to EVK among students, with those students coming from households with 'traditional' livelihoods recalling significantly more ethnoveterinary medicines than those whose parents had commercial occupations, meaning that they were performing wage labour. Nabhan (1998) also noted that the effect of formal schooling may be exacerbated by parents working in wage labour, which further reduces the time available for

knowledge transmission between children and their parents through participation in and observation and imitation of adult subsistence activities (Zarger 2011, Rogoff 2003). It also indicates a move from a subsistence to a market-based economy and acculturated lifestyle, and concurrently a reduced dependence on local natural resources among some families. In Amazonia, Reyes-Garcia *et al* (2006) found a negative correlation between economic development, judged by participation in wage labour, and ethnobotanical skills. Quinlan and Quinlan (2007) found in the Caribbean that while commercial occupations alone did not affect plant-naming ability, they interacted with formal education such that those who had commercial occupations were able to recall fewer traditional medicines with each year of schooling that they possessed. Although these studies focused on adults not students, it can be expected that if parents lack TK, they will be unlikely to teach it to their children, and their children will not learn from observing their parents, thus the link between occupation and TK will pass to the next generation. Cruz-García (2006), found that mothers' knowledge of wild food plants in Western Ghats, India, and their attitudes toward them, were positively correlated to their children's knowledge of and attitudes toward wild food plants.

4.4.4. Active teaching

Indeed there was a positive relationship to theoretical EVK where students declared that they had been actively taught at home. It is possible, however, that some students may not have recognised when they were being taught at home, as TK is embodied in everyday life and cultural activities (Wyndham 2009). Furthermore, factors such as whether or not youths are taught EVK at home may be related to parents' occupation as discussed above. Nevertheless, it is notable that students who recognised having been taught at home were able to recall more EVMs than those who did not. Most commonly, students said that they were taught by parents and grandparents (vertical transmission), with some also mentioning unrelated members of older generations (oblique transmission). This suggests that EVK transmission requires time spent with older family and community members, as previously noted, but furthermore it suggests that these 'teachers' can help to reduce EVK loss among students by taking opportunities where ever possible to pass on their knowledge during school holidays and home visits. Lozada *et al* (2006) suggest that active 'teaching' of TK is important in knowledge transmission, based on their case study of cultural transmission of knowledge in a rural

community in Argentina. Similarly, Nabhan (1998) describes the success of community-based educational programmes such as summer camps and field trips in slowing or averting the loss of TK and traditions among Native American communities.

4.4.5. Practical experience

Finally, EVK was positively related to attendance of *ronjo* among students, and most unschooled males had attended *ronjo*, while unschooled females had taken an active role in animal care at the home. This strongly supports previous research on ethnomedicinal knowledge at Noonkodin school, which suggested that practical experience in a cultural context was positively related to students' TK, with those who had attended the forest retreat of *orpul* having the greatest ability to recall human ethnomedicines among students in forms one to four (Bradley 2012). There is a wealth of literature in various other environments which highlights the importance of practical engagement in local activities for learning TK. Children participate in informal education through work, play and general day to day life in their natural and cultural environment. Rogoff (2003, in Zarger 2011 pg377) calls this 'guided participation in cultural activities', and similarly Ingold (2000:416) describes the process of "enskillment" through engagement in the "dwelt-in world". When Zarger (2011) studied traditional knowledge acquisition among Q'eqchi' Maya children, she found that to ask how children learned about local resources and subsistence activities she had to use the verb 'to work' as well as 'to learn', as learning was inextricably linked to childhood chores. Hunn (2002) found that Zapotec children acquire a great deal of TK through engagement in adult work activities; these included weeding and gathering, fetching medicinal plants, and caring for animals. In her work with Rarámuri children, Wyndham (2009) highlighted that experiential and performative learning, or "knowing through relationships with plants", is central to TK acquisition. Zent (2001:57) found that Hoti children in Venezuela who had more direct and intense contact and interaction with local natural resources had a greater level of ethnobotanical knowledge than children in less remote communities which were less dependent on the forest. All of these studies point to the importance of hands-on experience in TK learning, and they are supported by studies of environmental education, which have also shown that practical learning enhances students' knowledge. For example, Ruiz-Mallen *et al* (2009) found that constructive engagement with local

activities and experts positively impacted students' environmental learning in a preparatory school in Mexico.

