N ANALYSIS OF CAMEL CALF GROWTH AND SURVIVAL UNDER PASTORAL CAMEL PRODUCTION SYSTEMS IN SAMBURU

BY

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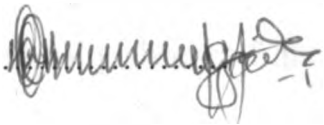
esis submitted to the University of Nairobi in partial fulfilment of the rement of the Masters of Science degree in Livestock Production Systems

rtment of Animal Production; Faculty of Veterinary Medicine, University of bi.

May 2010

claration

eclare that this thesis is my original work and has not been presented for a ree in any other University.

er Mungai Ihuthia ...  Date ...9/9/2010...

s thesis has been submitted for examination with our approval as University ervisors.

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dication

my dear wife Hannah Nyambura for her great encouragement and moral
port and to our daughters, Teresia Nyakanyi, Esther Wakonyo and Precious
ki who had to bear with my absence from home while pursuing the studies.

knowledgement

emost I wish to acknowledge the ASAL-based Livestock and Livelihood Support Project LPRO) coordinator Mr. J.K. Tendwa for financial support for the training and the project of ch it would not have been possible to complete in time without the funding. The training cer Mr. E. Mbogo and the project Accountant Mr. Owilli, all of ALLPRO, were very patient n my frequent visit to their offices for assistant. I am grateful to the Director of Livestock duction (DLP), Mr. Kiptarus, for allowing me the study leave without which I would not have ceeded for further studies.

cial thanks to Dr. R.G. Wahome and Prof. M. Wanyoike for their constructive advice and ections while preparing the project proposal, carrying out the field work and when writing up thesis.

rict Livestock Production Officer (DLPO) in Samburu Mr. M. Ouma was very supportive le conducting the field work .He assisted in organizing the communities and allowing one of staff, Mr. F.K. Ng'ang'a, to assist in data collection. I owe a lot of gratitude to the Samburus Turkanas who allowed me their camel calves to work with and gave their time to respond to nterview.

Chairman to Kenya Camel Association (KCA), Dr. Ngeywa and the entire executive mittee played a great role to ensure I do my field work in time and I benefited from their erience with camels. A lot of thanks to Dr. Njanja of Kenya Agricultural Research Institute RI) Muguga for his supportive assistance and advice while carrying out the field work.

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ist of Abbreviations

)G	Average Daily Weight Gain
LPRO	Asal Based Livestock and Livelihood Support Project
AL	Arid and Semi Arid Lands
S	Central Bureau of Statistics
P	Director of Livestock Production
PO	District Livestock Production Officer
O	Food and Agricultural Organization
K	Government of Kenya
RI	Kenya Agricultural Research Institute
A	Kenya Camel Association
F	Kenya Camel Forum
LD	Ministry of Livestock Development
LD SP	Ministry of Livestock Development Strategic Plan
LEP	National Agriculture and Livestock Extension Programme
J	Tropical Livestock Unit

stract

urvey was conducted to document traditional camel and camel calf management practices in ıburu with the objective of identifying gaps and suggesting possible solutions. During the ey 59 calf records were taken and 30 respondents representing their households interviewed Opiroi, Barsaloi and Kawop locations. The data was collected using a structured stionnaire. Linear measurements and actual live weight of the camel calves were taken so as stimate correlations that could be used in determining calf weight. It was observed that the munities in the study area kept camels, cattle and small stock to optimize range resource use. ıale animals constituted a high proportion for different livestock kept at 73% for camels, 65% cattle, 75% for goats and 72% for sheep. The respondents reported no specific breeding gramme for the camels. Breeding of closely related camels was reported by 52.15% to 60.15 f the poor and rich wealth categories of respondents suggesting inbreeding. Abnormalities may be related to inbreeding were reported. Feed availability was reported by 76.6% of ondents to vary with season, with the wet season providing more feed than the dry one. The onal feed scarcity was reported to cause camels to feed on poisonous plants. A common, but onous plant, *Capparis tomentosa,* was reported to form a significant component of the els' diet during the dry season. A need to explore its usefulness as feed and find ways of erating its poisonous effects was identified. Herding of camels to pasture was constrained ıbour scarcity forcing restricted grazing of calves. Calf nutrition was further aggravated by petition with humans for the milk; a situation made more difficult where a market for milk ed. Either because of tradition or due to scarcity of animal health and extension services iders, the respondents were dependent on ethno-veterinary practitioners. Camel calves had DG of 212 g/day up to weaning at 8 months. The male calves had a higher ADG (281 g/day)

the females (168 g/day). The vegetation condition at birth, significantly ($P<0.05$) affected el calf growth and survival. The mortality rates of camel calves remained unacceptably high n average of 50% and were higher for male calves at 56% than female calves at 43%. The ality could be due to such reported practices reported as colostrum denial, milk access ation, malpresentation during birth and mismothering. The correlation of predicted weights the actual live weights was high ($r = 0.963$) for the general regression equation derived from three linear body measurements of abdominal girth, heart girth and shoulder height bined. Abdominal girth coefficient of determination R^2 was high (91.4%) than heart girth %) and shoulder height (17.2%), making it the best single weight predictor. The findings rmined intervention points for improving camel calf growth and survival.

IAPTER ONE

neral Introduction

nels overcome the challenges of water, feed shortage and high temperatures characteristic of ity by their anatomical, behavioural and physiological adaptations (Payne, 1990; Wilson, 3; Field, 1993; Field, 2005). These adaptations are useful only when the calves born survive grow to maturity. Calf survival is very important for it ensures herd progression and in the term, benefits of camel ability to survive in arid condition are realized. Without offspring e would be no perpetuation of life and more so of such an important animal which have oted to harsh conditions of arid and semi-arid lands (ASALs). Camel calf rearing is a lenge to the pastoralists in northern Kenya and is reflected in high calf mortality rates lson, 1984; Kuria, 2004). When the calf mortality is more than 15%, it is time to intervene ne, 1990, Ndungu *et al.*, 2001). Calf survival is crucial for certainty of future of pastoralists' le source of livelihood. Milk is the main product from the camels, a source of food not only he calves but also for pastoralists' households. So to the weak and most vulnerable groups of ple; the women, children and the elderly who cannot follow cattle to the grazing satellite *yattas* (Wilson, 1984; Payne, 1990; Evans, 1995). The death of the calf affects the volume of produced by the dam (Simpkin, 1998).

high calf mortality in pastoral camel rearing system is among the major challenges oralists kept highlighting in different camel fora. The pastoralist experiences 37% to 73% ality rates in female and male camel calves, respectively (Schwartz and Walsh, 1992). The lem is further compounded by the fact that camels are spreading to the southern range lands ch are much more humid than the traditional camel home range (Schwartz, 1992; Field,), where calf mortality is expected to be even higher. The causes of this calf mortality were

ght to be due to health and nutrition (Schwartz and Walsh, 1992). From a participatory emiology study on camel calves of the Samburus and Rendilles semi nomadic pastoral stock production systems, it was concluded that health alone could not be expected to ove on growth rate of the camel calves if other measures were not integrated in the vention packages (Njanja *et al.*, 2003).

uring survival and high growth rate of camel calves would guarantee increase of the camel , a resource for the pastoral livelihood. Therefore, this study analyzed and documented the oral camel production system, investigated the factors responsible for growth and survival of camel calves, and generated a simple to use equation for estimating camel calf live weight easy to take linear measurements. This assessment of traditional camel calf management form basis of possible improvement in pastoral camel calf rearing and provide valuable sitory of traditional knowledge that is important for management of camel calves.

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IAPTER TWO

Literature Review

Samburu district

buru district lies on $0^0$4' and $2^0$31'N, $36^0$20' and $38^0$10'E neighbouring Turkana in the nwest, Baringo in the southwest, Marsabit in the northwest, Isiolo in the east and Laikipia in outh. Samburu district has a surface area of 21,000 km^2; it is administratively divided into 6 sions and 39 locations. Human population is estimated at 175,350 of whom 80% live in the areas (CBS, 2002). Livestock rearing is the mainstay of the livelihoods in the district; most bitants are Samburus and Turkanas who are essentially pastoralists. Eight percent (8%) of district is considered as high rainfall area receiving over 875mm p.a. and is used in limited production and forestry. The rainfall is erratic at times coming in storms and mostly equate for crop farming. The rest of the district is considered rangelands, best utilized for nsive livestock production or wildlife exploitation (Shaabani and Walther, 1992).

Classification and Geographic distribution of camels in the World

els belong to order Artiodactyla, sub-order Tylopa and family Camelidae. Camel species of genera camelids (old world camels) found in the world are; *Camelus dromedarius* (one ped) and *Camelus bactrianus* (two humped). *C. dromerius* is found in the hot deserts and *C. rianus* in the cold deserts of Asia. The other genera of Ilamoids (new world camels) consists e species: Guanaco (*Lama guanaco*), Vicuna (*Vicuna vicuna*), which are wild; and Llama *a glama*), and Alpaca (*Lama pacos*) which are domesticated (Wilson, 1984; Kuria, 2004; deh and Dawa, 2004; Larson and Judith, 2004). The lamoids are found in the cold heights of

Latin America (Wardeh and Dawa, 2004). Camels found their way to Kenya from Somalia a domestication in Southern Arabia between 1 and 4 B.C. (Bulliet, 1975; Wilson, 1984; Ku 2004).

2.3 Camel population and breeds in Kenya

There are three breeds in Kenya; Turkana, Rendille/Gabbra, Somali, based on the tribes w keep them. However, genotypic and phenotypic differences exist among them (Simpkin, 19 Simpkin, 1998; Hülsebusch *et al.*, 2002; Kuria 2004). Phenotypic differences especially the bo measurements were clear for all camel breeds (Hülsebusch *et al.*, 2002). Hanotte and Mb (2002) separated the Kenyan camels into two groups, the Rendille and the Gabra on one gro and the Somali and Turkana on the other though number of markers were few. Further analy separated the camels into two groups; Somali and Gabra – Rendille – Turkana (Mburu *et* 2003) The Somali type is further classified into four namely Hoor, Siifdaar, Gelab a Eydimmo based on milk production, lactation length, age to attain sexual maturity, hardness a weight gain (Hussein, 1993; Adams and Kaufmann, 2002). Rendille distinguish four differ types among the Rendille camels; Dabach, Godan,Coitte and Aithimaso (Adams and Kaufma 2002) and bases their classification on milk yield, fitness during rainy and dry season and season tolerance. Gabbra too have four different types namely Qorti, Mirgissa, Baku and A and bases their classification on performance, morphology and adaptations (Adams a Kaufmann, 2002).

Kenya has an estimated camel population of 2,2000,000 (KNBS, 2010) which constitutes 10% domestic herbivore biomass (MoLD, 2008). Camels formed 5.5% of total TLU in Sambu district (MoLD, 2008). Camels are spreading to the southern range area formerly outside

home range for camels and are, relatively more humid with moderate temperatures (Field, 20

Problems related to camel rearing are likely to increase posing greater challenge to the industr

2.4 Camel production in Samburu

The camels are mainly kept in low land comprising 92% of the total area of Samburu dis

(Shaabani and Walther, 1992). The camels are fed mainly on natural vegetation and especi

shrubs and forbs of semi arid and arid regions. The area lies in agro- ecological zones (AEZ

to VI. The Turkanas and the Samburus nomadic pastoralist exploit these grazing areas which

most suited for keeping livestock. The vegetations have adapted into utilizing the scarce mois

and are in form which is not palatable to most livestock except the camel and may be goats

wildlife which have adapted to aridity (Shaabani and Walther, 1992: Herlocker, 1992).

The most common strategy by pastoralists to cope with drought is herd mobility which aim

making use of spatially different vegetation type and productivity in variant places (Galvin *et*

2001; Mworia & Kinyamario, 2008). The access to different vegetation species and producti

ensures maintenance of livestock population stability and body condition (Ellis & Swift, 19

and maximizes use on available feed resource in the range.

2.5 Adaptation of the camel and its potential as a source of food for pastoralists

Due to its drought resistance qualities the camel has high potential as a source of food for

communities in ASAL which, in many situations, would be effectively utilised for livest

keeping. The adaptation to the adverse weather conditions (Payne, 1990; Wilson, 1984; Fi

2005) enables the camels to provide milk for families in the pastoral areas especially during

dry/drought periods. Camels are rarely slaughtered except on ceremonies. In comparison v

other livestock, the potential of camels is mostly under-estimated due to lack of information meat and milk production. A major reason for this is that most camel products never reach market but are consumed within the producer community, and where these are traded, they exchanged in kind instead of cash (Schwartz and Walsh, 1992). The camel will stay lon without water and have a variety of shrubs and acacia trees to feed on unlike cattle which grazers and have to be watered every third or fourth day (Grandin *et al.*, 1991; Tolera and Abe 2007). When the grass is depleted the grazers, that is cattle and sheep suffer shortage of fe and have to migrate in search for pasture unlike the browsers, (that is camels and goats), wh feed on deep rooted browse species that remain green longer into the dry season.

2.6 Camel calf mortality and colostrum

High camel calf mortality has been associated with denial of access to colostrum after b (Wilson, 1998). A study done on a Kenyan ranch showed that low colostrum intake in the f 24 hour of life and not low immunoglobulin G (IgG) concentration presumably causes early mortality (Kamber *et al.*, 2001). The average IgG concentration in the camel colostrum is hig than that recorded in the literature for cattle and horses (Kamber *et al.*, 2001). Within 24 hou birth the stomach of the calf can absorb the whole molecule of the antibodies protein with digesting it (Kamber, 1995). Beyond this period the intestinal lining of the newly born becomes increasingly impermeable to the immunoglobulin. Most of the absorption takes pl within the first 12 hour and by 24 hour the intestinal closure is almost complete. It observed by Kamber *et al.*, (2001) that the IgG concentration reaches maximum level in serum of the camel calves within 24 hours after birth.

The camel calf do acquire its passive immunity from colostrum. Passive immunity g temporary protection by transfer of immune substances from a resistant dam. It is critical the calf should suckle the milk as soon as possible after birth to boost its immune system take the advantage of the high nutrient content of the colostrum which is very rich in prot energy, minerals and vitamins. Camel calves as is true for other mammals are born with antibodies and active immunoglobulin synthesis starts from two weeks of life, reachin protective level at two to three months of age (Kaufmann, 2003).

One of the most important vitamins found in colostrums is ascorbic acid (vitamin C) and it established by Al- Sultan (2008) that injection of Ascorbic acid effectively increases lysoso concentration in colostrum deprived camel calves. This suggests that the vitamin C may enha the immune effect on camel neonates. Dietary supplementation of ascorbate increases plas immunoglobulin and stimulates cellular and humoral immunity in a variety of species.

The current study endeavours to understand the pastoralists' (Samburus and Turkan perception of these facts about colostrum and how and why their camel management practi may or may not incorporate them. A comparative study in perception of causes of camel losses between the pastoralists of Marsabit and scientists by Kaufmann (2003) revealed t Rendilles, Gabbras and Somalis restricted colostrum due to diarrhoea. This was scientifica sound where there is uncontrolled intake of colostrum. The excess protein was not absorbed the gut thus causing diarrhoea. In view of the scientifically proven importance of access colostrum by neonates, the extreme reaction by the pastoralists of prohibiting colostrum v unsound.

2.7 Camel milk

From the FAO data (2007), of the estimated 566.9 million tonnes of milk produced in the w 85% is cow milk. The camel milk occupies a small proportion of 0.2% far behind buffalo or e the goats and ewes. Of this 55% is taken by calves (Faye, 2004). Individual camel milk yiel not well documented in Africa but it ranges from 1000 to 3300 litres per lactation (Simp 1998, Faye, 2004). In Asia the milk production is 650 – 6000 litres per lactation (Khan and Iq 2001). Though camel milk production is low compared to cows globally, at housel subsistence level it is very important in the environment where the camel is reared. In a past production system, considering the available resources, camel milk production exceeds tha other livestock. In Ethiopia, the Afar farmers rearing cattle and camels simultaneously got average a daily yield of 1 to 1.5 litres of milk from Afar Zebu against 4 to 5 litres with Dan camels (Richard & Gerard, 1985). Schwartz & Walsh (1992) reported the productivity of ca as 1250 Kg of TLU/year which was higher than that of goats at 300 to 500 Kg and of zebu ca at 550 Kg/ TLU lactating female per year in the horn of Africa.

Camel milk just like other animals is an important feed for the calf before weaning. It determi the growth rate and vigour for the baby calf. The milk contains the important feed compone such as proteins, sugars, minerals and vitamins. The camel milk is rich in vitamin C. Tables and 2.2 showing the camel milk composition compared with the cow milk. Generally proportion of vitamin C is much higher in the milk of cow and camel than the other vitamins that may explains the role of ascorbic acid in immunity of animals. The mineral content of ca milk is generally low compared to cow milk as is displayed by Table 2.3 below.

