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**CHARACTERISATION OF THE SHEEP AND GOAT BREEDING PRACTICES OF  
THE PASTORALIST GABRA AND RENDILLE COMMUNITIES OF NORTHERN  
KENYA**

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A thesis submitted to the Graduate School in partial fulfilment for the requirements of the  
Master of Science Degree in Animal Production (Animal Breeding option) of Egerton  
University.

**EGERTON UNIVERSITY**

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## DECLARATION AND APPROVAL

### 1. DECLARATION

This thesis is my original work and has not, wholly or in part, been presented for an award of a degree or diploma in any other University.

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### 2. APPROVAL

This thesis has been approved for final submission with our approval as University supervisors.

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**This work is dedicated to**

**Mrs. Lenah K. Mbuku,**

who stood by me in all situations and felt my pain as hers,

who inspired and propelled me to great heights of achievements,

who would never allow me to quit without trying,

who dared me to hope for the best and

whose unconditional love lifted me.

Thank you

Mama



## ABSTRACT

In Kenya, management of small ruminants in pastoral production systems involves application of indigenous knowledge pertaining to animal breeds and breeding practices. Characterisation of such indigenous knowledge has so far received little attention. This study was carried out in Marsabit district of northern Kenya among the Rendille and Gabra communities, and aimed at characterising breeding practices in relation to implementation of community-based breeding programmes. This entailed the determination of pastoral animal identification systems, and actual and theoretical pastoral selection practices for breeding bucks/ rams. In addition, the factors that bring about the differences between the actual and theoretical selection practices were identified. Data were collected from a total of 200 respondents (100 from each community) in a four-month field survey using semi-structured and structured questionnaires. Data on the actual and theoretical pastoral selection practices for breeding bucks/ rams were analysed through calculation of indices, which represented a weighted average of all rankings of a particular trait. Ranks were based on the first three choices of priority traits by the respondent. The index was derived as the sum of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for a particular trait divided by sum [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all traits in the selection criteria. This study showed that in the pastoral systems, most of the animal identification is done through ear notching, branding and coat colour of the animals. Characteristics with an index  $\geq 0.200$  were considered important, and included big body size (Rendille, 0.260; Gabra, 0.251) and milk yield (Rendille, 0.206) for the buck's dam. Big body size (Rendille, 0.264; Gabra, 0.245) and offspring quality (Rendille, 0.252; Gabra, 0.265) were considered important attributes for the buck's sire. Important attributes for the ram's dam were big body size (Rendille, 0.246; Gabra, 0.216), offspring quality (Rendille, 0.200; Gabra, 0.235) and fat deposition and drought tolerance among the Rendille (0.233) and Gabra (0.246), respectively. For the ram's sire, big body size (Rendille, 0.235; Gabra, 0.233), offspring quality (Rendille, 0.200; Gabra, 0.235) and fat deposition (Rendille, 0.203; Gabra, 0.220) were important characteristics. Prolonged droughts, diseases and parasites, socio-cultural beliefs and genetic composition of the animal were identified as factors contributing to the variation between the targeted and the actual selection practices. This study showed that pastoralists identify their animals and have deliberate breeding practises. Productive and adaptive traits are important in the selection of breeding stock. This study provides a framework needed for the development of community-based genetic improvement programmes for indigenous small ruminant genetic resources within the constraints of slowly changing pastoral conditions.

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## LIST OF ABBREVIATIONS

|         |                                                                                                                                        |
|---------|----------------------------------------------------------------------------------------------------------------------------------------|
| AMREF   | African Medical Research Foundation                                                                                                    |
| AnGRs   | Animal genetic resources                                                                                                               |
| ASAL(s) | Arid and semi-arid land(s)                                                                                                             |
| BMZ     | <i>Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung</i> (German Ministry of Economic Co-operation and Development) |
| CBM     | Community-based management                                                                                                             |
| CBO     | Community-based organisation                                                                                                           |
| CBOGIL  | Community-based organizations for the genetic improvement of livestock                                                                 |
| DAGRIS  | Domestic Animal Genetic Resources Information Systems                                                                                  |
| EU      | European Union                                                                                                                         |
| FAO     | Food and Agricultural Organization of the United Nations                                                                               |
| GEF     | Global Environmental Facility                                                                                                          |
| GDP     | Gross domestic product                                                                                                                 |
| GoK     | Government of Kenya                                                                                                                    |
| GTZ     | German Technical Cooperation                                                                                                           |
| IK      | Indigenous knowledge                                                                                                                   |
| ILRI    | International Livestock Research Institute                                                                                             |
| KARI    | Kenya Agricultural Research Institute                                                                                                  |
| KMC     | Kenya Meat Commission                                                                                                                  |
| LMD     | Livestock Marketing Division                                                                                                           |
| MAF     | Missionary Aviation Fellowship                                                                                                         |
| MARD    | Ministry of Agriculture and Rural Development                                                                                          |
| PRA(s)  | Participatory rural appraisal(s)                                                                                                       |
| SPSS    | Statistical Package for Social Sciences                                                                                                |
| SrGRs   | Small ruminant genetic resources                                                                                                       |
| SSA     | sub-Saharan Africa                                                                                                                     |
| TLU     | Tropical livestock unit                                                                                                                |