4.5. Practical knowledge of students and non-students

In a random selection of Maasai students who had demonstrated some knowledge of EVM by naming at least one livestock disease and one treatment in their freelists, there was no significant difference in their substantive (practical) knowledge compared to their unschooled peers or elders. This indicates that those students who are learning EVM outside of formal education are gaining a practical understanding of which EVMs to use for which disease, and how to prepare and administer them, rather than simply theoretical knowledge of EVM. This is consistent with the explanation discussed previously for naming ability: practical experience is important for children to learn TK. It suggests that where children had learnt about EVM, they had learnt the full use and preparation of medicines, rather than just being told the names of medicines outside of a use-context. In fact, one student could not remember the name of a disease treated by a medicinal plant she had listed, but was able to recall the preparation, where it was found, and knew that it was for a disease that affects cows. This example suggests that skills and contextual knowledge are more easily remembered than lexical knowledge.

Chapter 5. Conclusions and recommendations

The aims of the study presented in this dissertation were to investigate the attitudes toward and use of EVM in Eluwai village and record the most salient ethno-medicinal treatments used for livestock in the local community, and to compare students' knowledge of EVM with their unschooled peers' and elders'. Although the results presented here may be considered exploratory given the limited scope of the research carried out, several preliminary conclusions can be drawn: first, about the use of EVM in this area, second, about relationships between intercultural education and attitudes toward EVK, and third, about the relationships between formal education and EVK.

This dissertation has highlighted the continued importance of EVM to pastoralist communities, including the Maasai of Eluwai, Tanzania. In Eluwai, EVM was found to be used complementarily to conventional veterinary medicines, but often preferably. Where conventional medicines were favoured the reason was often that EVM was ineffective against certain diseases, but also that some EVMs have become more difficult to obtain. This finding warrants investigation into the demographic status and sustainability of harvesting of medicinal plants in this area. Indeed, some instances of unsustainable harvesting, particularly of bark were noted during the research. On the whole, this study supports existing literature and recommendations that EVM can and should play a role in sustainable development of pastoral and agro-pastoral societies, as it is safe, effective and culturally appropriate.

Noonkodin students' positive attitudes and interest in learning EVK suggest that the intercultural curriculum, location of the school, and presence of local teachers have a positive impact on students' cultural pride and attitudes toward TK, and may help to reduce TK loss, acculturation, and out-migration of young people to cities. Their interest, coupled with the finding that students on average have less knowledge of EVM than their unschooled peers, suggests that it would be astute to develop an EVM programme as part of the existing indigenous knowledge programme at Noonkodin School, in order to equip students with the skills necessary to continue to raise livestock, at least as a part of their livelihood, after completing school. Noonkodin School can serve as an example for educators, governments and other indigenous communities of the benefits of a culturally

sensitive education for sustainable development of rural communities, and for biocultural conservation; young people who value TK and local resources are more likely to preserve them.

While formal schooling was found to be negatively related to young peoples' EVK in this study, there is clearly a complex array of factors that contribute to knowledge erosion among young indigenous students. Factors such as commercial occupation of parents and active teaching at the home appear to interact with formal schooling in their impact on EVK, suggesting that families, communities and educators should work together to preserve TK among the younger generations. Furthermore, in agreement with research on students' ethnomedicinal knowledge (Bradley 2012), this study suggests that practical experience is highly important in learning EVK, and supports the recommendation that context-based practical learning is the best way to incorporate TK into formal education systems. Should an EVM programme be developed at Noonkodin, it would be prudent to incorporate contact with local experts, and a practical programme of teaching including collection of wild plants, diagnoses of livestock diseases, and hands-on experience in treating livestock. Furthermore, Tanzania and other countries could improve upon previous attempts (such as ESR) to incorporate indigenous values and knowledge into school curricula by developing practical programmes in consultation with local communities and experts.