Table 2.1: Composition of camel and cow milk (%)

Average %	Dry matter	Lactose	Fat	Protein	Ash
Camel milk	12.63	4.62	3.70	3.45	0.74
Cows milk	12.80	4.80	3.70	3.50	0.80

Source: Ramet (2001)

Table2.2: Vitamin composition of camel and cow milk (micrograms / 100g)

Vitamin	**Camel milk**	**Cow milk**
Pantothenic acid	88.00	350.00
Vitamin A	15.00	45.00
Vitamin C	2370	2000
Thiamin	33	45
Riboflavin	41	150
Vitamin B6	52	35
Vitamin B12	0.15	0.30
Niacin	461	93
Folic acid	0.41	5.9

Source: Ramet (2001)

Table2.3: Mineral composition of camel and cow milk (mg/100g)

Average	Ca	P	Ma	K	Mg
Camel	116	67	33	99	11
Cow	125	96	58	140	12

Source: Ramet (2001)

2.8 Calf management

Different communities differ in their management of the calf and that has implications to growth and survival of the calf. Camels dam at parturition require very little assistance if any is only necessary in case of difficult birth (Kamber, 1995). However the calf that is bo requires immediate attention to ensure it survives. A careful stockman ensures mucus is clea from the nose and the mouth and breath is initiated. The calf should get ample amoun colostrum for passive immunity transfer to reduce mortality (Mc Giure *et al.*, 1975; Rea *et* 1996). Camel calves unlike other herbivores are weak to stand immediately after birth should be assisted so that they can suckle and form a bond with the dam. The young have active part in forming and maintaining the bond with their mothers (Murphey and Ruiz-Mirar 1998).Different pastoral communities have marks for identification of their animals and un other pastoral communities Samburus marks the camel calves about a week after birth.

Provision of adequate amount of milk is important for calf growth. Field (1979) reported h growth rates of 378 g/day to 655 g/day where camel calves got up to 75% of the dam's m production in the dry and wet seasons respectively. In the same environment but under Rend management where the calf faces enormous competition for the milk, growth rates of 222 g/ and 255g/day in dry and wet seasons were obtained respectively. The competition for the ca milk worsens in dry periods when complementation from other types of livestock is reduced nil. Based on bovine calf, for the animal to grow normally, should be fed milk 8% to 10% of body weight (MCMU, undated). Probably the same proportion of feeding milk to the camel may apply. Camel keeping areas have predators and calves are the most vulnerable enclosures become handy to ensure the survival of calves.

2.8. 1 Weaning

The calf weaning age depends on environmental and genetic factors (Lasley, 1987). It can depend on health status of the calf and production aims. When the objective is to increase herd, camel calves may be weaned early to allow early conception of the dam or may be dela to prolong the lactation. The environmental aspects include the nutrition of the embryo in uterus and after birth through the milk production of the dam (Lasley, 1987; Willis, 1998; N 1999). A calf weaning age in normal circumstances is 6 to 12 months (Noor, 1999). Among Somali, a calf weaning age is 8 to 18 months (Farah *et al*, 2004) and it ranges from 8 to months among the Samburu. The weaning age is important for determining economic efficie of a production system (Lasley, 1987; Willis, 1998). The weaning weight determines reproduction efficiency of the herd. Thus an efficient system is expected to have high growth of calves implying calves will mature quickly and be weaned at an early age.

2.9 Camel feeding, supplementation and watering

Camel supplementation in many situations entails only provision of sodium chloride (Na Often this involves taking the camels periodically to the sites with natural salt lic Supplementation with other feeds apart from natural pastures is not a common practice pastoral production systems. However, feed supplementation is known to increase ca productivity. An on farm experiment in Erer valley of Eastern Ethiopia studied the effect supplementation to lactating dromedary camels on milk production (Derege and Uden, 20 There was a significant increase in milk production with protein and energy supplementation both dry and wet seasons. Feeds in arid areas are very seasonal and in the drought cycle ther always a time of scarcity. Supplementation may improve production but the availability and cost might be prohibitive. In Djibouti the peri-urban camel dairy herd has been successfu

supplemented. A study in Tunisia showed that supplementary feeding of dromedaries un range condition during late pregnancy and post-partum period improved productive reproductive parameters (Hammadi *et al.*, 2001). Just like other types of livestock, camels h to be watered periodically. However due to its adaptive characteristics, the camels requires frequent watering than cattle (Wilson, 1998; Field, 1993). Young camel calves are of separated from their mothers during the day to control suckling in Samburu (Simpkin, 19 The watering frequency is affected by factors such as feed succulence, ambient temperature water availability (Evans, 1995).

2.10 Calf health

The calf is most susceptible to diseases at early stages of life because of low immunity. handling and housing is crucial at this time because of predisposing factors (Hartung 19 Prevention of the calf diseases is important to cut the cost of production and increase survi rate of calves ensuring the progression of the camel generations. The gestation period of cam which is about 387 days is longer than all the livestock kept by the pastoralist, calving interva long averaging 24 months for pastoral herds in Kenya and so calf death is such a great loss to pastoralist or stock farmer (Wilson, 1998). This partly explains why growth of the natio camel herd is slow compared with that of other stock.

2.11 Calf growth and camel productivity

Growth rates depend on management and milk availability to the calf. Reduced milk competit allows the calf to access more milk and the growth rate is expected to increase. The age maturity would relatively be reduced. The productivity of camels in range is reduced by l

growth rate, long gestation period, a long calving interval and low survival rate of camel cal

According to Field (1979) Gabbra and Rendille calves in Marsabit district of Northern Ke

gained 222 g/day in the dry period of the year and showed little improvement in the wet sea

to 255g/day. In the same area but under experimental condition, gains were as high as 655 g/

Faye (2004) reported that in traditional systems the daily growth rate of the camel up to one y

is 190-310 g. In more intensive production system this can be 440-580g/day and in Austral

maximum of 1100 g was reported (Faye, 2008). Other factors influencing growth are

environment and general climatic and vegetational conditions, during the period of gro

(Wilson, 1984). Female camels mature earlier than males and attain sexual maturity at the ag

3 years but are not bred until at 4 to 5 years of age (Evans and Powys, 1979; Simpkin

Guturo1995; Tefera and Gebreah, 2001; Kuria, 2004). The males start showing breeding acti

at the age of 5 to 6 years (Kuria, 2004) but are fully sexually active at 6-9 years and

continue to serve upto 14 to 15 years (Tefera and Gebreah 2001). Camels are seasonal breed

but in warm regions this is triggered by nutritional status and tends to mate during rainy sea

(Yagil and Etzion, 1980). Consequently the calves are born in the rainy season when feed

plenty enhancing their survival and growth. Simpkin and Guturo (1995) reported an abortion

of 26% and a calving rate of 21% in Kenya, lower than 50% calving rate in Ethiopia (Tefera

Gebreah, 2001).

Most of the camels in Kenya are kept in the pastoral systems where accurate record keepin

almost non-existent. However, the camel is reported to maintain a longer lactation period t

cattle (Kuria, 2004). In Dromedaries the lactation period varies from 9 to 18 months, with p

production on the seventh month (Yagil, 2000). A lactation of one year was recorded in north Kenya with a milk yield of 1897 Kg (Field, 1979).

The camel meat contributes about 0.4 % of world meat production (FAO, 2007). This is indee small proportion with little impact in the world. However, camel meat has some cultural valu Traditionally camel meat consumption is not common in a subsistence pastoral system excep ceremonies such as *Mugiet* (initiation of a Samburu to eldership). The carcass is large and ne to be shared among many households. Male calves are sacrificed to recover milk that would h been taken by the calf and are slaughtered in such ceremonies. Fat male camels may also slaughtered to provide meat in times of severe droughts among the Rendille (Kuria, 2004). dressing weight is about 59% (Schwartz and Walsh, 1992) and the carcass weight can reach to 300 or more for adult camel. The meat production is lower than from other ruminants; Kg/TLU/year against 14 Kg for cattle and 35 for small ruminants (Faye, 2004). This is attribu to slow growth rate.

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CHARPTER THREE

3.0 GENERAL CAMEL PRODUCTION PRACTICES IN SAMBURU

3.1 Introduction

Camel rearing in the northern rangelands of Kenya is challenged by poor feed availability, p reproductive performance and high calf mortality (Schwartz and Walsh, 1992). Feed quan and quality fluctuate with season thus affecting the camel nutrition and body condition, whic turn influences camel productivity. The effect of feed fluctuation extends to milk product which has a bearing on the calf and human nutrition largely based on milk. Reproduction fac such as long gestation period, calving interval and age at first parity affect the rate of camel h growth. Although maturity in camels is naturally attained later than for other livestock kept pastoralists, it is aggravated by feed availability, forage quality, salt supplementation and lab (Kuria, 2004).The pastoralists may not be aware of subclinical effect related to feed quality mineral salt deficiency (Kuria, 2004). Northern Kenya pastoralists except the Samburus h traditionally kept camels over many generations but the national camel population has remai fairly constant. It is generally accepted that the pastoralists have accumulated wealth knowledge in range camel management. However, the knowledge is neither adequat documented, nor evaluated to determine its usefulness. The researcher in this study interviev pastoral camel herdsmen of Samburu district, in Northern Kenya and documented traditio management practices with a view of identifying gaps and challenges in camel production.

3.2 Materials and Methods

3.2.1 The study area

Opiroi, Barsaloi and Kawop locations within the larger Samburu district were the focus of survey. Opiroi is located on the Eastern side of Kirisia hills and is 1500 m.a.s.l, the med

annual rainfall is 500 to 600 mm; Barsaloi is on the riverline of Barsaloi lagga and is 15 m.a.s.l with median annual rainfall of 450 to 500 mm while Kawop is in Albarta plains and 1200 to 1500 m.a.s.l. with median rainfall of 400 to 450 mm. The three locations w purposefully chosen because they are among the camel rearing area within the ALLPRO proj working sites. The sites are the pilot areas for the ALLPRO where Participatory Integra Community Developments (PICDs) methods to identify and prioritize community needs h been conducted. Some micro- projects are being implemented in the sites. Households w selected from clustered random samples of *manyattas*. Each location had a number of *manyat* which comprises a number of households. Selected households within a *manyatta* to considered required had one or more camels with calves. The household heads w interviewed. The first two locations are inhabited by the Samburus and the other by Turkanas.

3.2.2 The respondents

The thirty respondents interviewed comprised 28 men and 2 women who were house heads a knew their camel herds well and had other information pertinent to the household. Wom headed households were widows. When administering the interview a translator fluent Samburu or Turkana was used in the three study areas. A feedback workshop was also done cross-check the information obtained during the survey after the analysis. The interviews w done during the dry season.

3.2.3 The survey instrument and the data collected

A structured questionnaire was developed, pre-tested and used to capture data on househo demographics, herd structure, camel calf management and breeding, livestock feeds, feedi

practices and constraints, extension and health services, reproductive performance and marke of livestock products (see Appendix). Responses were sought from persons who owned can even though they kept other livestock.

The data collected consisted of the following:

1. Pastoral camel rearing practices: Livestock herd structures, dam management practi herd size, camel keeping experience, housing of calves, environmental control.
2. Range condition in general recorded as observed at that particular interview moment,
3. Breeding system: Criteria for selection of breeding camel dams and sires, awarenes consequences of inbreeding and measures taken if any, to avoid inbreeding.
4. Disease control recorded: The ranking and perceived importance of camel diseases causes, the scope and extent of utilizing the local knowledge on disease treatment acc to animal health services.
5. Feeding of the camels: Pastoralists feeding of the camel, the level of competition milk, milking styles.

3.2.4 Analysis of the data

Data analysis involved the use of non parametric tools. Initially, explorative analysis was can out to establish categories of camel keepers for further analysis. Categories to classify respondents were generated from the herd structure using the Tropical Livestock Unit (TL (Jahnke, 1982). The aim was to standardize the livestock owned by pastoralists and then form bases for the categories of the respondents in the three locations of the study area. Responde proportions, counts or frequencies to specific management practices was generated based on

es established. The resultant data comparing categories was tabulated and presented
rtions or frequency histograms.

Results and Discussion

Camel management

l rearing is not practised in isolation but is integrated with other types of livestock
al production system. Pastoralists are known to keep different types of livestock as me
versification and spreading risks. In view of this wealth status, livestock distribution h
ure and other management practices are analysed.

.1 Wealth status, livestock distribution and herd structure

ralists in the three locations namely Opiroi, Barsaloi and Kawop kept varying numbers
ock. The numbers were transformed into Tropical Livestock units to weight the livest
d (Jahnke, 1982). Then respondents were categorized into three clusters based on TL
d; the rich (>76TLU), intermediate (21 – 75 TLU) and poor (<20 TLU). Responde
iewed in Opiroi, Barsaloi and Kawop locations had a total of 335.1 TLU, 270.6 TLU, a
TLU, respectively. The distribution of the respondents among the wealth categories a
cations is shown in Figures 3.1a and b. In Kawop location, in total, the proportion of
and intermediate livestock owners kept about the same numbers of livestock (115 and
TLU). However, the poor livestock owners of Kawop averaged 10.5 TLU and those
i kept an average of 17TLU; while the medium owner category of Kawop owned m
than those of Opiroi at 36 and 32.8, respectively. Apparently these were rand
outions because of the small sample size. Probably it is for the same reason that the Opi
ad 71 TLU a number above the 61 kept by the Kawop rich. There were no respondents in

Figure 3.1a: Wealth status distribution described by TLUs owned by respondents

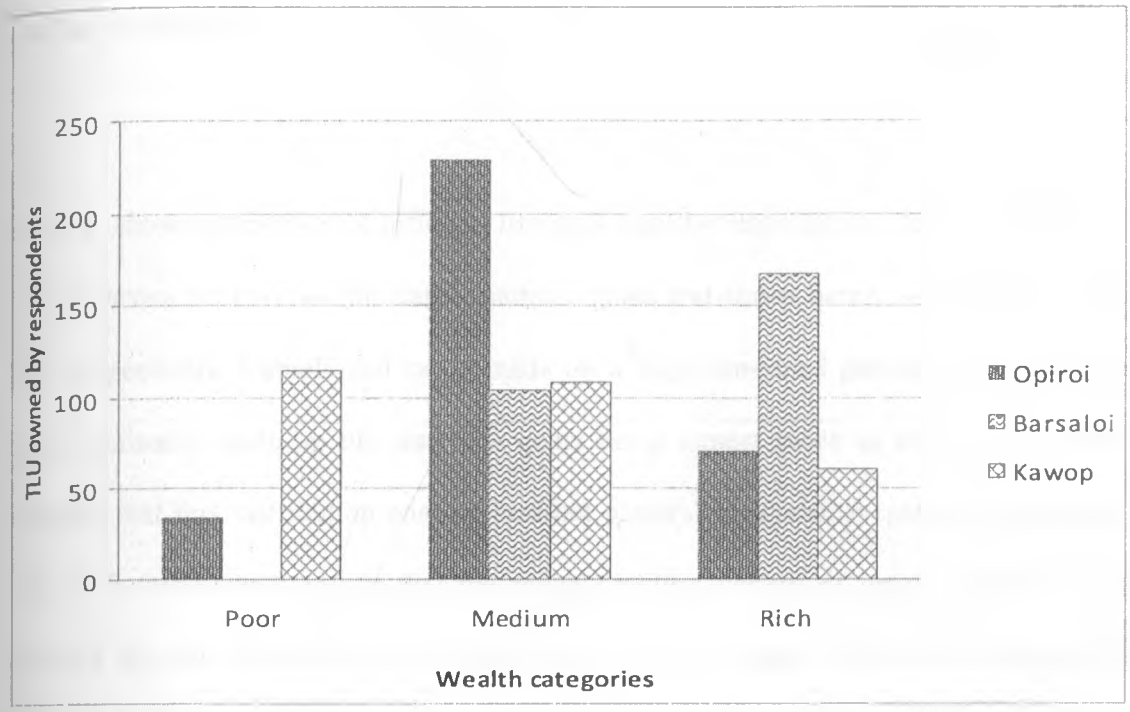
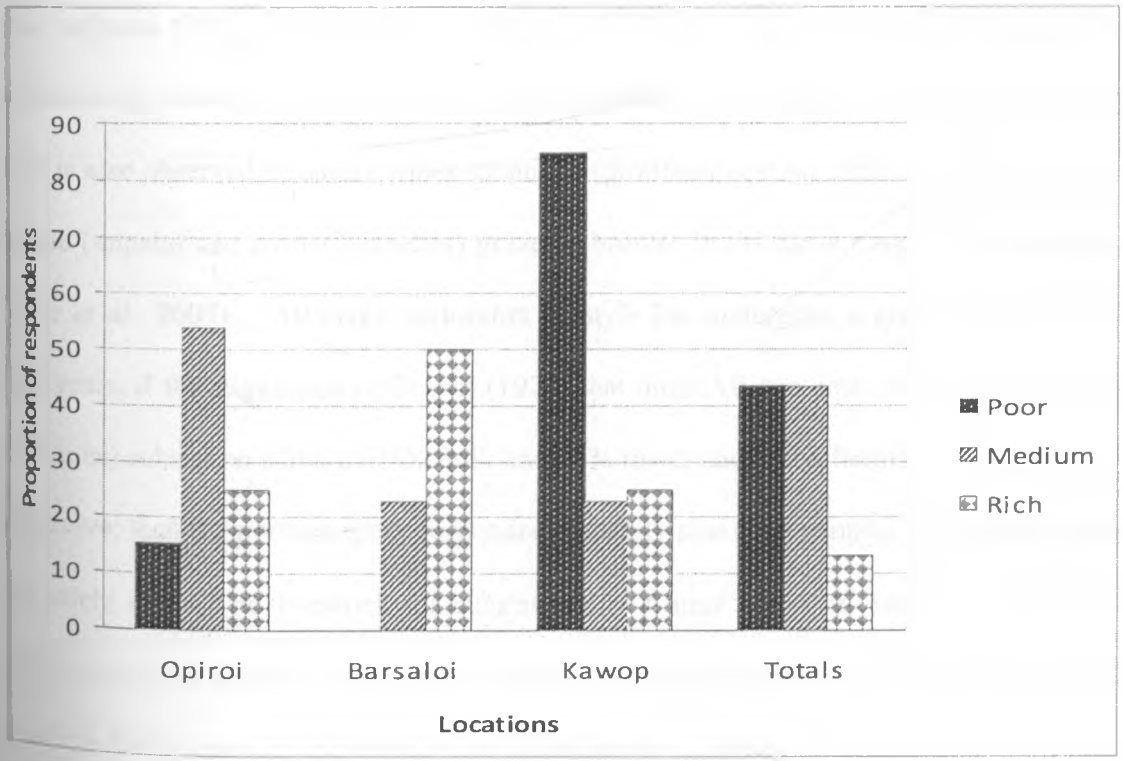


Figure 3.1b: The proportion of respondents' wealth status distribution per location.



the poor category from Barsaloi location. The location's rich kept an average of 83.5 TLU e and the intermediate ones kept an average of 34.5 TLU.