## CHAPTER ONE

### GENERAL INTRODUCTION

#### 1.1. Background information

In Kenya, livestock genetic resources contribute approximately 10% to the total gross domestic product (GDP) (MARD, 2000). Among these genetic resources, small ruminants (i.e., sheep and goats) are an important component of the subsistence, economic and social livelihoods of the human population (Kiwuwa, 1992). They are especially important to women, children and the aged who often are the most vulnerable members of the society in terms of under-nutrition and poverty (Kosgey, 2004). Kenya is endowed with a wide variety of indigenous small ruminant breeds that have evolved to adapt to the prevailing harsh environmental conditions and traditional husbandry systems (Baker and Rege, 1994; Lebbie and Ramsay, 1999). These genetic resources provide both tangible benefits (e.g., meat and milk for home consumption, cash income from animal and milk sales, manure used as crop fertilizer and fuel, fibre and skins) and intangible benefits (e.g., savings, an insurance against emergencies, cultural and ceremonial services) (Kiwuwa, 1992; Makokha, 2002; Njoro, 2003; Kosgey, 2004). Therefore, their characterisation both at molecular and phenotypic levels becomes important.

There have been some attempts at characterising SrGRs both at molecular and phenotypic levels in Kenya. Molecular characterisation involves identification of representative samples of breeds/ strains that should be a priority for conservation on the account of the unique genes that they possess (Rege and Gibson, 2003). In addition, the information derived from such an exercise, especially those that identify quantitative trait loci (QTLs) for traits related to adaptation and disease tolerance, could lead to use of marker assisted selection in breeding programmes (Okeyo and Ayalew, 2004). At the molecular level, blood groups and protein polymorphisms have been widely used to give precise and accurate results regarding genetic variability in indigenous fat-tailed and fat-rumped hair sheep (Mwacharo et al., 2002; Baker et al., 2003).

Phenotypic characterisation involves description of the origins, developments, population sizes and structures, distribution, typical features and phenotypic performances of these resources in defined management and climatic environments (Okeyo and Ayalew, 2004). In Kenya, the few characterisation studies have concentrated on phenotypic and production characteristics of livestock (Chemitei, 1973; Kimenye, 1983; Blackburn and Field, 1990; Hüelsebusch and Kaufmann, 2002; Mwacharo and Drucker, 2005). There has



been little attempt to characterise the breeding practices of small ruminants in the country. In view of this, it becomes imperative to distillate information concerning the breeding practices of small ruminant keepers who, over years, have remained to be the custodians of the indigenous gene pools.

The majority of SrGRs are predominantly kept under pastoral production systems in the ASALs. It is worth noting that pastoral development and performance can be pegged on accurate and lucid descriptions of the lives of these nomadic people, who are daily faced with problems of subsistence, but who are bound and protected by a tight web of traditions and rituals, which are rooted in a sober and basic traditional wisdom – the indispensable minimum to give a truly human aspect to their lives, beyond simply surviving from day to day. The pastoralists play an important role in developing domestic animal diversity and in stewarding livestock breeds with important genetic traits. They do this using IK that often represents “tacit” rather than expressed knowledge (Köhler-Rollefson and McCorkle, 2000). The IK about animal breeds and breeding is the knowledge that communities use to manipulate the genetic composition of their livestock (Lokhit Pashu-Palak and Köhler-Rollefson, 2005). It includes knowledge and experience about the genetic attributes of livestock and inheritance, as well as conscious strategies and social mechanisms that influence the gene pool. Such IK is imperative when designing and setting up community-based genetic improvement programmes. The small ruminant genetic diversity encountered is the product of local environmental conditions, combined with traditional breeding practices of communities (Njoro, 2003). In addition to considering physiological and behavioural aspects, it would be important to also document local name(s) and breeding practices, and local concepts about them, as well as social dimensions, i.e., knowledge about the institutions and breeding goals that have shaped them.

## **1.2. Objectives**

The overall objective of this study was to characterise current small ruminant breeding practices in relation to their integration in community-based genetic improvement programmes. The specific objectives were:

1. To determine and assess pastoral animal identification systems.
2. To determine actual and theoretical pastoral selection practices for breeding bucks/ rams.
3. To identify causes of the differences between the actual and theoretical selection practices.