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Royal Museum for Central Africa, online collections, Prelude Medicinal Plants Collection. URL:http://www.africamuseum.be/collections/external/prelude/view_country?cc=TZ&cat=V [accessed 01/06/2013, 17/07/2013]

Disease Identification.

The following resources were used to translate vernacular names of diseases to their biomedical names:

Infonet Biovision, Zoonotic diseases. URL: http://www.infonet-biovision.org/default/ct/670/animalDiseases [accessed 2/10/2013]

Mollel, S. (2013) Pers.Comm during fieldwork [22nd May-16th June 2013].

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Appendix 1. Ethnobotanical remedies

The following table lists all of the ethnobotanical EVMs mentioned by informants, as well as which diseases they can treat, and preparations described by informants. Uses in bold print were the most commonly mentioned. Resources used to discern Latin names from vernacular names can be found in the bibliography.

Latin name	**Family**	**Local name(s)**	**Veterinary use(s)**	**Part used**	**Preparation**
Aloe secundiflora Engl. *Aloe spp.*	Xanthorrhoeaceae	*Osukuroi* (M), *katani pori* (S), *mshibiri mwitu* (S)	***Kideri***	Leaves	Grind/cut in to pieces, put in chickens' drinking water/ drop the juice from the leaves into drinking water
			Ormilo		Cut into pieces, boil, cool, give decoction orally
Acacia drepanolobium Harms ex B.Y.Sjöstedt	Fabaceae	*Eluwai* (M) *Oluai* (M) *Mbali mbali* (S)	Retained placenta	Bark	Boil until water is red, may add magadi, cool, give decoction orally
Acacia mellifera (M.Vahl) Benth.	Fabaceae	*Eitu/eitii/oiti* (M)	*Olokirikir* Retained placenta	Bark	Boil in water, cool, give decoction orally
Acacia nilotica (L.)Willd. ex Delile.	Fabaceae	*Orkiloriti* (M)	*Ormilo*	Roots	Boil with water, cool, give decoction orally
			Worms	Bark	Mix with *magadi*, boil, cool, give decoction orally
Acacia xanthophloea Benth.	Fabaceae	*Org'ilai* (M)	*Olodokulak* *Lipisi* *Nunuk*	Roots Bark	Boil until water is dark red, give decoction orally
			Orltikana		Boil, may add *magadi*, give decoction orally
			Orkipioy		Take bark from roots, mix with water, wait several hours, inject

Agave sisalana Perrine.	Agavaceae	*Katani* (S)	*Ormilo* *Lipisi*	Leaves	Grind or cut and mix with water, give orally
			Eneririi *Emukuji* Lice		Grind, mix with water, use to wash the body
			Oloirobi		Boil with water, cool, give decoction orally
Azadirachta indica A. Juss.	Meliaceae	*Ormabait* (M) *ormabaini* (M) *mwarubaini* (S)	*Engirowaj* *Ormilo*	Fruits Leaves	Grind, boil, cool, give decoction orally
Azanza garckeana (F. Hoffm.) Exell& Hillc.	Malvaceae	*Ormooto* (M)	*Oloirobi* *Nunuk*	Sap	Apply topically to affected area
Balanites aegyptiaca (L.) Delile.	Zygophyllaceae	*Orng'oswa* (M)	*Ormilo*	Bark	** see ndulele
Cannabis sativa L.	Cannabaceae	*Bangi* (S)	*Ormilo*	Leaves	Put in water and give orally
Capsicum frutescens L.	Solanaceae	*Pilipili* (S)	***Kideri*** *Embong'it*	Fruit	Put in drinking water
Clerodendrum myricoides	Lamiaceae	*Ormakutukut/ emakutukut* (M)	*Orltikana*	Roots	Mix with water, doesn't matter if you boil, leave for at least 2 days, give orally. May mix with *orgilai* and *magadi*
Commiphora africana (A.Rich.) Engl.	Burseraceae	*Oltemwai* (M)	*Eneririi* Lice	Sap	Apply topically to affected areas
Crotalaria lachnocarpoides Engl. OR Embelia sp	Fabaceae OR Myrsinaceae	*Olchani onyokie*	*Olodokulak*	Bark	Grind, mix with water, don't boil, wait several hours until water is red then give orally
Croton dichogamus Pax.	Euphorbiaceae	*Oloiborbeneck* (M)	*Ormilo*	Roots	Boil with water, cool, give decoction orally
Croton scheffleri Pax.	Euphorbiaceae	*Olchani lorpukel/ Enjani lorpukel* (M)	*Lipisi*	Bark	Mix with water, do not boil, wait then give orally
			Orltikana *Engerotic*	Root	Boil in water, cool, give decoction orally
Erythrina absyssinica Lam ex DC.	Fabaceae	*Oloponi/ oloboni* (M)	*Oloirobi*	Bark	Boil in water, cool, give decoction orally