Fig. 3.2 shows proportion of different livestock kept by respondents. The respondents repor their livestock proportions for cattle, camels, goats and sheep being 44%, 41%, 11% and TLU respectively. Camels and cattle made up a high combined proportion of 85% while small ruminants made up the rest with goats being almost twice as many as the sheep. I probable that this distribution enables best-bet pastoral ecosystem vegetation utilization. E and Swift (1988) pointed out that the range provides variety of grazing levels for differ livestock species. It is also evident that domestic or wildlife herbivores living together subsist different levels and plant species of grazing or browse (Teferi *et al.,* 2008). Camels which predominantly browsers make use of encroaching bush thus opening the range for grazers intermediates (Migongo-Bake and Hansen, 1987). Also grazing one livestock species influence the sward structure and botanical composition benefiting other grazing stock spec This is also observed in nature where camelids (giraffes), equines (zebra), bovidae (wildebee caprae (impala) and ovines (gazelles) graze or browse in the same range (Mc Naughton, 19 Soder *et al.,* 2007). Although pastoralist lifestyle has undergone a great change over the fifty years, if the suggestion of Brown (1971) that most African pastoral families (equivalen 6.5 adults) subsist on a diet of 75% milk and 25% meat; and that a family required 27 to 31 T to survive; then the poor category respondents' family size (7±4 people), in the study area, co not solely depend on livestock for subsistence. Camel herds on average consisted of 7 females and 27% males across all the locations in the study area (Table 3.1). Of these 40% w breeding females and 4% breeding bulls, the rest were immature camels and calves. Goat and

Figure 3.2: Proportion of species composition as reported by respondents

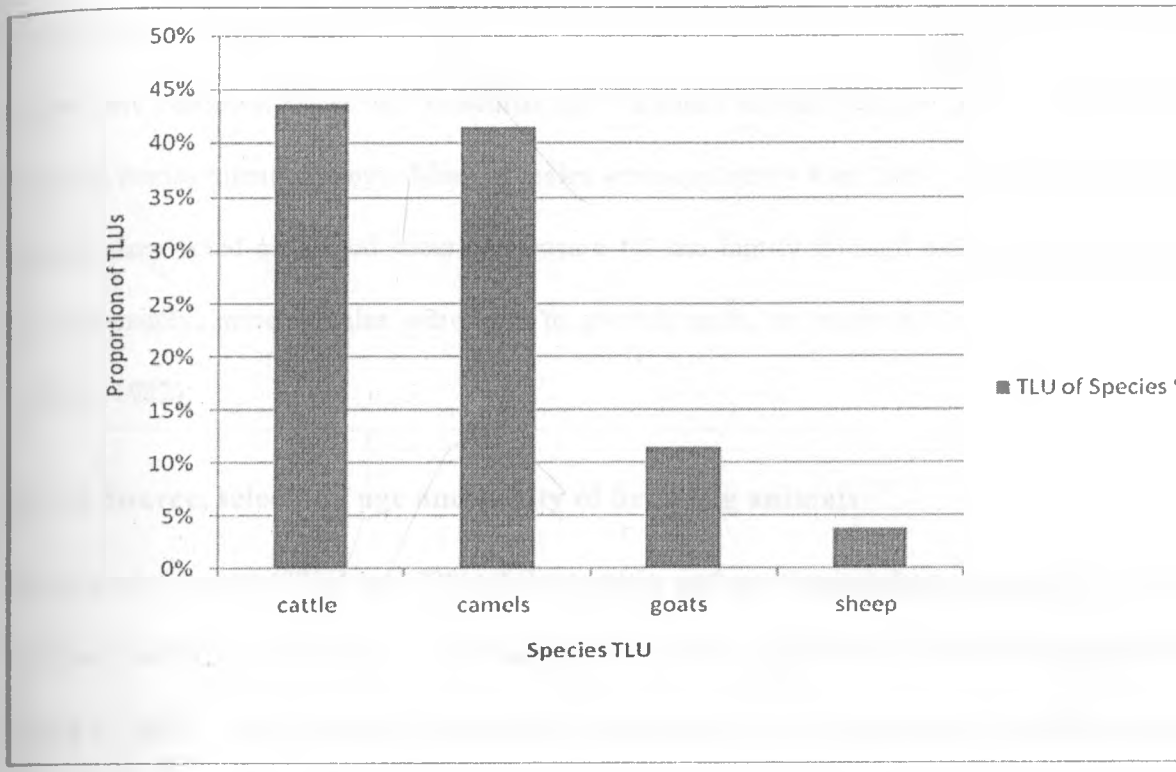


Table 3.1: Proportion of sex of livestock kept by pastoralists in Samburu

Species	Males %	Females %
CAMELS	27	73
CATTLE	35	65
GOATS	25	75
SHEEP	28	72

sheep flock sex ratios were 65% and 35%; 72% and 28% for males and females respectiv
Elmi (1989) reported similar herd structure in a Somali camel herd and noted that majority
males were castrates. However, Samburus and Turkanas seldom practice camel castration a
breeding management strategy. More of males were apparently kept than is normally accepta
because they acted as a food security measure for the family through exchange with cere
Proportionately, more females were kept to provide milk, the main product from the syst
(Jahnke, 1982).

3.3.1.2 Source, selection, age and parity of breeding animals

Thirty seven percent (37%) and 23% of the wealthy and poor respondents respectively, bou
breeding bulls from the market or exchanged/barter trade (Table 3.2).The pastoralists did
appear to have a clear breeding programme as portrayed by their acquisition of breeding bu
Most respondents either borrowed a bull or bought one from the market. Failure to see the n
to rear own replacement bulls may be translated to mean lack of a breeding programme. Cam
that are taken to market are mostly culls for reasons known only by the seller. Customs dict
that a pastoralists only sells the worst performing animals not suitable for breeding. This in eff
impacts negatively on the general herd growth and translates to low level of production.
addition, no records exist for most animals bought from the market, as the traders may not ha
or tell, the whole history of the animal.

Most of the respondents listed similar criteria for selection of breeding bull namely; lack
defects, fertility and lack of sexually transmitted diseases, good temperament, and lack
reproductive disorder. According to Elmi (1989) Somalis selects the sires and dams based on

Table 3.2: Proportion of respondents reporting breeding management practices in Samburu

Category	Proportion of respondents (%) practicing inbreeding observing abnormalities (n=30)	
Inbreeding practice	% Practicing Inbreeding	% Observed abnormality
Very rich	83	58
Rich	40	60
Poor	63	24
Very poor	40	20
Source of replacement of stock	Rear own stock	Buy from market
Poor pastoralists	20	23
Wealthy pastoralists	20	37

productivity and temperament. The information is derived from memory or observation of
herd.

Inbreeding was practiced by all categories of respondents (see Table 3.2 above). The pastoral
allowed closely related camels to mate resulting to inbreeding. The range of responde
proportion reporting inbreeding was quite high in all the categories; 40% to 63% and 40%
83% for the poor and the wealth categories, respectively. Abnormalities such as deformed le
short ears, cryptochidism and infertility had been observed and were reported during
interviews. The generation interval in camels which is already long because of their lo
gestation period- 300 to 400 days (Yasin & Wahid, 1957; Evans & Powys, 1979; Payne, 19
Simpkin & Guturo, 1995; Wilson, 1998; Kuria, 2004) can be further lengthened if sub-ferti
occurs in either bulls or cows. In such situations genes for abnormalities take long before th
are discovered. If decisions have to be made, then they are delayed resulting in an economic l
to the pastoralists.

Camels' first parity was about four years old implying that the first service was at three years
age as reported by 87% of the respondents. Bissa *et al.,* (1998) study on Bikenari breed show
growth continues beyond 4 years even if lactating so long as they were adequately fed. Fi
percent (50%) of respondents reported calving interval of 2 years; 30% reported calving interv
of 3 years and 17% intervals of over 3 years. Calving interval of more than three years genera
slows the growth of the camel herd and this partly explains the stunted growth of the natio
herd. The calving intervals reported concur with those in literature (Evan & powys, 19
Wilson, 1998; Tefera & Gebreah, 2001; Kuria, 2004).

3.3.2 Camel feeds and feeding practices

Camels derive their feed from natural shrubs, trees and other forbs available in the range. study area had varying densities of Acacia trees; *Acacia tortilis, Acacia mellifera, Aca senegal, Acacia brevispica* (thornless acacia) and other shrubs e.g *Salvadora persica, Cor spp.* etc. Comparatively, there is more feed for the camels than other livestock and thus the h proportion of camels in the study area. According to Schwartz, (1992) camels have adapt features related to feeding behaviour and nutritional physiology. Camels are able to sel browse of best qualities between seasons and can increase the retention time of poor qua feeds for the microbes to break the fibrous materials. Further camels can recycle and use body urea for microbial protein synthesis much more efficiently than other ruminants. Howe there are seasonal fluctuations of feeds, a characteristic of range lands and influences the bo condition of camels. There are challenges related to camel feeding described below.

3.3.2.1Constraints to feeding

Feed shortage was considered by 33.3% of respondents as a serious problem opposed to 23.3 who thought not a serious problem. The remaining 43.3% viewed feed availability as an avera problem (Table 3.3). In spite of variety in the range, feed availability fluctuations minimize camels feed choices causing them to turn to poisonous plants (*Capparis tomentosa)* as w evident in the study area (Fig. 3.3). Plant poisoning is cited as one of the problem in the stu area. *Capparis tomentosa* Lam. family Capparaceae is a climbing shrub or small tree up to 10 (Elffers *et al.*, 1964) which can be reached by camels and their calves. The plant is known have many uses such as human disease medicine and food as is indicated in the literatu (Birgitta and Caroline, 2000; Sama and Ajaioba, 2006; Akoto *et al.*, 2008) but pastoralists are

Figure 3.3: A picture of a camel foraging *Capparis tomentosa* at Opiroi

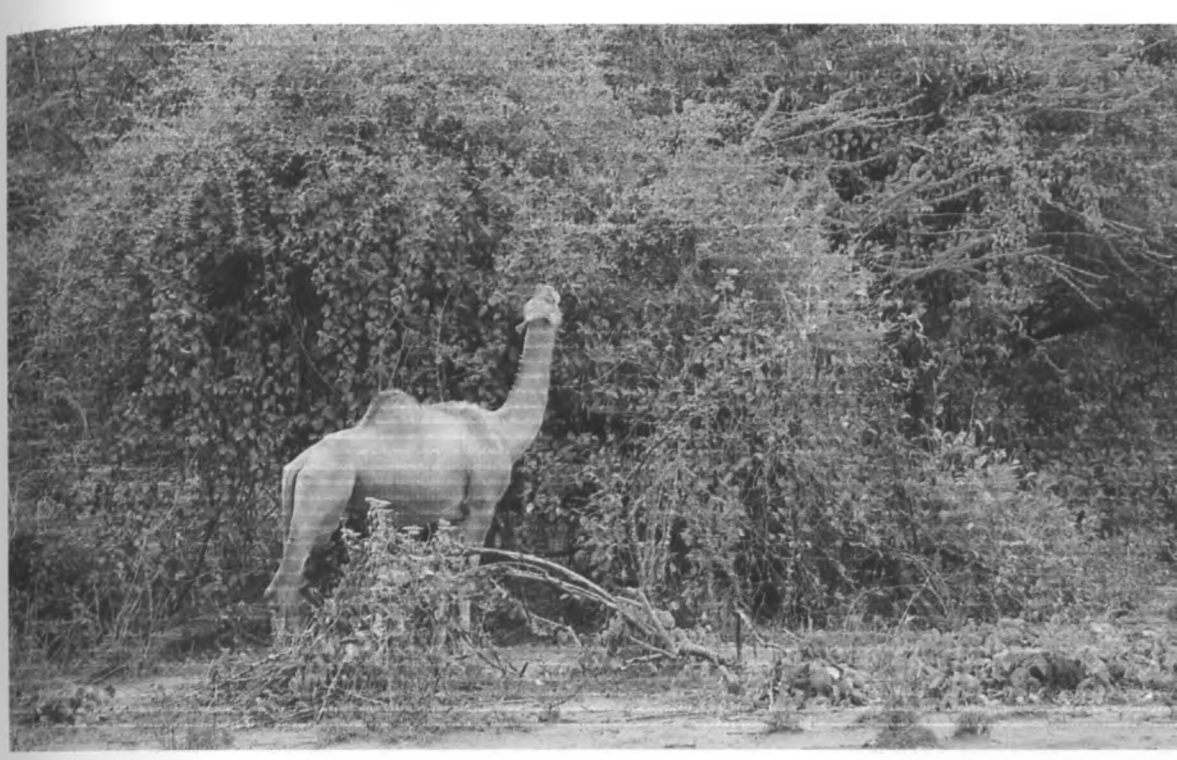


Table 3.3: Ranked constraints of camel feeding

	Proportion of respondents (%) n=30		
Constraint/ Rank	Labour	Shortage of basal feeds	others
Always a problem	23.3	33.3	
Only a problem	36.7	43.3	
Not a serious constraint	40	23.3	
Insecurity			23
Mobility			3.3
Poisonous plants			3.3

categorical of its poisonous properties to camels. The picture in Fig. 3.3 shows a camel feed on this poisonous plant at Opiroi. The plant is always green and is commonly found alo riverine where camels feed from during the dry spells. The plant fruits and flowers, as repor by respondents are known to cause paralysis in camels (Schwartz, 1992). The antidote is known though the pastoralists administer concoction of ground charcoal and fat of lamb to affected camels. The shrub can be reached by the camel calves which are more vulnerable th the adults. The plant is not easy to eradicate but pastoralists attempt cutting (Fig. 3.4). Howev it vigorously re-grows. In addition 23% of respondents viewed labour as a constraint to feed while 36.7% not a constraint as such. A herder is required to take care of animals in the field they feed. Young calves are left in enclosures the whole day as no one is available to herd th (see Fig. 3.5). School enrolment still remains very low among the pastoralists for this reas According to Esilaba (2005) the illiteracy level in Samburu is quite high (80%). However th are other reasons of keeping camel calves in the enclosures such as restricting the camel calf suckle in order to avail milk to the family, age or size requiring protection from the predato Labour needs override these others. The proportion of respondents considering insecurity a constraint to feed availability was 23.3%. Animals' forage radius and mobility was reduced insecurity impacting negatively on productivity, calf growth and the environment.

3.3.2.2 Watering and salt supplementation to camels

The proportion of respondents reporting watering interval for the camels being week fortnightly or over two weeks were 83%, 14% and 3% respectively. Most watering points w reported to be 2 to 30 Km away. The communities near the water points could afford to wa frequently thus explaining the high watering frequency reported. Watering interval of one mon

Figure 3.4: A picture of a dry *Capparis tomentosa* after being cut

Figure 3.5: A picture of camel calves enclosed in the whole day at Opiroi

reported by 2% was only applicable where camels had access to green vegetation with h water content for example along riverine areas in a dry season or during wet periods. Eighty f (84%) of respondents took their camels to salt licks monthly and 16% after two months (Ta 3.4). The distance to salt licks was 20 to 60Km away and that may explain the lapse betw visits. Very young camel calves could not walk such long distances for saltlick due to th vulnerability and yet are at a critical stage for salt requirements. Mineral salt is crucial for bo development and other physiological functions. Lack of essential mineral can lead to poor g growth, weak bones which can break easily, diarrhoea, anaemia, infertility, poor reproduction (NAP, 2000; Radostits *et al.*, 2000). Insecurity and seasonal flooding prone zones such as Sug valley limited access to salt licks.