### **1.3. Research questions**

1. How do the pastoralists identify their animals?
2. What actual and theoretical selection practices do pastoral communities utilise in the breeding of bucks/ rams?
3. What factors cause differences between the actual and theoretical selection practices of the pastoralists?

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1. Small ruminant production in Kenya

Sheep and goat populations in Africa have recently been put, correspondingly, at about 191 and 159 million heads, representing about 30 and 32% of the world's total populations, respectively (FAO, 2003). In addition, distribution trends by ecological zones indicate that the arid areas take a substantial share of the African small ruminants, accounting for 36% of the sheep and 39% of the goat populations. In Kenya, small ruminants (mainly the indigenous animals) are predominantly kept under pastoral production systems in the ASALs. These areas account for 80% of the country's landmass and have traditionally been characterised by low human populations (Kinyamario and Ekeya, 2001). Currently, however, these areas are experiencing increasing human populations, recurrent droughts, tribal conflicts, dramatic urbanisation, and monetarisation of economies and income change that endanger the survival of pastoral systems (Peters, 1999; Kosgey, 2004).

Table 1 presents the statistics of sheep and goats populations, skins, calculated off-take, total meat produced and value from 2000 to 2003 for Kenya. For the sheep, the total meat recorded an upward trend for the period despite the fact that the population was highest in 2001 but declined in 2002. The national sheep flock is estimated at 7 million and is growing at a rate of 3.6% annually as a result of the increasing human population size and subsequent reduction in land sizes (MLFD, 2003). These factors explain to a large extent the rise in off-take, total meat produced, skins and the value of the flock.

Table 1. Estimated sheep and goats populations, skin figures, meat quantity in percentage and monetary value in Kenya Shilling (KSh)

| Species                   | Year   |        |        |        |
|---------------------------|--------|--------|--------|--------|
|                           | 2000   | 2001   | 2002   | 2003   |
| <i>Sheep</i>              |        |        |        |        |
| Population ('000)         | 7,050  | 8,238  | 7,353  | 8,145  |
| Skins ('000)              | 1,862  | 1,673  | 2,662  | 2,451  |
| Calculated off-take (%)   | 24     | 20     | 36     | -      |
| Total meat (metric tonne) | 26,999 | 33,698 | 38,598 | 35,545 |
| Value (million KSh)       | 4,050  | 3,637  | 5,790  | 5,332  |
| <i>Goats</i>              |        |        |        |        |
| Population ('000)         | 10,007 | 10,780 | 11,226 | 11,926 |
| Skins ('000)              | 2,107  | 2,008  | 2,684  | 3,855  |
| Calculated off-take (%)   | 21     | 18     | 23     | -      |
| Total meat (metric tonne) | 30,552 | 43,007 | 38,918 | 55,899 |
| Value (million KSh)       | 4,583  | 4,365  | 5,838  | 8,385  |

Source: MLFD (2003).



For goats, there are approximately 11.3 million head predominantly kept in large-scale meat production systems with an annual growth rate of approximately 4.1%. The high growth rate is a result of the increased human population pressure on a finite land base (MLFD, 2003). The relative importance of goat products varies from one region to another due to ecological, economic and cultural factors. As shown in Table 1, the total goat meat output declined in 2002 despite the fact that the population has been on the increase. Generally, goats contribute significantly to the meat, milk, fibre, pelts and skins used locally (MARD, 2000).

### **2.1.1. Importance of indigenous small ruminants**

Small ruminants provide sustenance, cash income, socio-cultural linkages and insurance against risks in fragile and harsh environments (Jaitner et al., 2001). However, it is difficult to accurately determine the contribution of these animals to the human food supply and general welfare. Available statistics are misleading because much of the production from these species does not enter formal trade channels and are therefore not reported (Kosgey, 2004). In addition, negative biases have existed. For instance, the goat, a key actor in the small ruminant production theatre of animal agriculture in Africa was once referred to by the colonialists as "a problem child of African agriculture", causing soil erosion and deforestation and being an absolute nuisance in crop-based farming systems (Kiwuwa, 1992).

Generally, the average share of livestock in the agricultural GDP in sub-Saharan Africa (SSA) has been estimated at 25% but this increases to 35% when traction and manure are considered (Winrock International, 1992). Estimates of the value of meat, milk and skins from small ruminants and cattle from different regions of Africa are presented in Table 2. The East African region produces the highest number of livestock products, i.e., meat, milk, hides and skins compared to other regions. Cattle produce higher value of annual output of meat, milk and hides (about 70%). Approximately 40% of the total estimated value of annual output of products from small ruminants is derived from the East African region. This is reflected by the monetary value attached to the products in each region (Table 1).