Hypoxis gregoriana Rendle.	Hypoxidaceae	*Esenyi/esenyay* (M)	*Lipisi Orltikana*	Tubers	Remove skin, boil, cool, give decoction orally
Jericicomopsis grisea		*Olaisai* (M)	*Eneririi*	Leaves	Grind, mix with water and salt, give orally
Juniperus procera Hochst. ex Endl.	Cupressaceae	*Oltarakwai* (M)	*Im'beneck Lipisi*	Bark	Burn, smoke must be inhaled
			Enyoo		Burn, smoke glands
Lannea schweinfurthii Engl.	Anacardiaceae	*Orupande* (M)	*Orltikana*	Roots	Boil with water, cool, give decoction orally
Mangifera indica L.	Anacardiaceae	*Muembe* (S)			
Olea europaea ssp. africana L.	Oleaceae	*Olorien* (M)	***Oloirobi*** *Lipisi* ***Orltikana*** *Olokirikir*	**Bark** Roots Leaves	Boil until water is black, filter, give decoction orally. May add salt or magadi
Olinia rochetiana Juss.	Oliniaceae	*Orkinyei* (M)	*Nunuk*	Roots	Boil in water, cool, give decoction orally
Pappea capensis Eckl.&Zeyh.	Sapindaceae	*Oltimigomi* (M)	*Orltikana Oloirobi*	Roots Bark	Boil in water, cool, give decoction orally
Plectranthus spp.	Lamiaceae	*Mzugwa* (S)			
Rhamnus staddo L.	Rhamnaceae	*Orkokola* (M)			
Rhus natalensis Bernh.	Anacardiaceae	*Ormisigiyoi* (M)	*Olodokulak*	Roots	Boil with water, cool, give decoction orally
			Ormoko	Sap	
Salvadora persica Wall.	Salvadoraceae	*O'remit/ o'remiti* (M)	*Engeeya naada*	Roots	Boil in water, cool, give decoction orally
Solanum incanum L.	Solanaceae	*Ndulele* (S)	***Oloirobi***	Roots	Boil with water, cool, give decoction orally
			Engerotic	Fruits	Take the juice, mix with magadi, give orally
			Engirowaj	Fruits	Take the juice and inject to the neck
			Ormilo		Take the juice and give orally OR mix with bark of ***orng'oswa*, boil, cool, give decoction orally