The Opiroi communities used Barsaloi lagga (sandy riverbed) both for watering and salt lic The Lpus communities at Barsaloi location used Suyian lagga to water and avail salt to th camels. They claim it has superior quality of salt than Barsaloi lagga. Both laggas have visi sports of salt deposit and halophyte (*Salvadora persica*) growing along the riverine. Though pastoralists occasionally take their camels for the natural salt lick, the effect of salt quality w not easily determined. Problems related to mineral deficiencies are not easily conceptualized camel keepers unless at advanced stages (Kuria, 2004). There is need to do study on mine supplements in samburu for inference can only be made based on Marsabit district report (Ku *et al.*, 2004). The quality of salt supplementation might differ based on the geological factors a vegetation available. Forage mineral concentration also varies considerably and is dependent many factors including species, soil mineral concentration, climatic conditions and season of t year (Kuria *et al.*, 2004).

Table 3.4: Proportion of respondents reporting watering and salt lick frequency for camels Samburu

Watering and saltlick frequency	watering	saltlick
One week	82	0
Fortnightly	16	0
One month	2	84
Two month	0	16

It was noted in Samburu that pastoralists with the intention of supplementing their camels common table salt (see pictures in Fig 3.6 & 3.7).Table salt (Nacl) which is meant for hun consumption might be deficient in other essential element required by the camels. The requirement for camels varies with season (Faye *et al.*, 1991) due to seasonal variation vegetation quality (Elmi, 1989; Wardeh, 2004; Kuria *et al.*, 2004). Therefore supplementation for camels is necessary.

However, the reasons for not supplementing camels with the right type of mineral salt numerous, namely, limited extension services to camel keepers, low purchasing power due to prevailing poverty and availability due to long distances to the shopping centres where agro shops are located. Mineral salt is known to improve livestock fertility, reduce incidences retained afterbirth and increases milk production, increase weight gain, improves on bo development and growth (NAP, 2000). According to Kuria (2004) mineral supplementation dams increased the growth rate of Rendille camel calves by 60.1% and 38.1% attributed increased amount and quality of milk available to the calves.

Figure 3.6: A picture of a herder showing common table salt in the trough at Opiroi

Figure 3.7: A picture of common table salt in a trough at Opiroi meant for camels

3.3.3 Marketing of camel milk

The respondents reported selling the camel milk. Fifty seven (57) percent of respondents s camel milk mostly to the local market (Fig. 3.8) and a small proportion to their neighbou Majority of milk vendors are from Kawop location probably because of their proximity Baragoi shopping centre and the high poverty levels (Table 3.5). Eighty eight (88%) of 57% respondent selling milk came from Kawop location where 53% were poor households. Twe percent of respondents selling milk came from Opiroi where the ratio of the poor and the wealt respondents was the same. No sale of milk was reported at Barsaloi not because they did n want to but because of distance to the shopping centres and lack of customers. About 45% milk was sold though variation existed from one household to the other depending on the numb of persons in the family. The price of camel milk ranged from Ksh20 to Ksh30 per lit Marketing of camel milk, though a source of income to the household aggravated the constra of milk availability to the calf. This scenario worsened during dry season, negatively affecti the growth and survival of young calves solely depending on milk. During the rainy season t milk production increased and there was complementation from other stocks which return fr satellite *manyattas*. When milk is in excess, preservation technologies such as milk condensati may be applied to improve the shelve life of the product and improve food security at t household level. According to Simpkin (1993) and Farah *et al.*, (1995), when 250 g of sugar added to a litter of milk and boiled until only 0.5 kg or 500ml remains , the shelve life of milk increased to over six months. This condensed milk can be used by the pastoralists during the d period.

Figure 3.8: Proportion of respondents selling camel milk

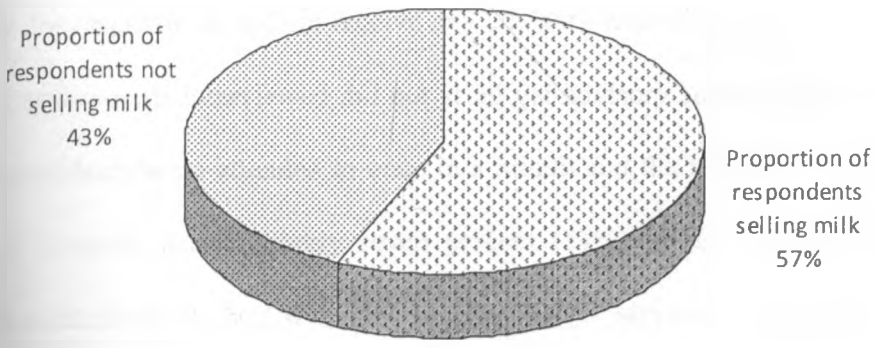


Table 3.5: Respondents reporting marketing of camel milk as per locations (%)

Categories	Opiroi location (%)	Barsaloi location (%)	Kawop location (%)
Very rich	0	0	35
Rich	6	0	0
Poor	6	0	29
Very poor	0	0	24

3.3.4 Access to extension, health services and frequency of service provision

Access to extension and health services is very important in livestock industry. However alm all the respondents did not receive any advisory extension services. Ninety seven percent (9 of respondents interviewed did not at all get advisory services from extension workers, 35% respondents were attended to once in a month and the message passed by the few workers on livestock health. Eighty seven percent (87%) of the respondents did not seek extens services because they were not aware of such services. This clearly showed that there knowledge gap. The extension service providers were not able to effectively reach out the ca owners and neither did the pastoralists seek the information and worse still they did not kn whether such services exist. The respondents reported that the main animal health providers w Agrovet shops (56.7%), Ethnoveterinary (20%) and unqualified private vendors (6.7 Respondents who sought the government services were minimal (3.3%) in Table 3.6. frequency of service provision is displayed in Table 3.6. Ninety eight percent (98%) respondents attended to their livestock whenever there was a health problem in the he Alternatively they turned to community based animal health workers (16.7 %) or ethnoveterin (16.7%) or Agrovet shops (36%). Private veterinary services were not available at the local le but most Agrovet shops owners or employee had veterinary background and in the process selling drugs would offer some extension services on how to use the drugs.

Government services were less frequently used because they were not available except emergency or outbreaks. The Government institutions were far away with limited extension sta Pastoral areas had a seriously shortage of extension field workers. The areas were very extens and sparsely populated and had poor infrastructures leading to poor networking.

Table3.6: Proportion of respondents reporting service provision

Categories of animal health service provider	Number of contact	Proportion of respondents (%) n=30		
	Service providers contacted	Frequently used	Rarely used	Never u
Agro-vet shops	56.7	36	40	23.3
Ethno-veterinarian	20	16.7	30	53
Private veterinarian	6.7	0	0	100
Gok veterinarian	3.3	0	10	90
others				
CBAHWs	13.3	16.7	30	53
Self	13.3	98	0	0

Though the importance of livestock as means of livelihood to pastoralists cannot be underscor livestock sub-sector is accorded little attention and is one of the most poorly funded in Agriculture sector (GoK, 2010). The observation shows there is a knowledge gap because m of respondent do not seek technical services from relevant institutions. Neither do the instituti reach the pastoralists effectively due to the reasons stated before. Further extens methodologies used are not appropriate to pastoral areas. Appropriate extension methodolog to the pastoral communities needs be developed and used to effectively bridge the knowle gap.

3.3.5 Management of health problems

Most pastoralists in the study area bought drugs and treated the cases themselves or resulted herbs and other traditional treatments. When a calf was infested with ticks or mange, old eng oil was applied with or without acaricide. This may have had some negative effect to you calves because pheromones were masked off and more often than not result to calf reject (Fraiser & Broom, 1997) and caused heat problem as well. The pastoralists are then in a dilem yet ticks are known to cause paralysis to young calves (Dioli *et al*, 1992). Ticks find a habitat in the fur along the spine and sucks blood from the calf affecting its health status. This result tick borne diseases, anaemia or calf paralysis.

Hundred percent (100%) of respondents bought drugs for external parasites, and less than 20 for internal parasites, orf or internal infections (Table 3.7). For almost all animal health proble pastoralists have local herbs to treat implying there is a lot of wealth in indigenous knowled regarding diseases and treatments (Wanyama, 1997). There are a lot of plants used for medici purposes in Samburu (Wanyama, 1997). Preparation of these types of medicines is an issue. Al

Table 3.7: Management of common health problems

Health Problem	Management practices reported by respondents (%) n=30				
	Call a vet	Buy drugs	Traditional herbs	others	Do nothin
Dairrhoea	0	0	13	0	0
Plant poisoning	0	0	17	7	7
Internal infection	0	3	0	0	0
Internal parasites	0	13	17	7	0
External parasites	0	100	13	23	10
orf	0	17	13	0	3

there is the variation of quantities administered resulting to overdose or under dose which h consequences of either killing the animal or causing the resistance. Some plants are known to toxic. There is little scientific research validating claims made of their effectiveness. The con of active ingredients is unknown and further exploration on medicinal plants is required.

3.4 Conclusion and Recommendation

3.4.1 Conclusion

- Different types of livestock species were kept for the purpose of diversification optimum utilization of scarce and fragile range resources in Samburu.
- There lacks good camel husbandry practices resulting to poor productivity and reproduction.
- Camel feeds availability fluctuates with seasons. Feeds are plenty and of good qua during rainy seasons and vice versa in drought. Camels turn to poisonous pla (*Capparis tomentosa*) in time of feed scarcity.
- Extension and health services are weak causing the pastoralists to turn more to traditio healers who may not have adequate knowledge on some of the diseases for camel.

3.4.2 Recommendation

- Good camel husbandry practices should be promoted to enhance productivity reproduction of camels.

There is need to establish the poisonous alkaloids concentration in the various parts of the plan *Capparis tomentosa.* Develop the antidotes to them.

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CHARPTER FOUR

4.0 Factors That Affect Growth and Survival of Camel Calf

4.1 Introduction

Camel calf growth rate is affected by milk available from the dam because of its dependency nutrients from milk. The milk produced by the camel dam is related to the body condition wh is affected by the condition of the vegetation it feeds on among other factors. Vegetation in rangelands fluctuates in quality and quantity depending on the moisture availability and nutrie in the soil and forage species. Moisture availability is highly related to erratic and unrelia rainfall. Milk quantity produced by camel dams fluctuates with the vegetation condition. survival of camel calf highly depends on nutrition though there are other factors such as disea and management. Schwartz and Walsh, (1992) reported high mortality rates of 73% for m calves and only 37% for females for pastoral herds in Northern Kenya. Such high mortality, greater than the acceptable 15%, requires re-evaluation of the production system to establish causes and establish the intervention points for higher calf survival rates (Payne, 1990; Ndun *et al*, 2001). The survival of calves has a bearing in the herd growth which for the camel Kenya has remained fairly constant over years. Pastoralists will not realize the full benefit camels when the herd decreases or stagnates. There is need to document camel calf rear practices in this largely pastoral production system to establish the causes of the high c mortality and suggest management practices to reverse the situation. In this study pastoral ca herdsmen of Samburu District were interviewed, in Northern Kenya to document camel c mortality rates and traditional management practices with a view of identifying challenges camel calf rearing.

4.2 Materials and Methods

4.2.1 The study area

This is as described in chapter 3.

4.2.2 The respondents

This is as described in chapter 3.

4.2.3 The survey instrument and the data collected

The structured questionnaire described in chapter 3 had a section to capture data on camel c management and feeding practices (see Appendix). In addition, a record sheet was used to coll information on each calf sampled in the camel herd. Fifty nine (59) calf records were taken. T calves were suspended on a scale by a sling and the live weight taken. The data collect consisted of the following:

1 Pastoral calf rearing practices: calf management from birth to weaning; housing (if an access to dam for suckling, age at access to grazing, age at weaning.

2 Range condition in general recorded as observed at the time of administering t questionnaire and recall information at the time of birth.

3 Camel calf mortality and its suspected or identified causes.

4 The calves live weight was recorded. The calves' body condition was also recorded usi the designed scale of 1-9 (see appendix).

4.2.4 Analysis of the questionnaire

The data was screened for outliers after which three categories of the calves were establish very young (1 -100 days), fairly young (100 – 300 days) and post-weaned (300 – 400 days) further investigation. The proportion of death rates was determined from the record. Furt using the Excel and Genstat to run the data, the growth curves, histograms describing vari practices and site effects were derived from the data.

4.3 Results and Discussion

4.3.1 Camel calf growth

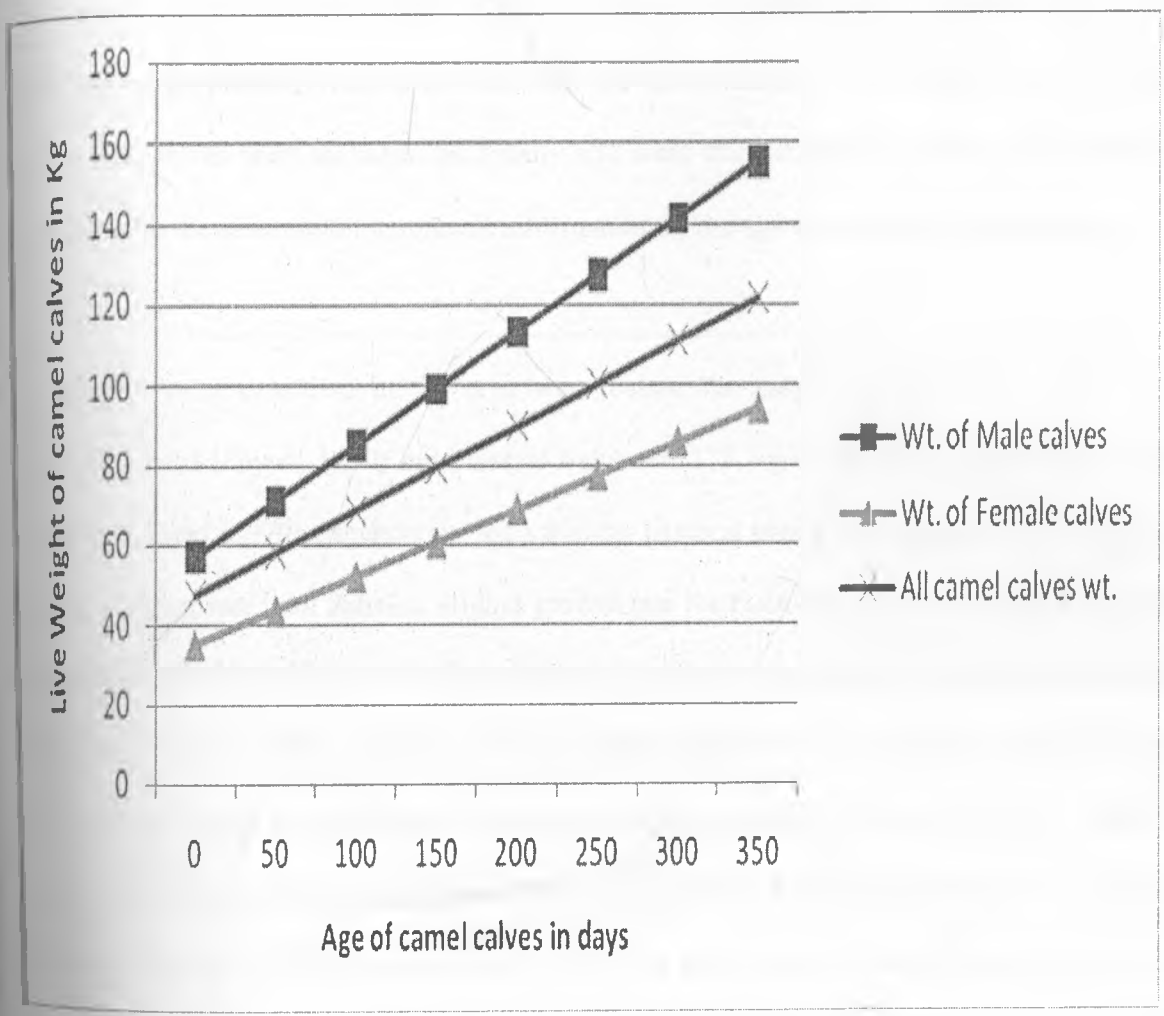
The estimated average daily gain (ADG) was 212g/day for both the male and female calv When this was segregated on the basis of calf sex the ADG for male and female was 281 and 1 g/day respectively. The ADG was estimated from the gradient of the best fit line equation of derived growth curve (Figure 4.1). The derived growth curves were extrapolated to zero days age to estimate the average birth weight at 47.5 Kg. The respective estimate birth weights male and female calves were 57.14 Kg and 35 Kg. The regression equation used to estimate ADG is:

$$Y = a + bx$$

where Y = weight at age x; a = constant (birth weight); b = gradient of the best fit line of regression

The age at which camel calves were weaned was commonly reported by camel keepers as months (240 days). The average weight of the calves at this age was estimated at 98.4 Kg fr the derived respective regression equation (y=0.212x + 47.14).