Solanum spp.	Solanaceae	*Mnafu* (S)			
Tarchonanthus camphoratus L.	Asteraceae	*Osendu* (M)	*Lipisi Orltikana*	Leaves	Boil until water is black, cool, give decoction orally
			Nunuk		Rub on back
Terminalia brownii Fries.	Combretaceae	*Orbukoi* (M)	*Olodokulak*	Bark	Boil until water is yellow, cool, give decoction orally
Triticum spp.	Poaceae	*Endapa* (M)	*Olodokulak*	Grains	Grind, mix with water, give orally
Scutia myrtina (Burm.f.)	Rhamnaceae	*Osanagururi* (M)			
Turrae abyssinica	Meliaceae	*Olchani engashe/ enchani engashe* (M)		Roots	Mix with water, give orally
Warburgia ugandensis Sprague	Canellaceae	*Osokonoi*	*Ormilo*	Bark	Mix with water, do not boil, wait until colour changes, give decoction orally
Withania somnifera (L.)Dunal.	Solanaceae	*Ol-esayet* (M)	Snake bite	Leaves	Grind to make a poultice
Zanthophylum chalybeum Engl.	Rutaceae	*Eng'arooji/ arng'arooji* (M)	*Olodokulak*	Bark	Boil in water, cool, give decoction orally
Zanthoxylum chalybeum Engl.	Rutaceae	*Oloisuki* (M)	*Im'beneck*	Bark Roots	Mix with bark/roots of **emukutan*, boil, cool, give decoction orally
			Orltikana Olokirikir Oloirobi		Boil until water is black, may add *magadi*, cool, give decoction orally
		Endaboi			
		Endadang'anay-el (M)			
		Endatwen (M)	Orltikana	Roots Leaves	Boil until water is green, cool, give decoction orally
		Endijay (M)	*Orltikana*	Leaves	Grind, mix with water, give orally
		Engowhai (M)	*Engirowaj*	Bark	Squeeze out the liquid and give orally
		Enjanipus (M)	*Oloirobi*	Roots Leaves	Boil in water, cool, give decoction orally

		Mereti (S)			
		Mjoovo	*Kideri*		
		Mrungunrungu (S)			
		Olchani lekinyois (M)			
		Oldulet (M)	Retained placenta	Leaves	Grind, mix with water, give orally
		Olekiushi (M)	*Orltikana*	Roots	Boil in water, cool, give decoction orally
		Olendanu (M)	Fleas	Leaves	Grind, mix with water, use to wash
		Oloisembeka (M)			
		Olorondo (M)	*Enyoo*	Leaves	Grind and rub on glands
			Retained placenta	Leaves, roots	Boil in water, cool, give decoction orally
		Olsukututi (M)	*Ormilo*	Leaves	Mix with water
		Ong'erenundus (M)			
		Xatte			

Appendix 2. Non-botanical EVMs

The following table lists non-botanical EVMs named by informants. Translation was done in the field through the interpreter.

Treatment	**Veterinary use(s)**	**Preparation/administration**
Animal fat	*Fangas*	Apply to legs and mouth
	Kideri	Mix with ashes and apply topically around the eyes
	Ticks	Apply to affected areas
Ashes	*Nunuk* *Oloirobi* *Kideri*	Apply topically to the back, the whole body, or affected areas
Blood	*Engeeya nairowa*	Take the blood of a healthy cow and inject to the neck of an infected cow
Chasing	*Embongit*	Chase the cow until it burps
Cheese	Disease of the *ingaati* (wildebeest)	Rub around the eyes after cauterising
Clay/mud	*Diarrhoea* *Embongit*	Mix with water so it's thick like porridge, give orally, can mix with *pumba* (maize kernel skins) to make it palatable
	Ormoko	Burn, then and apply clay topically
	Emoilaa	Mix with urine and give orally
Cutting	*Embongit*	Cut stomach to release gas (must be done by skilled person)
Honey	Cough	Mix with *magadi* and water and give orally
Hot iron	*Eririi* *Ormoko*	Burn affected areas to cauterise lesions/pox.
	Ormilo Disease of the *ingaati*	Burn the top of the head
	Olodukurum	Put a roll of leather inside the anus and burn inside
Milk	*Kuhara damu/Olodokurum*	Pour into the anus after cauterising
Molasses	*Oloirobi*	Mix with salt, rub on mouth
Ormaluwa (alcoholic drink made from wheat and bananas)	*Olodokulak*	Give orally