Figure 4.1: The growth curves of the best fit line for camel calves



NB: Wt - Weight

According to Kuria (2004) the average birth weight for Rendille camels in Marsabit was 35
From available literature birth weights ranged from 25.8 kg in Tunisia to 37.3 kg in India
were lower for females than males (Wilson, 1984).The birth weight estimated in the cur
study was high probably due to the fact that the measurements were taken once for differ
calves. The calves were managed differently and were from different localities. The estimat
also based on the assumption that recall information on the age of the calves was accurate.

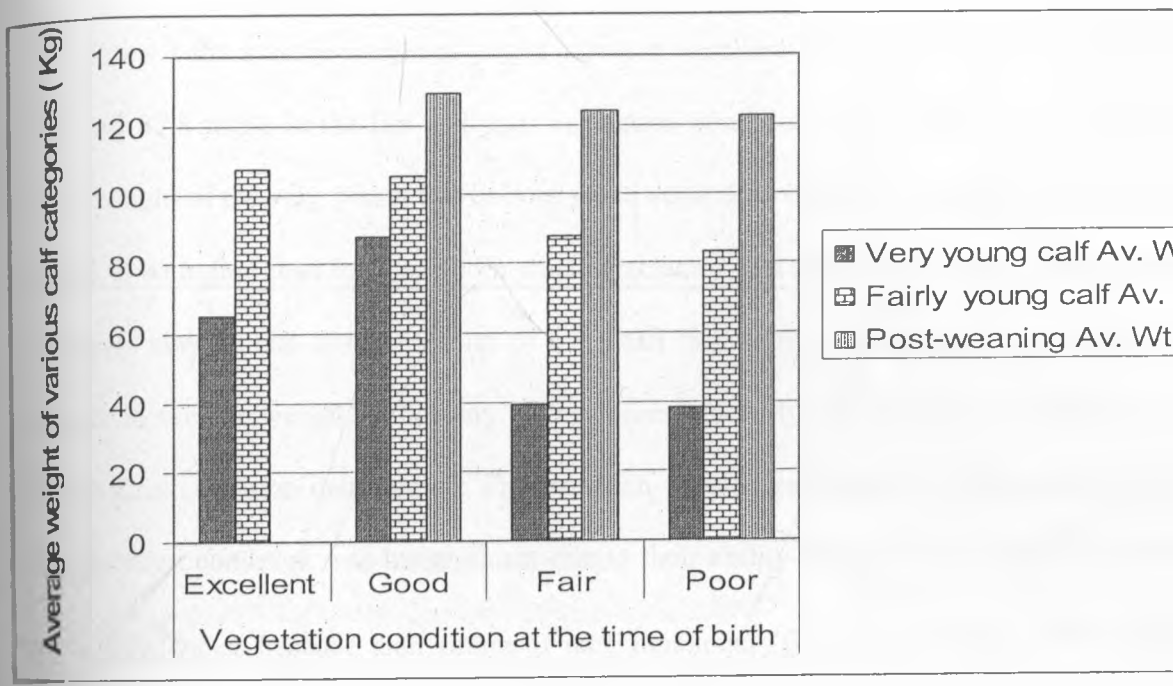
The growth rates exhibited in the area were below the range of 300 to 400 g/day for
indigenous herd (Payne, 1990) but close to values of 275.7 g/d and 222 g/d reported by Ku
(2004) and Field (1979) respectively for a similar pastoral production system. The male cal
grew at a higher rate than females. Higher growth rate for male animals is widely reported an
explained by a higher feed conversion efficiency and lower proportion of fat in the live wei
gain (Bishop *et al.*, 1991). However females mature earlier but at a lower weight than ma
According to Wilson (1998) breeds with lighter birth and mature weights may gain weight
rapidly than breeds of heavier weights. Field (1979) reported a high growth rate of 378 g/d
655 g per day (dry and wet season) during the first year of life in an experimental herd w
supplementation and health care services in Northern Kenya. In USSR, Meredov (19
reported a growth rate of 950 to 1030 g/day for one year while Degen *et al* (1987) reported a r
of 680 g/day up to 180 days of age. In India, Khanna (1988) reported a growth rate of 244
810 g/day from birth to one year while Khanna *et al* (1990) reported 349 -732 g/day for Biken
breed and 254-800 g/day for Kachchhi breed. These higher growth rates reported from India a
USSR and by Field (1979) were better due to management including supplementation clea
showing the growth potential of camel calves in pastoral production systems.

4.3.2 Effect of vegetation on growth

Feed availability and vegetation condition fluctuates seasonally indirectly affecting the growth. This is because vegetation condition determines the nutrients available to the dam hence the amount of milk she produces. The calf is dependent on milk until the rumen becor functional usually at 3-4 months of age for a camel calf (Craplet, 1963; Wilson, 1984). calves were classified based on age in days into very young (1 – 100 days), fairly young (10 300 days) and post-weaned (300 – 400 days).

Figure 4.2 shows the effect of vegetation condition at the time of birth on the camel calf wei at the time of administering the questionnaire. The general expectation is for the average wei of the three categories of camel calf to decrease with deterioration of vegetation conditi However the calves reported to be born during the excellent vegetation condition deviates fr this. Also defying this trend was the post-weaned group calves all of which had similar weig in spite of vegetation condition at their birth varying from good to poor. This may be attribu to errors associated with recall information. Interpretation of vegetation condition classificati such as the difference between excellent and good, would also vary among the respondents a contribute to the errors. However, the fairly young and very young calf groups exhibited trend towards decreasing weight as the vegetation condition changed from good to poor. T trend was especially pronounced for the youngest calves. This disparity in response to vegetat condition at the time of birth among calf age groups may be explained by the capacity of anim to recover from periods of nutritional stress (Kellems and Church, 1998; Freking *et al*, 20 Summers and Spratt, 2000; Martínez-Ramírez *et al.*, 2008; Read and Tudor, 2004). The ol calves would have had adequate time to recover from any earlier growth checks due to nutritio

Figure 4.2: Effect of vegetation condition at birth on the camel calf live weight during the three stages of growth



inadequacy. In contrast the very young calves were still dependent on milk so that the vegetat condition at birth as it affects dam nutrition is still critical in determining their growth rates.

From Table 4.1 the average weight of young calves in excellent and good vegetation condition 65 Kg and 87.8 while in the fair and poor vegetation condition this is 39.3kg and 38 kg. T average weight of the very young calves born when vegetation condition was excellent would expected to be higher than for those born when vegetation was described as good. This appar discrepancy may be due to inaccuracies of the recall information on vegetation condition. T difference in average weight for the very young calves and fairly young calves was significant the vegetation condition deteriorated. The variation in average weight of post-weaned calv with vegetation condition was insignificant due to their ability to browse and make up for a nutrient deficiencies because their rumen is then functional (Ørskov and Ryle, 1990; Ørsk 1986). The variation in feed condition affected camel milk production and therefore the c growth. The average calf body condition followed the trend of fluctuating feed availability.

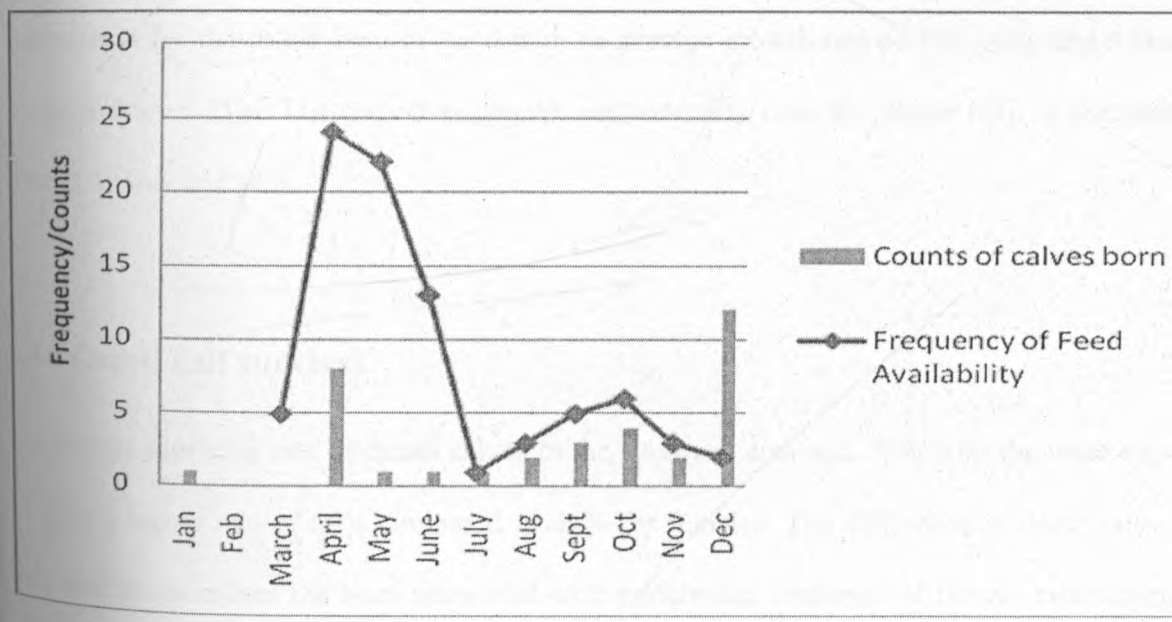
4.3.3 Sexual activity and calving season

The process of growth is initiated by a successful conception during mating season. Camels a seasonal breeders and increases sexual activity when feeds are in abundance. In the trop temperature, humidity and nutrition determine the intensity of sexual activity in camels (Husse and Ahamed, 2009).These condition appear most favourable during the rainy season. Figure 4 shows that most calving took place in April and December which implies that mating took pla the same time previous year since the gestation period is about 12 months (Wilson, 1998; Kur 2004). This coincided with the long and short rain seasons in the study area.

Table 4.1: Camel calf average weights in relation to vegetation condition at birth

		Vegetation			
Category		Excellent	Good	Fair	Poor
Very young	Av. Wt (Kg)	65	87.8	39.3	38
Fairly young	Av. Wt (Kg)	107.5	105.6	88	83
Post-weaned	Av. Wt (Kg)	-	129.1	124.1	122.5
Av. body condition					
camel calves		5.67	4.8	4.6	4.4

Figure 4.3: Frequency of feed availability and counts of calves at birth



Further Fig. 4.3 shows the two peaks of months when feeds for the camels are perceived to be plenty by respondents. The first peak is in the months of April and May and the other in Octob November. These peaks correspond to the long and short rains, respectively. Increased moistu in the soil results in stimulation of plant growth and hence increase in herbage biomass. T body condition improves as a result and this in turn stimulates the sexual activity of camel bu and females.

A comparison of the time of birth and perceived feed availability shows that by three to fo months when calves are able to utilize forages, those born in April had a more favourable fe availability situation than those born in December. The latter group of calves was exposed to subsequent long period of low feed availability up to April. This was reflected in bet performance for the calves born in April with an average growth rate of 290 g/day and a low mortality rate of 33%. The respective growth and mortality rates for calves born in Decemb were 150 g/day and 46%.

4.3.4 Camel calf survival

The average mortality rate of camel calves in the surveyed area was 50% with the male calv showing a higher rate of 56% compared to 43% for females. The difference in death rates male and female calves has been associated with preferential treatment of female calves whi e viewed as the future of the herd in terms of growth and milk production. Schwartz and Wal (1992) reported higher milk off-take for human consumption from dams with male calve Schwartz and Walsh (1992) similarly reported higher mortality rates of 73% for male calves a only 37% for females for pastoral herds in northern Kenya. The average mortality rates of cam

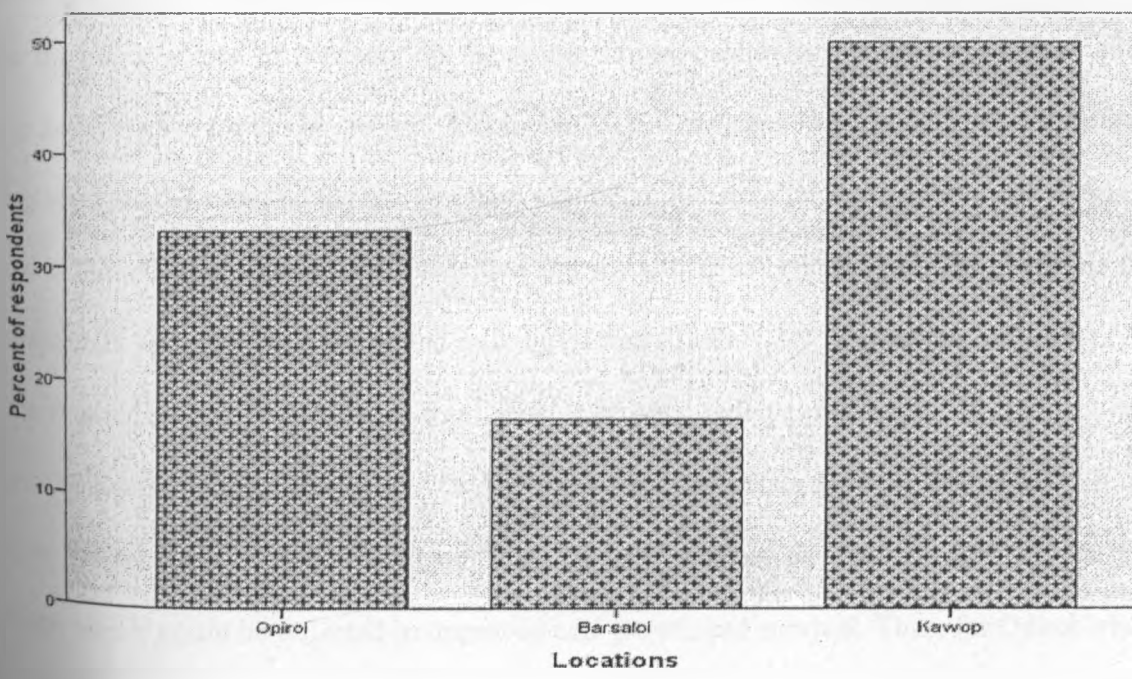
calves in the current study is higher than the 15% recommended by Payne (1990) and Ndung'u *al* (2001) but similar to the 50% reported by Wilson (1984).

A major contributor to the high camel calf mortality is reported to be denial of access colostrum for the young (Wilson, 1984). In the current study 63.3% of respondents denied cam calf access to colostrum (Table 4.2). Proportion of respondents reporting colostrum limitati from Kawop, Opiroi and Barsaloi locations were 50%, 33% and 17%, respectively (Figure 4.4 Some pastoralists reported milking off all the colostrum for household use. Though t importance of colostrum to the calf cannot be underscored, it was perceived as a cause diarrhoea by some pastoralists. Colostrum is vital for the survival of the new born because provides the neonate with passive immunity when taken within 24 hours of birth (Kamber, 199 Kellems and Church, 1998; Kamber *et al*, 2001). Access to colostrum within the first 24 hours important because the intestinal mucosa becomes increasingly impermeable to immunoglobuli in form of macromolecules. After 24 hours of birth closure of intestinal mucosa to absorption the macromolecules is reported (Bush and Staley, 1980; Kamber, 1995; Cunningham and Klei 2007). However even beyond this time immunoglobulins in the gastro intestinal tract provid immunity by neutralizing pathogenic bacteria and prevents diarrhoea (Foley and Otterby, 197 Bush and Staley, 1980). Additionally colostrum contains transferrin and lactoferrin bindi factors which restrict bacteria growth in the gut (Besser and Gay, 1994). In addition to providi passive immunity to the neonate, colostrum is rich in vitamins (A, E and C), protein (casei minerals and energy in form of fat and sugars necessary for growth (Miller, 1979; Kellems a Church, 1998).

Table 4.2: Period of time before postnatal camel milk becomes acceptable for human consumption (% respondent)

Period	Frequency	Percent	Cumulative Percent
Immediately	9	30	30
One day	1	3.3	33.3
Two days	3	10	43.3
One week	14	46.7	90
Over one week	3	10	100

Figure 4.4: Proportion of respondents (%) who restrict access to colostrum for their calve in the three study locations



n= 30

Newborn calf rumen being nonfunctional their dietary nutrient requirements are provi through colostrum or milk (Kellems and Church, 1998; Ørskov and Ryle, 1990; Ørskov, 198

It also has a laxative effect to the calf and makes it expel meconium (Juergenson, 1977; Kamb 1995). Though pastoralists associate calf scouring with colostrum ingestion, the obser diarrhoea among the camel calves could be attributed to a number of things. The teats could contaminated with diarrhoea causing organisms such as *E.coli, Salmonella spp* and *Colostridi perfringens* and as the calf suckles the milk, they are ingested (Salih *et al*, 1998). Milk may a ferment in the stomach when taken in excess and cause diarrhoea. Protein and lactose bei components of milk including colostrum, if taken in excess could cause diarrhoea (Miller, 197

Table 4.2 shows that 43.3% of respondents use camel milk within two days after birth in spite the fact that milk is highly required by the calf because of the colostral content. Though m forms the major source of nutrients for the young calves, pastoralists limits its access to all higher milk off-take for the household. A competitive phenomenon between the calf and huma is displayed. In the event of adverse weather, when complementation from other stock as a m source is limited, this competition intensifies and the calf usually loses out. The extent of t competition is indicated by the reported milking pattern (Table 4.3a). The results show that 63 of the respondents milked out the four teats thus only leaving residual milk for the ca Respondents milking three teats were 7%, 27% milked out two teats and only 3% milked out o teat. As the number of teats milked out decreases the amount of milk available to the c increases which would be reflected in improved calf growth and survival. Thus, for Opiroi whe 27% of total respondents milked out between one and three teats, the camel calves should ha performed better compared to the other two sites. This was true for calf mortality which w lowest at 33% compared to 51% and 54% for Kawop and Barsaloi respectively Table 4.3b. The

Table 4.3a: Number of teats milked by respondents (%) in different study location

Teats milked	Locations % respondents n=30			Total
	Opiroi	Barsaloi	Kawop	
1	3	0	0	3
2	17	0	10	27
3	7	0	0	7
4	7	16	40	63

Table 4.3b: Dams and camel calf parameters means

Location	Camel calf mortality (%)	Camel calf body condition	ADG (Kg)	Dam Milk yield (Kg/day)	Dam body condition
Opiroi	33.31	5.5	0.47	3.3	6
Barsaloi	53.77	4.7	0.49	4.0	5
Kawop	50.56	4.3	0.28	3.2	4

lowest average calf growth rate of 0.28 g/day was recorded in Kawop. This was the site with highest number of respondents, 40%, milking out all the four teats and exposing the calves to highest level of competition for milk.