Poo of the anteater	*Olokirikir*	Dry, grind, mix with water, give orally
Poo of donkey	Ticks, fleas	Mix with *Olendanu* to make a soap
Rabbit liver	*Enemakain*	Dry the liver, boil it, then give orally
Salt/*magadi* (rock salt)	*Emukuji, eririi, oloirobi, ormoko, lice*. Also an additive to botanical remedies and conventional medicines such as amoxycilin	Mix with water and use as a wash, or apply directly to pox/lesions
Shaking	*Emonyita*	Hold the back legs of the goat or sheep and shake it
Snake venom	Retained placenta	Inject
Snuff	*Ormilo*	Administer nasally
	Embongit	Mix with water and use a syringe to put it in the mouth
Urine	*Oloirobi*	Use to wash
	Kideri	Put in the chickens' drinking water, can mix with *osukuroi*
	Also an additive to botanical remedies, clay/mud, and conventional medicines such as amoxycilin	
Withhold water	*Olokirikir*	

Appendix 3. Diseases

The following table lists all diseases named by informants in freelists and interviews, as well as descriptions of symptoms given by informants, and which animals are affected. All treatments mentioned for each disease are also listed. See bibliography for resources used to discern biomedical names from vernacular names.

Biomedical name	**Local names**	**Symptoms**	**Animals affected**	**Treatments mentioned**
Anaplasmosis [Also east coast fever (ECF)]	*Ndigana baridi* (S) *Ndigana moto* (S) *Orltikana* (M)	Swollen glands, piloerection, excessive saliva, shivering, loss of appetite, shortness of breath, cough, fatigue	Cows, goats/ sheep, donkeys	*Org'ilai, oloisuki, orupande, olchani lorpukel, olorien, osendu, esenyi, oltimigomi, endijay, olekiushi, endatwen ormakutukut*
Anthrax	*Kimeta* (S) *Engeeya nairowa* (M) *engirowaj* (M) *Engeeya oongoiliil* (M)	Sudden death	Goats/ sheep, cows, donkeys, dogs	*Engowhai,* blood
Arthritis?	*Engeeya naada* (M)	Joints seize up, pain in joints	Cows	*O'remit*
Babesiosis	*Olodokulak* (M)	Shivering, blood in the urine, chapped skin	Cows	*Orbukoi, endapa, ormaluwa, ormisigiyoi, eng'arooji, org'ilai, olchani onyokie, endapa*
Beriberi				
Bird flu	*Mafua ya ndege* (S)			
Blindness	*Upofu wa macho* (S)			
Bloat	*Embong'it/ Embong'iti* (M)	Swollen stomach	Cows	Cut the stomach, chase the cow until it burps, snuff, *pilipili,*
Boil/abcess	*Jipu* (S)			

Bovine cerebral theileriosis (BCD)	*Kizunguzungu* (S) *Ormilo* (M)	Making rotations, crying, piloerection, shivering	Goats/ sheep, cows, donkeys	*Katani, osukuroi, ndulele, ormabait, bangi, orkiloriti, h*ot iron, snuff
Coccidiosis	*Kuhara damu* (S) *Olodokurum* (M)	Diarrhoea mixed with blood	Cows	Hot iron, milk
Constipation	*Kuvimbiwa* (S) *Emonyita* (M)	Arched back, crying	Cows	Shake
Contagious bovine pleuropneumonia (CBPP) (Rinderpest)	*Ugonjwa mapafu* (S) *Orkipioy* (M) *Olodwa* (M)	Shivering, diarrhoea, cough, breathlessness, swollen stomach	Goats/ sheep, cows, donkeys	*Magadi,* water, *olorien, orgilai*
Cough	*Engiroget* (M)			Honey, *magadi*
Diarrhoea	*Kuarisha* (S) *Engerotic* (M)	Diarrhoea	Goats/ sheep, cows	Clay, *olchani lorpukel, ndulele*
East coast fever (ECF) [also anaplasmosis]	*Ndigana baridi* (S) *Ndigana moto* (S) *Orltikana* (M)	Swollen glands, piloerection, excessive saliva, shivering, loss of appetite, shortness of breath, cough, fatigue	Cows, goats/ sheep, donkeys	*Org'ilai, oloisuki, orupande, olchani lorpukel, olorien, osendu, esenyi, oltimigomi, endijay, olekiushi, endatwen ormakutukut*
Ebola				
ECF, CBPP?	*Lipisi* (M)	Diarrhoea, excessive saliva, cough, swollen glands	Cows, Goats/ sheep	*olorien, osendu, esenyi*
Ephemeral fever	*Nunuk* (S) *Enunwai* (M)	Shivering, swollen stomach, fatigue	Cows	Ashes, *org'ilai*, *osendu*, *orkinyei*
Epilepsy	*Kifafa* (S)			
Fever	*Tetemeko ya n'gombe* (S) *Olokirikir* (M)	Shivering	Cows	Withhold water, poo of the anteater, e*itii, olorien, oloisuki*
Fleas	*Viroboto* (S) *Iloisusu* (M)		Goats/ sheep, cows, dogs	Poo of donkey, *olendanu*
Flu	*Mafua/Kifua* (S)			