4.3.4.1 Effect of vegetation on calf survival

The average mortality rates of camel calves was reported as 31%, 42%, 61% and 56% excellent, good, fair and poor vegetation condition respectively (Table 4.4). The survival of cam calves decreases as the condition of vegetation deteriorates. Adequacy or otherwise of nutriti of the dam during the peri-partum period is highly correlated to survival of the young (Bellow 1997). The calves born when vegetation condition is good will have enough milk from the da Most of the new born diseases are nutrition related (Holden *et al.*, 1991; Tibary *et al.*, 200 Improved calf nutrition is associated with a higher ability to fight off diseases hence hi survival rates.

Table 4.4 show the effect of vegetation on mortality rate of camel calves and other stock. T trend in camel calf mortality rate in relation to vegetation condition at birth was also exhibi among small stock (Table 4.4). The inconsistent response of cattle to vegetation condition m be explained by the fact that cattle herds were reported to have a higher mobility compared camels. Cattle are mainly grazers (Migongo-Bake and Hansen, 1987, Rutagwenda *et al*, 198 and have limited choice of forage especially during droughts. The land is degraded due interaction of climatic and bio- factors (Ho, 2001) reducing the biomass. Annual grasses characteristic of a degraded land dominates and are short lived reducing the herbaceous lev available to cattle (Tarhouni *et al*, 2007). The greatly reduced and inadequate pasture for cat necessitates high mobility of cattle to meet the nutritional requirement for survival (Ellis a Swift, 1988). In contrast camels had low mobility mainly because of their adaptive

Table 4.4: Camel calves and cohorts mortality rates in relation to vegetation condition

	Vegetation			
Category	Excellent	Good	Fair	Poor
Mortality (%)				
Camel calves	31	42	61	56
small stock	39	42	37	53
Cattle	-	38	28	5

characteristics (Rutagwenda *et al*, 1989; Kuria, 2004), especially, their ability to feed trees a shrubs which were abundant in the study area. Because these plants are deep rooted, they tend remain green longer into the dry season than the herb layer plants. Thus the camels tend remain closer to the settlements throughout the year.

4.3.4.2 Site effect on camel calf growth and survival

The location effect was significant ($P < 0.05$) for the dam and calf body condition (Table 4.3 The camels and their calves had a better body condition score in Opiroi (6; 5.5) than in Barsal (5; 4.7) and Kawop (4; 4.3).The dam body condition influences the calf body condition sco since it reflects the dam's nutritional status thus indirectly affecting milk production. The old calf is also able to utilize roughage and therefore directly influenced by the locality throu availability of forage. However, the effect of site on milk yield, calf growth and survival was n statistically ($P > 0.05$) significant (Table 4.3b above). Though not statistically significant, t difference especially between Kawop location and the other two for ADG; Opiroi and the oth two for mortality rate appear biologically significant. Little residual milk was left for calves Kawop while more milk was availed to calves at Opiroi supported by pattern of milking (Tab 4.3a above). The effects of site on milk yield, calf growth and survival are long term and cann be determined by a one time data collection as was the case with body condition. Milk yiel calf survival and growth are influenced by interaction of many factors. The factors that are like to affect milk yield are nutrition, temperament, water intake, calf presence when milking an feed availability (Simpkin, 1998). Growth is an inherited trait but is largely influenced by th plane of nutrition (NAP 2000; NAP, 2001). Milk yield too is heritable though its heritability usually lower than that of growth (Calo *et al* 1973; van Vleck *et al.*, 1985; Veseth *et al.*, 199 Karn *et al.*, 1994; Magana and Segura, 1997; Cilek and Sahin, 2009).

Table 4.5b: Summary of one way analysis of variance of location on dam and calf body condition, daily milk yield, calf survival and calf growth (average daily gain (ADG,

Response measured	DF	Mean square	F	Probability
Dam Body Condition	2	13.3226	19.81	P<0.05
Calf Body Condition	2	4.645	3.99	P<0.05
Dam daily milk yield (Kg/day)	2	3.976	1.901	P>0.05
Calf Survival (%)	2	1.917	0.89	P>0.05
Calf growth (ADG, g)	2	545	0.42	P>0.05

Feeds in the range fluctuate with season affecting the growth. Nutrition and health sta determine the survival of camel calves.

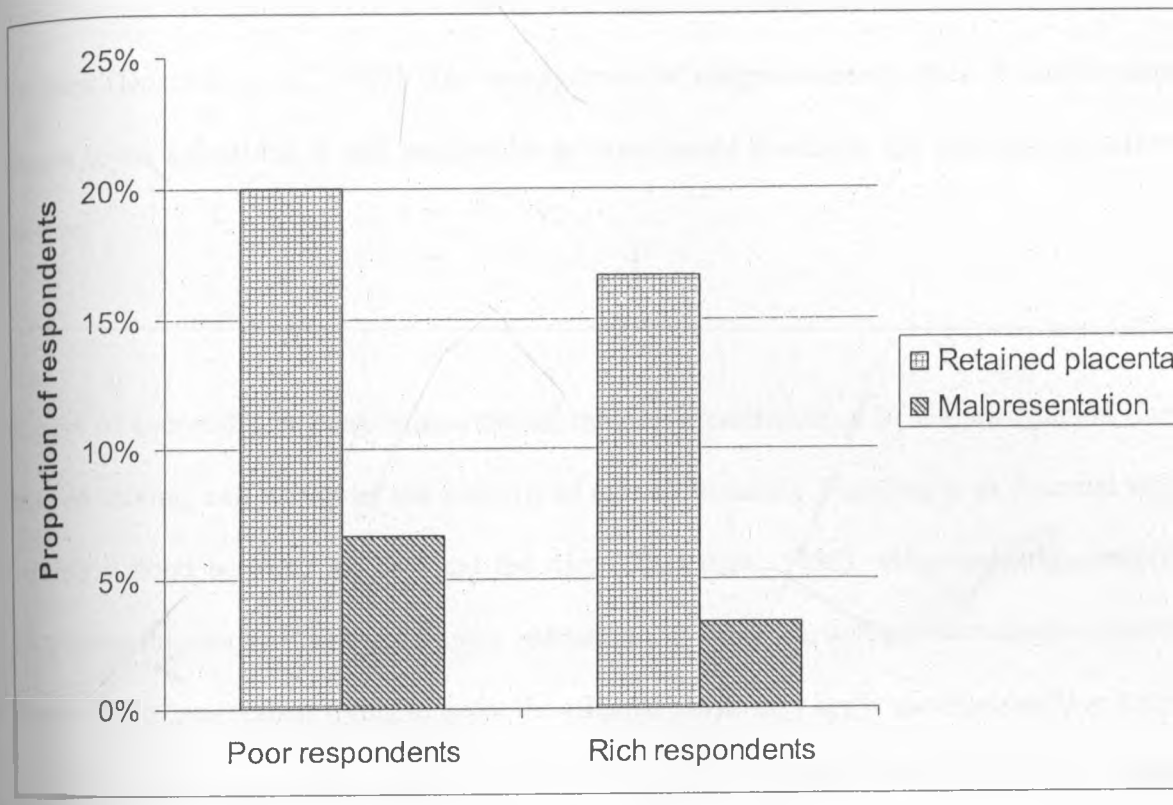
4.3.5 Other management practices that may affect camel calf growth and survival

Other management practices that may affect calf growth and survival which include; retain placenta, malpresentation and mismothering. Malpresentation which is an abnormal position calf at birth may lead to mismothering. The dam suffering a long difficult birth may not be ab to stand up for suckling. The calf may also be too weak to suckle and hence the bonding betwe the mother and the calf is weak (Blackshaw, 1986)

4.3.5.1 Malpresentation

Malpresentation is one of the perinatal problems reported by 10% of camel keepers (Figure 4. In Saudi Arabia, Noakes *et al* (2001) reported 43% and 57% of the malpresentation cases bei maternal and foetal respectively. Malpresentation is an abnormal position of calve at bir making normal delivery difficult and at times impossible. The most common malpresentati observed among camels are lateral deviation of the head and carpal flexion. In a norm presentation the front feet are presented first, with the bottom of hooves facing downward a with head following on top of knees. Hide legs also coming out first is also normal thou uncommon. Malpresentation may be because the camels are malnourished, weak, emaciated have narrow pelvic bones. The resultant effect of malpresentation is dystocia. Of the foet causes, faulty postures makes 90% of the cases while maternal causes, uterine torsion is t highest with 50%, primary uterine inertia 20%, incomplete cervical dilation 20%, and vagin and vulva stenosis 10% (Noakes *et al*, 2001).

Figure 4.5: Peri- natal problems as reported by respondents (%)



A dytocial calf may suffer anoxia and if acute the calf may die (Bellows, 1997). If it survives delivery the calf will be weak and take long to stand and suckle. The plasma antibodies i dystocial calf are reported to be low due to time lapse before the calf can suckle colostrum fr the dam (Donovan *et al.*, 1986). The management of malpresentation when it occurs pose danger to the animal but if well handled by an experienced stockman, the dam and the calf n survive.

In case of successful delivery mismothering may be a consequence of malpresentation due delayed calving, calf weakness and inability of the calf to suckle. Suckling is an essential step creating a bond between the calf and the dam (Blackshaw, 1986). Malpresentation results postpartum injuries such as vaginal tears, perineum and vulva tear and posterior ataxia conditi Inexperienced pastoralists trying to assist the affected camel may apply too much pulling force the foetus causing tissue tears. Such injuries are common to heifers bred too early and more by a large bull (Dioli *et al.*, 1992). When these postpartum injuries are untreated they may lead permanent infertility.

4.3.5.2 Retained placenta

Thirty seven percent (37%) of respondents reported retained placenta among their camel he (Figure 4.5). Though a high proportion of pastoralist reported retained placenta as importa literature reports indicate this is a very minor problem with less than 2% recorded in Bikan camels of India (Sharma *et al*, 2000). However, Tibary *et al.,* (2005) reported retained place and other reproductive disorders as common in camels and associated this to hypocalcemia other trace mineral deficiencies. Minerals deficiency is a common problem in camels un pastoralists' management (Kuria, 2004). Thus, the camels in the study area may have be

similarly affected. Mineral deficiency reduces milk production directly affecting the c nutrition. Also retained placenta may result from abortion caused by infection such tripanosomiasis or brucellosis. These infections lower camel productivity and hence little milk the calf.

4.3.5.3 Mismothering

Mismothering is the inability of the camel dam to take care of the new born calf by eith rejecting the calf or producing inadequate amount of milk for the calf. Mismothering by cam was more prevalent among the poor (52.5 %) of the respondents compared to (47.5 %) of t wealthy (Table 4.6). There is a relationship between mismothering and calving difficulti When the dam suffers a long difficult birth it may not be able to stand up for suckling.

The calf may also be too weak to suckle and hence the bonding between the mother and the ca is weak (Blackshaw, 1986). That weak bond between the calf and the dam may result mismothering. The faster the bond is formed between the calf and the mother, enhanced suckling, the faster the mother accepts the newly born calf. The problem was more common the first calf heifers though it was also reported among older camel cows as shown in Table 4. Fraiser and Broom (1997) stated that maternal care complex is a consequence of genet physiological and experiential factors. The first calf heifers lack the experience of suckling t calf and learn with subsequent lactations. Oxytocin the hormone involved in milk let down is lo for the first calf heifers and increases with parity (Bruchmaeir *et al*, 1992; Tančin *et al.*, 200 Any factor delaying the milk let down may cause mis-mothering. Frightening the anim increases the inhibitory hormones (adrenaline) to the milk let down and that may increase t chances of mismothering. As the animal grows older, hormonal imbalance and other

Table 4.6: Reported mismothering incidences and coping strategies (%)

Mismothering	Rich respondents %	Poor respondents %	Total %
First calve heifers	27	30	57
Older dams	13	14.5	27.5
others	7.5	8	15.5
Strategies for coping			
Force mothering	33	27	60
Hand rearing	0	3	3
Do nothing	67	70	37

physiological malfunction may set in and explain the reported mis-mothering in older ca dams in spite of the acquired experience (Houpt, 2000).

To manage the vice pastoralist use several strategies; force mothering through pain infliction closing the anus to stop defecation causing discomfort, scaring by pretending to be a preda attacking the calf, blindfolding the mother and retaining her in the enclosure. Schwartz (19 reported the practice by pastoralists of closing the anus of the camel dam in case of calf rejecti The camel dam cannot defecate causing discomfort which increases to a level it forgets to re the calf. These practices are also common among the Somalis (Elmi, 1989). The calves t were rejected were hand fed with milk from other camels or maize meal porridge by a sm proportion of respondents among the poor. The proportion of respondents practicing for mothering was 27% among the poor and 33% for the rich (Table 4.6). More of the r respondents resulted to forced mothering than the poor while only the poor resorted to ha rearing. This may suggest that the poor attached a higher value to those calves and were will to do much more to ensure their survival.

4.4 Conclusions and Recommendations

- The average growth rate of camel calves was 212 g/day. The male calves exhibited higher growth rate of 281 g/day than females at 168 g/day. Though the growth rate within the range expected in pastoral production systems, the potential for better grow exists with improved calf management and provision of health care services as is sho in available literature.

- The vegetation condition at birth affected camel calf growth and survival. The grov rate and survival increased with good vegetation condition. This was explained by fact that with good feed availability, nutritional status and milk production by the d was improved. For the calf mainly dependent on suckling for the first three months of l this would result in better performance.

- The mortality rates of camel calves remained unacceptably high with an average of 50 Male calves had a mortality rate of 56% and females 43%. This was largely explained practices affecting growth and survival namely colostrum denial, milk access limitati and probably malpresentation during birth and mismothering.

4.4.1 Areas for further investigation

- To establish the causes of the perceived high incidences of retained placenta in can herds.

- Investigate on alternative sources of feeds to revamp nutrients in time of shortage a reduce fluctuation of milk production and calf mortality.

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CHAPTER FIVE

5.0 Correlation of Actual Live weight and Estimates of Live weight

5.1 Introduction

Live weight measurements is an important management tool which can assess the growth ra and the effect of feeding regime on farm animals (Brown *et al.*, 1973; Kunene *et al.*, 200 Indication of live weight especially for a growing animal is important in assessing growth ra and for determining dosage in drug administration (Hile *et al.*, 1997; Thiruvenkanden, 200 Estimation of body weight can be useful in the evaluation of feeding programmes, nutritior status and such management practices as selection of replacement heifers (Dingwell *et al.*, 200 Body weight information can also be used in determining the monetary value of animals and t efficiency of rearing. It's an important tool in marketing of animals; the farmers can get value f their animals when prices are pegged on the weight. Body measurements are also used in bre identification and classification, a prerequisite for management and conservation of anim genetic resources (Al- Hazni *et al.*, 1994; Gatesy and Arctander, 2000; Mwacharo *et al.*, 200 Linear body measurements are useful in estimating the live weight of animals and especially in a place where weighing machines are not available (Bhadula *et al.*, 1979; Hile *et al.*, 199 Raji *et al.*, 2008; Cam *et al.*, 2010). They indicate animal size and weight in a less complicat and inexpensive way (Heinrichs *et al.*, 1992; Goe *et al.*, 2001). The potential of breeding sto may also be assessed through linear body measurements (Luo *et al.*, 1997; Alderson, 199 According to Rege (2001) and Zechner *et al.*, (2001), breeding goals can also be evaluated b morphological descriptions. There are two categories of linear body measurements, the skelet and the tissue measurements (Essien and Adesope, 2003; Kunene *et al.*, 2007). Skelet measurements such as ulna length, body height and length, chest and chest depth better descril

inherent characteristics while width, girth and body weight indicate muscle and fat deposit and are nutrition related (Blackmore *et al.*, 1958; Kamalzadeh *et al.*, 1998; Kunene *et al.*, 2007

Schwartz *et al.*, (1983) developed the linear body measurement equation from mature cam while Simpkin (1998) measured calves but included calves older than one year. Kuria *et* (2007) study was for calves up to seven months. There was only one study for prediction weight for calves less than one year old in similar pastoral production systems. This is critical period for assessing the performance of the camel calf. The current study endeavoured develop a regression equation to predict weight of camel calves up to one year.