Foot and mouth disease	*Homa ya mifugo/n'gombe* (S) *Oloirobi* (M)	Pox on the mouth and legs, piloerection, shivering, fatigue	Goats/ sheep, cows	*Endijay, olorien, emukutan, oloponi, pilipili,* ashes, salt, cut ears- bleed
Fungal disease	*Fangas* (S)	Scratches and loss of hair around the mouth and feet, loss of nails	Chickens	Rub sheep fat on the mouth and legs
Grasses (disease from eating certain grasses)	*Im'beneck* (M)	Piloerection, diarrhoea, shivering, anorexia	Cows	Wheat and water, *oltarakwai, oloisuki, emukutan*
Haemorrhagic septicaemia (HS)	*Emburuo* (M)	Swelling	Cows	None mentioned
Helminthiasis(worms)	*Minyoo* (S) *Orkurto* (M)		Goats/ sheep, cows	*Orkiloriti, magadi*
Hoof rot disease	*Ugonjwa wa kuoza kwato* (S)			
Insect poisoning	*Emoilaa* (M)	Falling down	Cows	Clay and urine
Lice	*Chawa* (S) *Paipai* (M)	Scratching, hair loss	Goats/ sheep, cows	Salt/*magadi*,
Lumpy skin disease (LSD)	*Upele* (S) *Vipele* (S) *Eririi* (S) *Eneririi*(M) *Olomorooj* (M)	Pox all over the body, dry skin, hair loss	Goats/ Sheep	*Oltemwai, oremiti,* hot iron
LSD? Mange?	*Ormaromui* (M)	A skin disease similar to mange or LSD, but affecting the legs and mouth only	Goats/ sheep	Hot iron
Malaria	Malaria (S) *Engajang'ani* (M)			
Mange	*Emukuji* (M)	Hair loss, chapped skin	Goats/ sheep	*Magadi, katani,* oil
(Bovine) Malignant catarrhal fever (MCF)	*Uginjwa wa Ingaati* (S)	Blindness	Cows	Cheese, hot iron
Miscarriage				
Newcastle disease	*Kideri* (S)	Diarrhoea, blindness	Chickens	*Pilipili, osukuroi, katani,*

	Mdondo (S)			*mjoovo*
Pneumonia				
Pox	*Ndui* (S)			
Rabies	*Kichaa cha mbwa* (S) *Erasunoto* (M) *Oloirirwa* (M)	Running lots, barking lots, biting	Dogs	Conventional vaccine, kill
Rift Valley	*Bonde la ufa* (S)			
Swine flu	*Mafua ya nguruwe* (S)			
Ticks	*Kupe* (S) *Irmaheru/ Irmaheri* (M)		Goats/ sheep, cows, dogs	Poo of a donkey, animal fat
Trypanosomosis	*Ndorobo* (S) *Malale* (S) *Endorobo* (M)	Anorexia	Cows	*Magadi*
	Enemekain (M)		Cows	Rabbit liver
	Enginyoisi (M)			
	Enyoo (M)	Swollen mammary glands	Cows	*Oltarakwai, olorondo*
	Nado endoliti (S)	Disease in bones when there are not enough grasses		
	Ormoko (M)	Bleeding swellings/pox on the mouth, legs and back	Goats/ sheep, cows	*Oltemwai,* hot iron
	Oser (M)	Diarrhoea	Goats/ sheep	*Magadi*