5.2 Materials and Methods

5.2.1 The study area

This is as described in the chapter 3

5.2.2 The instruments and data collected

Randomly selected camel calves were weighed using a scale. Fifty nine (59) camel calves we weighed. These calves were of different age and sex but up to one year old. The age of the can calves were determined from recall information given by the camel owners. The camel calves be weighed were gently suspended on a scale using a sling and the weight taken. A tape measu (30 m) was used to take the linear body measurements, early in the morning, before the calv were fed or taken out to graze, to reduce the error. The linear measurements taken were t shoulder height, the heart girth and abdominal girth of the calves' body.

5.2.3 Analysis of the data

The linear regression equations of the best fit of the body linear measurements were deriv from the data run in Genstat® (VSNI, 2008). The output was fitted into the model which w used to estimate the live weight of camel calves. The estimated live weights were correlated the actual live weight and coefficient of correlation used to determine the degree of associatio Also projected linear body measurements were fitted into Schwartz's *et al.*, (1983), Simpkin (1998), Kuria's *et al.,* (2007) and the models derived from this study in order to compare th and generate respective growth curves.

5.3 Results and Discussion

The general model describing the estimation of live weight through body linear measureme was similar to the one used by Hile *et al.*, (1997), Mwacharo *et al.*, (2006), Alade *et al.*, (200 and Keith *et al.,* 2009). This model is shown below.

$Y_i = a + bx_i + \epsilon_i$,

Where Y_i = estimated live weight of camel calves

i= 1.....n observations

X_i = Independent variables either heart girth, abdominal girth or shoulder height of cam calves

a= intercept on Y

b= regression coefficient of Y on x

ϵ_i= residual for observation

A descriptive statistics of the linear body measurements and actual live weights generated fr this study are shown in Table 5.1 The mean values were 1.17 ± 0.18 m, 1.32 ± 0.26 m, 1.2 0.18 m, 103.25 ± 39.04 Kg for heart girth (HG), abdominal girth (AG), shoulder height (SH) a live weight (Wt), respectively. Body weight is useful in determining the performance of anim in the farm (Keith *et al.*, 2009) but is often unavailable in the resource poor pasto communities. Regression of linear body measurements becomes handy in estimating the wei of farm animals (Bhadula *et al.*, 1979, Keith *et al.*, 2009).

Table 5.1: Descriptive statistics of linear body measurements

Linear measurement	Mean (m) n=30	Std. Deviation
Heart Girth	1.17	± 0.18
Abdominal Girth	1.32	± 0.26
Shoulder Height	1.29	± 0.18
Live Weight	103.25	± 39.04

A highly significant (P< 0.01) correlation coefficient of r =0.957 and r = 0.934 was fou between the live weights of camel calves and the abdominal girth and heart girth respectiv except for shoulder height where r = 0.432 (Table 5.2). This suggested that the abdominal g was the best single weight estimator contrary to Kuria *et al.,* (2007) and Mwacharo *et al.,* (20 who recorded heart girth. However, the r value for abdominal girth is similar to Kuria *et* (2007).

The predictive equation and coefficient of determination (R^2) expressed as a percentage varia for the body weight and estimated using the heart girth (HG), abdominal girth (AG), shoul height (SH) and a combination of two or three linear body measurement is shown in Table Abdominal girth coefficient of determination R^2 accounts for 91.4%, heart girth 87% shoulder height 17.2% of the body weight variation respectively. For simple linear regress abdominal girth equation (-73.9 + 142.42x) accounts for a higher percentage of variation would therefore be a more reliable single predictor of the weight of camel calves but the ti when measurements should be taken is critical for accuracy. It should be early in the morn when the animals have not fed to reduce the measurement variability. A multiple regression abdominal girth and heart girth explains 92.2% of the variation. An addition of shoulder hei in the regression causes an insignificant percentage variation (0.1%). The correlation of predic weights and the actual live weights at P< 0.01 was high (r = 0.963) for the multiple regress equation (-100.6 + 101.2AG + 58.2 HG + 9.91SH) derived from the three linear bo measurements.

Table5. 2: Correlation coefficients (r) between live body weight, heart girth, abdominal girth and shoulder height of camel calves.

	Body weight	Heart Girth	Abdominal Girth	Shoulder Heig
Body weight	1.00	0.934	0.957	0.432
Heart Girth		1.00	0.941	0.421
Abdominal Girth			1.00	0.397
Shoulder Height				1.00

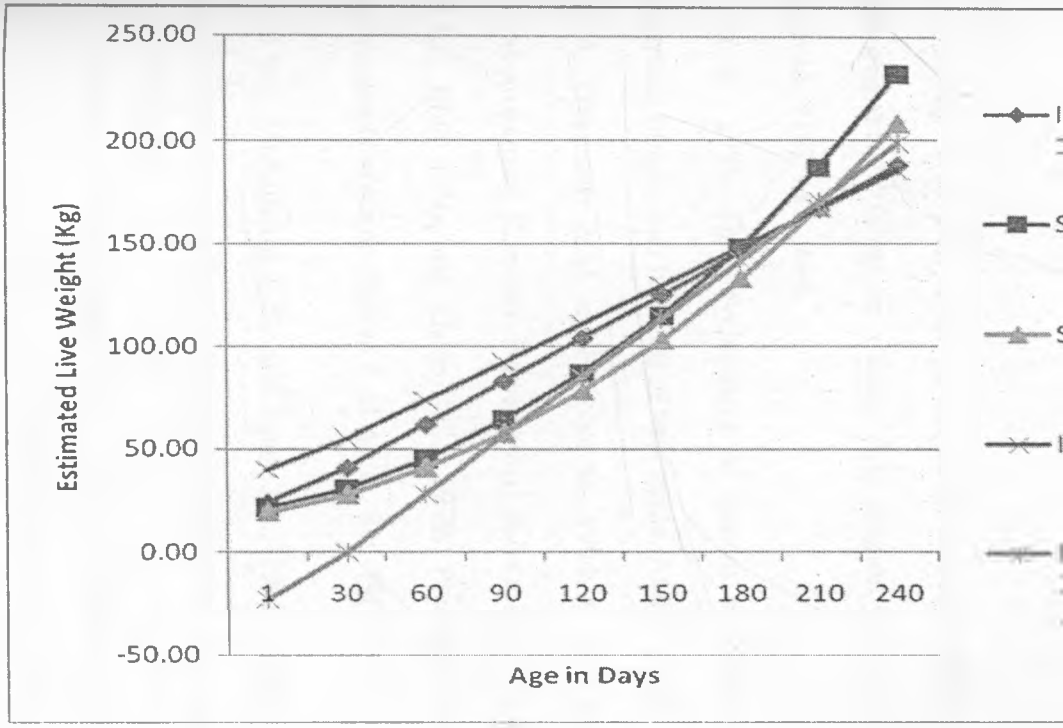
Table5. 3: The predictive equation and coefficient of determination (R^2) for camel calves' b weight using the HG, AG, SH and the combination of the three parameters base on the linear regression analysis.

Parameters	Regression equation	Adjusted R^2	Significar
HG	-113.0 + 197.7HG	0.87	**
AG	-73.9 + 142.42AG	0.91	**
SH	19.8 + 92.4SH	0.17	n.s.
Combined HG and AG	-92.5 + 101.2AG + 62.3 HG	0.922	**
All three combined (HG, AG, SH)	-100.6 + 101.2AG + 58.2 HG + 9.91SH	0.923	**

** P< 0.01 n.s.= not significant n=30

In order to compare models and respective growth curves, projected linear body measureme were fitted into Schwartz's (1992), Simpkin's (1998), Kuria's *et al.,* (2007) models and the o derived from this study (Fig. 5.1). Schwartz *et al.*, (1983) estimated the weight of camels by x HG x SH X 50. The multiplication factor was modified by Simpkin (1998) to 44.9 ± 0.26 camel calves. The growth curves generated by the regressions of this study are linear and g higher weight estimates for the first four months but show a low growth rate. Schwartz's *e* (1983) and Simpkin's (1998) regressions are exponential though the former depicts a fas growth. Kuria's *et al.,* (2007) regression model gave a linear growth curve similar to the one this study. It shows a faster growth. The variation from the expected sigmoid growth curve co be due to the small sample used in this study and the measurements which were taken once each calf. Repeated data collection proves difficult in a pastoral community because of h mobility. Also the calves measured were different and at different age and locality. In addit the age given was highly dependent on the accuracy of the recall information from responde The calves were under different management too. However in the pastoral systems wh migration is the norm, a onetime data collection is a better option.

Figure 5.1: Comparison of weight estimates from various regression equation



5.4 Conclusion and recommendation

Heart girth and abdominal girth regression (Y= -92.5 + 101.2AG + 62.3 HG) gave a bet estimate of weights of camel calves but for a single linear measurement abdominal girth preferred (Y= -73.9 + 142.42x). Shoulder height was non-significant for live weight estimati The results suggested that the values for linear body measurements when fitted in the formu gives estimated live weight of camel calves useful in ASAL. The predictive equations develop for estimating live weight of camel calves would enhance management of camels wh incorporated in the pastoral production systems.

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CHAPTER SIX

6.0 General Discussion

6.1 Introduction

Camels in a pastoral production system are critical for the of supply milk to the household. The recurrent droughts (Adger *et al.*, 2003), a characteristic of arid and semi arid lands, makes the camel a preferred stock due to its adaptive properties (Kuria, 2004). Camel rearing is constrained by inadequate feed resources which fluctuate with seasons, lack of herding labour, diseases, external and internal parasites and inadequate extension and health services. These result in reduced milk production that has a bearing not only on the growth and survival of the calf but also on the household livelihood. Data were collected on pastoral camel and calf rearing practices using questionnaires which were subsequently analysed. The study sought information on the general camel management practices and the factors that affect growth and survival of camel calf identifying the gaps while proposing the possible future interventions.

6.2 General camel production practices in Samburu

Variation of wealth status in terms of livestock owned existed among the pastoralists in the study area where the rich owned more TLUs than the Poor. This has implication on communal resource use because the few rich in the community have more TLUs and share the same common resources. It does not follow that the products from livestock utilizing

communal resources will be equitably distributed to the community. This result concurs with the literature report that wealth variation among households characterizes African pastoralists communities (Borgerhoff-Mulder and Sellen, 1994; Curry, 1996; Dahl, 1979; Dyson-Hudson 1980; Fratkin and Roth, 1990).

The livestock kept by the pastoralists are multispecies (camels, cattle, goats and sheep) and have a high proportion of females compared to males, the main reason being subsistence. The pastoral herd is essentially a dairy herd which is meant to provide the nuclear family with milk. The high proportion of camels in the study area is a reflection of this subsistence function. The camel is more reliable source of milk in drought prone areas and more so to the most vulnerable members of the society; the elderly, women and children who are normally left behind when livestock migrate. Droughts are a common occurrence with its cycles being less than 2 to 3 years in the recent past (Sivasani, 2000). Due to global climate change the situation is not likely to improve (Adger *et al.*, 2003) implying that reliance on camels as source of milk will intensify. Keeping more females than males is a safe guard against disaster; there is that hope that at least some breeding animals will survive for continuation of the herd. Inclusion of many species diversifies resource use and is also a way of spreading risks. Different livestock species have different feeding habits (Sanon *et al.*, 2005; Ouedrago-Kone *et al.*, 2006) and given a free choice consume mixed diets showing partial preferences for certain forages (Parsons *et al.*, 1994; Hester *et al.*, 1999.; Rutter *et al.*, 2004). Defoliation by animals is selective both between plant parts and between plant species (Bullock and Marriott, 2000). Greater outputs have been reported when cattle and sheep are grazed together and also for camels and cattle/sheep (Nicol and Collins, 1986; Wright and Connolly

1995; Nicol *et al.*, 2005). Grazing animals are known to exhibit trophic interaction patterns while feeding in the free range (Nyangito *et al.*, 2008) though competition may arise in time of feed scarcity.

There was no defined breeding programme and the market was the main source of breeding animals. Most animals brought to the market in a pastoral setup were culls and therefore not best for breeding purposes. Since milk production is the main function of the pastoral herd, selection of breeding camels should bear that objective. Camels within the herd that are better in milk production should be selected and the germ plasm conserved. Therefore any breeding programme for camels should be to boost milk production putting into consideration the feeds availability to support that productivity. Production is only after body nutrient for maintenance requirements have been met. Lack of feeds may negate the gains of breeding. Adoption of production technologies, including better breeding management would increase milk production per animal. This would have the effect of reducing the number of animals required to support a household which is quoted as 23 – 26 for a household of seven (Field, 1985). The environment will better support fewer camels with higher productivity for a longer period, into the drought and thus more milk in time of greatest need not only for the family but also for the camel calf. Also increased productivity by better management is equally important especially with commercial orientation of livestock sector as envisaged in vision 2030 (GoK, 2007; MoLDSP, 2009)

It was generally observed that heifers were served earlier than the recommended four years (Bissa *et al.*, 1998). That has implication on the camel because the partitioning of the nutrients

gives priority to the foetus needs at the expense of the growing camel (Bauman and Curie 1980, Van Saun and Sniffen, 1996). This could still be critical in an environment where feed inadequacy is the norm as is generally true of the pastoral range areas. The resultant impaired growth and poor body condition may lower overall heifer performance due to increased incidences of birth complications.

Feed shortage was considered by most respondents as a serious problem. The seasona fluctuation of feeds remains the most challenging issue to camel productivity in the arid and semi arid lands. Milk production follows the cyclic nature of feed availability and that has a bearing on the survival and growth of camel calves. Unfavourable climatic conditions which limit forage growth and hence the availability, result in underfeeding of the camels Underlying problems of delayed puberty, suppressed ovulation, delayed postpartum ovulation and increased embryo mortality are unavoidable (Chillard *et l.,* 1998). Feed supplementation though not commonly practiced in a pastoral system could improve productivity tremendously. However, there were attempts of supplementation with salt but they were not satisfactory. A study on salt sources is important to validate the content and advice on deficiencies. Salt supplementation increased milk production and was associated with enhanced calf growth (Kuria, 2004) and is also reported to increase fertility and reduce retention of after birth (NAP, 2000). Majority of camel keepers do not seek extension services and neither do the service providers reach them frequently. The current extension policies are not pro-pastoralists. Revamping of extension services in the pastoral production system is crucial to improving camel productivity.

6.3 Factors affecting camel calf growth and survival

The major factor affecting calf growth and survival was reported to be feed availability which fluctuated with season. There were a lot of feeds during the rainy season which caused increase in milk production. The increased milk production had a direct effect on the camel calves' growth and survival. The growth rate was observed to be high during the time of feed abundance than the dry period and vice versa. The mortality rates were equally low when feeds were plenty. The mortality rates were noted to be aggravated by marketing of camel milk coupled with high levels of poverty as was in Kawop. The calves were left with very little residual milk to feed on. The growth rate in this location was low compared to other locations. Competition for milk affected growth and survival of camel calves and management practices should endeavour to reduce this phenomenon.

Other factors reported to affect calf growth and survival were access to colostrum and milk and management practices on pre- and post-natal period. Colostrum provision to the neonate within first 24 hours after birth is important for acquisition of passive immunity. Most respondents denied colostrum to the camel calf which partly explained the high mortality of 50% in the system analysed. Their belief that colostrum causes diarrhoea ignores the fact that diarrhoea can be caused by bacterial infection (Salih *et al.*, 1998), worm loads or nutrition especially trace mineral deficiency (Thomas, 2003; Thomas, 2009). Most respondents limited milk access to the calf to increase household off take. This resulted to the low growth rate of 212 g/day while the potential exist for a higher growth rate as was reported in a similar system by Field (1979) where the 75% of the milk yield was fed to the calf.

The reported pre- and post-natal problems of placenta retention, malpresentation and mismothering affecting calf survival can be minimized by improved camel management. Synchronizing breeding season with feed availability and selecting breeding bulls with reported easy calving, can considerably reduce retained after birth and malpresentations respectively. The managerial skills on handling malpresentation and mismothrering are crucial for the survival of the affected calf.

6.4 Correlation of actual live weight and estimates of live weight

A strong positive correlation ($r=0.963$ at $P< 0.01$) of actual live weight and estimates from linear measurements was exhibited in this study. This validated the use of linear body measurements to estimate live weight of animals applicable in places where weighing machines are not available or are cumbersome to use. Live weight estimates are used for accurate drug administration to the camels and also to assess the growth rate. The linear measurements are growth related and can determine the correlation of growth traits in animals (Schmidt *et al.*, 2006). Weight measuring through estimation is an important tool to the management of camels in ASALs.

6.5 CONCLUSION AND RECOMMENDATION

6.5.1 CONCLUSION

- Variation in the TLU as the measure of wealth exists among the poor, intermediate and the rich pastoralists.

- Pastoralists keep diverse livestock with high proportion of female than males mainly for milk provision for the household.
- Feed fluctuation with seasons impacted negatively on growth and survival of camel calves.
- The average camel calf growth rate in the pastoral production system was 212 g/d with males exhibiting a higher growth rate of 281 g/d than 168 g/d of female calves.
- The mortality rates of camel calves remained unacceptably high; the average was 50% with male calves exhibiting a higher mortality rate of 56% and females 43%.
- Marketing of camel milk impacted negatively on the growth and survival of camel calves.
- Animal health and extension services provision in the area were inadequate.

6.5.2 RECOMMENDATION

- Diversification of livestock herds of Pastoralists should be maintained and improvement on the productivity of the dairy herd sought.
- Community training on appropriate management practices of camels should enhanced.
- Due to the fluctuation of feeds, feed supplementation trials for camels should be carried out.
- Commercialization and privatization of extension and livestock health services should be evaluated and adjusted towards providing adequate extension services in pastoral production systems.

- Management practices that reduce pre and post natal problems, allowing colostrum and milk to the calves and hence reducing the mortality rates are important fo ensuring survival and growth of camel calves.

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List of Appendices

APPENDIX I: CALF MANAGEMENT QUESTIONNIARE

Samburu District

INTRODUCTION

I) This information is strictly confidential and will only be used for the purpose of this project

II) Fill answers to questions and/ or tick and rank your responses as accurately as you can remember.

OBJECTIVES

The overall objective of the survey is to describe the status of traditional production system the camel calf in Samburu district.

SITE AND FARM IDENTIFICATION

Questionnaire serial No._____

1. Enumerator's name:_____ Code:_____
2. Respondent's name: _____Age:_____ Sex: M [ ] F [
3. Sub location:_____
4. Location:_____
5. Division:_____

RESPONDENT PROFILE

(If possible,these questions should be asked at the end of the interview)

6. Is the respondent the head of this household: Yes[ ] No [ ]

If no to the above:

7. What is the respondents relationship to the head of household ?

   Husband [ ] Wife [ ] Son [ ] Daughter [ ] Worker [ ] Other [specify.....]

8. What is the marital status of the respondent ?

   Married [ ] Single [ ] Widow/Widower [ ] Divorced [ ]

9. Is the respondent having any formal education ? Yes [ ] No [ ]

10. If yes to the above, what is his/her highest level of education ?

    Primary school[ ] Secondary school [ ] Post secondary college [ ] University [ ]

11. Have you attended any of the following agriculture-based trainings ?

    Short courses in agriculture [ ] certificate agriculture [ ] Farmer Field school training [

    Other [specify.....]

HOUSEHOLD STRUCTURE AND FARM LABOUR USE

12. How many persons reside in the household according to their age groups and sex ?. **Giv**

    numbers.

	0-14 yrs	15-45 yrs	45-60 yrs	Over 60 yrs	Total
Males					
Female					

13. How many persons in the household are involved in livestock rearing activities accordi

    to age group and sex? **Give numbers.**

	9-14 yrs	15-45 yrs	45-60 yrs	Over 60 yrs	Total
Males					
Female					

14. Who performs the following livestock rearing activities on the farm (***Tick where relevant***).

Activity	Actor/Actress						
	Father	Mother	Son	Daughter	Hired labour	Others	Remarks
Grazing							
Cleaning housing/enclosures							
Spraying							
Milking							
Milk Sales if any							
Animal sales							
Manure sales if any							
Health management/care							

HOUSEHOLD SOURCES OF INCOME

15. What are the most important sources of income in your household ?.

(Rank from 1=most important to 5=least important)

SOURCES	*RANK*				
	1	2	3	4	5
Livestock products		[ ]	[ ]	[ ]	[ ]	[ ]
Remittance from relatives		[ ]	[ ]	[ ]	[ ]	[ ]
Salary/Wages		[ ]	[ ]	[ ]	[ ]	[ ]

Investments/business	[ ]	[ ]	[ ]	[ ]	[ ]
Credit/microfinance	[ ]	[ ]	[ ]	[ ]	[ ]

16. Out of the income from livestock produce, what proportion (%) comes from:

    Camel Milk sales [ ] other Livestock milk sales [ ] Camels sales [ ] other

    [specify.....]

17. What proportion (%) of milk consumed by human comes from:

    Camels [ ] cattle [ ] sheep [ ] goat [ ]

LIVESTOCK INVENTORY AND HERD STRUCTURE

18. What type of livestock do you keep in the manyatta? (*Rank them in order of importanc*

    (Rank from 1=most important to 5=least important)

SPECIES /TYPE	*RANK*						
	1	2	3	4	5	6	7
Camels	[ ]		[ ]	[ ]	[ ]	[ ]	[ ]
Local cattle	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Donkeys	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Sheep	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Goats	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Local chicken	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Others (specify.....)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

19. What is the herd structure of your livestock?

(i) Give the number in each category for camels

	Mature camels				Young camels			
Total	Breeding females	Breeding males	Non-Breeding males	Non-Breeding females	Heifers	Bulls	Heifer calves	Bul calv

(ii) Give numbers in each category for cattle.

	Mature cattle				Young cattle			
Total	Breeding females	Breeding males	Non-Breeding males	Non-Breeding females	Heifers	Bulls	Heifer calves	Bul calv

(iii)Give numbers for each species by sex.

	Goats	Sheep	Poultry
Males			
Females			

20. Which breeds of livestock and number are on the manyatta?

	camels	numbers	Cattle	numbers	goats	numbers	Sheep	numbers	Poultry	
(Breeds)										

21. Are your camel calves put in enclosures: Only at night [ ] Part of the day [ ] Both d

and night [ ] Not at all [ ]

22. If enclosed at any time, What type of enclosures do you have ?

i) Enclosed structure: thorn fence [ ] mud walled [ ] Others (specify.....

ii) Housing structure: polythene mud roofed with murram floor [ ] Grass thatched with

murram floor [ ] Others (specify.....[ ]

23. What is the major benefit you get from your camels?

(Rank from 1=most important to 5=least important)

BENEFIT	***RANK***				
	1	2	3	4	5
Milk for home consumption	[ ]	[ ]	[ ]	[ ]	[ ]
Cash Income	[ ]	[ ]	[ ]	[ ]	[ ]
Asset building	[ ]	[ ]	[ ]	[ ]	[ ]
Insurance	[ ]	[ ]	[ ]	[ ]	[ ]
Others (specify.....)	[ ]	[ ]	[ ]	[ ]	[ ]

CAMEL CALF MANAGEMENT AND BREEDING

24. Have your camels had some problem during giving birth? Yes [ ] No [ ]

25. If yes what are the problems? Oversize foetus [ ] wrong orientation of foetus [ ] s
birth [ ] others specify .....

26. Have you had camel mothers rejecting the calf? Yes [ ] No [ ]

27. If yes, which camels reject the calf: heifer [ ] first calving [ ] second calving [ ] calv
more than twice [ ] others (specify.....).

28. If yes what have you done to make her accept the calf? Force mothering [ ] hand rear t
calf [ ] inflict pain on the mother [ ] others specify.....

29. After how long does the calve start suckling the colostrum from the mother for the fi
time?. 30 min [ ] 1 hr [ ] 2 hr [ ] 3 hr [ ] 4 to 12 hr [ ] othe
specify..... hours.

30. State whether the calf is given assistance to get the first milk. Always [ ] rarely [ ] not
all [ ]

31. When the calf suckles for the first time ; the calf suckles the whole of the first milk [
milk out the udder once before the calf suckles [ ] milk out the udder once after the ca
suckles [ ] others specify .....

32. When calve is suckling colostrum, is there limitation on the amount? Yes [ ] no [ ]

33. If yes, how is this done? Allow suckling one quarter [ ] half [ ] limit time of access [ ]

34. What special care do camel calves require at birth? Ensure calve breathing [ ] disinfecti
of the calf naval[ ] tie with sterilized string the umbilicus [ ] colostrums suckling [
others (specify .....)

35. How soon after calving is camel milk acceptable for human consumption? Immediately
] one day [ ] two days [ ] one week [ ] over one week [ ]

36. At milking, how many teats are milked? One [ ] two [ ] three [ ] four [ ] half volume the quarter [ ]

37. How is the male calf treated? Denied milk [ ] given little milk [ ] offered eq opportunity to milk [ ]

38. If the male calf is denied or given little, why? Not valued culturally [ ] not a source milk [ ] others specify.....

39. What special care do camel calves require from birth to weaning? Feeding [ ] treatme [] protection against predators [ ] routine management [ ] others spec .....

40. How many calves have been born in the last one year? Spec males/females..... .

41. How many are alive? males .....females..... How many are dea males.....females.....

42. Do you ever see your young camel calves with deformed legs which recover later on live? Yes [ ] No [ ]

43. How many breeding bulls do you have in your herd? specify..... .

44. Do you raise your breeding bulls or do you acquire/borrow them from other pastoralists Born in own herd [ ] bought breeding bull [ ] borrowed breeding bull [ ]

45. Which are the criteria for selection of a breeding bull? Lack of defects [ ] fertile [ ] stro [ ] lack sexual transmitted diseases [ ] others specify.....)

46. For how many years is the same breeding bull serving in your herd? (the present a previous)

Present bull ..... Years; previous bull ..... years.

Do you allow the breeding bull to breed his daughters? Yes [ ] No [ ]

47. Did you ever observe abnormalities in the camels of your manyatta, like very small e
or no ears, deformed jaws, blindness or deafness, which are not caused by accident a
which do not recover? Yes [ ] No [ ]

If yes which one? Small ears [ ] deformed jaws [ ] blindness [ ] deafness [ ] reproducti
disorder(cryptorchidism) [ ] others .....

LIVESTOCK FEEDS AND FEEDING PRACTICES

48. Enumerate the Feed types available to camels on your manyatta.

Class of feed	**Type(specify)**	**Source**	**Class of animal fed** (*Tick the relevant*)				(P a
			Calves	*Milking camel*	*Dry camel*	*Camel Bulls*	
Roughage	1.local pasture grass						
	2. Acacia pods						
	3.fodder shrubs (specify.....)						
Minerals salts	1.Purchased compound salts						
	2.Common table salt						
	3. salt lick: frequency						
	3.Other (specify.....)						
Water (interval)	Type distance						

MAJOR FEEDING CONSTRAINTS

49. Which of the following are major constraints to livestock feeding in your area ?

(Rank follows: 1=always a problem; 2= only a problem seasonally; 3=not a seri problem)

CONSTRAINT	*RANK*		
	1	2	3
Shortage of basal feeds	[ ]	[ ]	[ ]
Lack of labour for feeding livestock	[ ]	[ ]	[ ]
Other (specify.....)	[ ]	[ ]	[ ]

50. In which months of the year do you experience:

Surplus feeds [i.....,ii.....iii,.....] and feed shortages [i.....,ii.....,iii.....]

51. What do you normally do when you have shortage of feed on your usual grazing are

Sale some animals [ ] Temporarily loan to friends/relatives [ ] Do nothing [ ] Migrate

Others;specify.....[ ]

52. Indicate the feed resource and months when available in your area (**Tick months**)

Forages	**Seasonal (month) Availability**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Pasture												
Fodder shrubs/trees												
Others (specify)												

53. What is the source of water for livestock on your manyatta ?

River [ ] Pond [ ] Lake [ ] Dam [ ] Borehole [ ] Piped water [ ] Protected spring

Other;specify.....[]

54. How far is the main water source from your manyatta ?

It is less than 500 m [ ] about 1 km [ ] about 2 km [ ] about 3 km away [ ] over 3 km [ ]

ACCESS TO EXTENSION AND HEALTH SERVICES

55. How many times in a month do you receive advisory services from the area extens

workers?

Once [ ] Twice [ ] more than two times [ ] not at all [

Others;specify.....[ ]

56. If the extension workers visit you at all, what extension messages do they often give yo

Livestock feeding [ ] livestock heath care [ ] camel husbandry [ ] crop husbandry [ ] s

conservation [ ] Others;specify.....[ ]

57. Do you usually visit extension offices to ask for services ? Yes [ ] No [ ]

58. If no to the above, why ?

Extension offices too far [ ] Service charges too high [ ] I have not thought of it

Others;specify.....[ ]

59. Who is the main animal health service provider in your area?

Government Vets [ ] Agro-vet shops [ ] Private vets [ ] Ethno-vets [ ]

Others;specify.....[ ]

60. What is the frequency of service provision?

Services	**Most frequent=1, Less frequent=2, Not used=3**
1. GoK vet.Services	
2. Private vets	
3. Agro-vet shops	

4. Ethno-veterinarians	
5. community based animal Health workers	
6. Own	
7. Others (specify)	

61. What are the three most common animal health problems on your camel calves and do you manage them?

Disease	**Management strategy practiced (1=call a vet; 2=buy drugs a treat; 3= use herbal medication; 4= do nothing; 5=Other;specify(.....)**
1.	
2.	
3.	

REPRODUCTIVE PERFORMANCE

62. What is the source of your replacement stock? (**Tick where appropriate**)

Rear Own [ ] Buy from market [ ] Exchange/barter

Other;specify.....[ ]

63. How do you know if your camel needs a bull ? (**Tick where appropriate**)

Change in camel behaviour (mounting, bellowing, restlessness etc) [ ]

Change in milk production [ ]

Change in feed intake [ ]

Mucus discharge from the vulva [ ]

Do not know [ ]

64. How often do your camels come on heat? (**Tick where applicable**) ?.

Every month [ ] Every two months [ ] Do not know [ ] Other, specify.....[

65. At what age do your camels produce their first calf? (**Tick where applicable**)

In less than 3 years old [ ] when3 years old [ ] when over 3 years old [ ]

66. How often do your camels calve down? (**Tick where applicable**)

Every 2 year [ ] every 3 years [ ] after more than 3 years [ ]

What time of the year are most calves born? Specify .....

MARKETING OF LIVESTOCK PRODUCTS

68. Do you often sell milk? Yes [ ] No [ ]

69. If yes to the above, where do you normally sell ?

Outlet (Tick where appropriate)	**Proportion**	**Remark**
[ ] Immediate Neighbors		
[ ] Local market		
[ ] Other;specify.....		

70. What proportion (%) and price of milk as per the type of the stock is sold?

	Price	proportion	remarks
Camel			
Cattle			
Small stock			

71. What are your main cash needs in a year ?

(Rank as follows: 1= most important; 2= occasionally important; 3=least important)

NEEDS	*RANK*		
	1	2	3
School fees	[ ]	[ ]	[ ]
Medical bills	[ ]	[ ]	[ ]
Cultural events/ceremonies	[ ]	[ ]	[ ]
Social/welfare engagements	[ ]	[ ]	[ ]
Domestic affairs (food, clothings etc.)	[ ]	[ ]	[ ]
Support to relatives	[ ]	[ ]	[ ]
Others; specify.....	[ ]	[ ]	[ ]

72. What do you estimate as your annual expenditure?

About Ksh. 20,000 [ ] More than Ksh20,000 but less than Ksh. 30,000 [ ] More than Ksh. 30,000 [ ]

73. Finally, is there one thing you would like to suggest which would improve the future of camel calf in your location ?.....

.....

.....

THANK YOU VERY MUCH FOR YOUR TIME

APPENDIX II: BODY CONDITION SCORING CHART

BCS 1. Extremely thin and weak, near death. Rough hair coat.

BCS 2. Extremely thin but not weak. Rough hair coat. Transverse processes project prominently, neural spines appear sharply.

BCS 3. Very thin. All ribs visible. Spinous processes prominent and very sharp. No fat cover felt with some muscle wasting.

BCS 4. Slightly thin. Most ribs visible. Spinous processes sharp. Individual processes can be easily felt. Slight fat cover can be felt over hump.

BCS 5. Moderate. Spinous processes felt but are smooth. Some fat cover felt over hump.

BCS6. Good. Smooth look with ribs not very visible. Spinous processes smooth and round. Individual processes very smooth, felt with considerable pressure. Significant fat cove felt over the hump.

BCS 7. Fat. Ribs not visible, animal smooth and well covered, spinous process felt under firm pressure. Considerable fat over the hump.

BCS 8. Obese. Camel is very fat with spinous processes difficult to feel. Ribs can not be felt. The hump is well covered with fat, the stomach is round and smooth. The rump is round.

BCS 9. Extremely obese. Camel has deep patchy fat over entire body. Dorsal spines, ribs, hooks, and spines fully covered and cannot be felt even with firm pressure. The hum full of fat.

APPENDIX III: CALF RECORDS

Calf identity	Calving date	Calf dam			Calf grand dam	Calf sire		Calf grand sire	Where calf is 1. sold 2. in herd 3. given out 4. died	Cattle Cohort (No)	No survived	Cause of death of cattle calves	Vegetation at camel calf calving
		identity	Milk Yield (Lts)	BC		identity	BC						

Date

Reasons for disposal	Age at disposal	mortality	cause of calf death	if sold amount in Kshs.	rate of exchange (no. of small stock/cattle)	current vegetation condition	Vegetation at the time the calf was born 1.excellent 2.good 3. fair 4. poor	Cattle calf	No survived
1. assist		1= male				1.excellent		Cohort	
2.dowry 3. exchange in kind 4. cash		2= feamle				2. good 3.fair 4.poor		(No)	