Table 2. Estimated value of annual output of meat, milk and hides/ skins from African ruminant livestock by sub-region (1995)<sup>a,b</sup>

| Species   | Product            | Value (million US\$) from each African region |         |         |         |         |          |
|-----------|--------------------|-----------------------------------------------|---------|---------|---------|---------|----------|
|           |                    | Eastern                                       | South   | West    | Central | North   | Total    |
| Cattle    | Meat               | 4,293.5                                       | 1,611.4 | 1,616.7 | 722.5   | 634.0   | 8,878.1  |
|           | Milk               | 2,647.1                                       | 534.5   | 424.2   | 144.4   | 277.0   | 4,027.2  |
|           | Hides <sup>c</sup> | 78.6                                          | 24.2    | 30.2    | 10.6    | 7.6     | 151.2    |
| Sheep     | Meat               | 740.6                                         | 391.8   | 422.2   | 101.3   | 878.1   | 2,534.0  |
|           | Milk               | 343.8                                         | 0       | 40.7    | 9.8     | 142.5   | 536.8    |
|           | Skins <sup>c</sup> | 36.9                                          | 17.4    | 21.7    | 4.3     | 28.2    | 108.5    |
| Goats     | Meat               | 732.5                                         | 189.1   | 598.8   | 146.5   | 251.2   | 1,918.1  |
|           | Milk               | 467.6                                         | 4.9     | 112.0   | 20.3    | 120.5   | 725.3    |
|           | Skins <sup>c</sup> | 35.6                                          | 8.7     | 28.6    | 6.1     | 7.8     | 86.8     |
| Sub-total | Meat               | 5,766.6                                       | 2,192.3 | 2,637.7 | 970.3   | 1,763.3 | 13,330.2 |
|           | Milk               | 3,458.5                                       | 539.4   | 576.9   | 174.5   | 540.0   | 5,289.3  |
|           | Hides/Skins        | 151.1                                         | 50.3    | 80.5    | 21.0    | 43.6    | 346.5    |
| Total     |                    | 9,376.2                                       | 2,782.0 | 3,295.1 | 1,165.8 | 2,346.9 | 18,966.0 |

<sup>a</sup>Estimated from 1995 population statistics, offtake/ productivity figures and local producer prices as of April/ May 1997.

<sup>b</sup> Source FAO (2003).

<sup>c</sup> Estimated from average local prices of air-dried hides/ skins.

## 2.1.2. Production systems

The levels of production and cost of maintenance of breeding females determine, to a large extent, the economic viability of animal production systems (Dickerson, 1970). In Kenya, different management systems, breeding practices and functions of small ruminants have evolved in response to factors such as climate, farmers' needs, and economic and technology levels (Njoro, 2003). This has resulted in the keeping of small ruminants under different production systems that are summarized in the following sections.

### Small-scale dairy-meat production system

These farming systems integrate crops and livestock, and are predominant features that continue to develop with an increase in human population (Steinfeld et al., 1996). In Kenya, crop-livestock mixed farmers are found mainly in the medium to high potential areas and land sizes are small for subsistence purposes (Rege, 1994). The animals kept are largely a mixture of indigenous, exotic and their crossbreds (Kosgey, 2004). In this system, survival and risk minimisation rather than increased productivity is important (Swift et al., 1996). The animals are confined to small areas for grazing or left to wander freely around villages

scavenging for feed (Gatenby, 1986). In this system, animals are a non-pooled resource and provide miscellaneous roles which edge on the expectation of the farmer (Wilson, 1985; Agishi, 1988; Peters, 1988; Ayalew et al., 2003). Small ruminants may provide agricultural inputs, such as manure and render the enterprise more secure by using residual capacities of production factors with low opportunity cost. However, breeding institutions are not well organised because this will naturally demand more labour, which is a serious problem especially in periods of farm activities (Gatenby, 1986).

### **Large-scale meat production system**

Pastoral farming systems are predominant in the medium to low potential areas. In these systems, livestock form a pivotal part of the socio-cultural life of the rural people. Crop production is difficult due to unreliable rainfall and high evapo-transpiration. The indigenous Red Maasai and Somali sheep, and the Small East African and Galla goats are mainly found in these systems (Kosgey, 2004). Most of the livelihood is directly from livestock use (Adu and Lakpini, 1988). Small ruminants are kept in large flocks and are valued due to their ability to survive periods of drought. Some members of the pastoral communities are increasingly adopting the agro-pastoral system due to decreased land sizes, sedentarisation and clan conflicts in pasture and water management, and changing lifestyles. This is being encouraged further by encroachment of farmers from farming communities (Kosgey, 2004). In general, pastoral communities attach high value to the flock size and its survival. They therefore almost exclusively raise indigenous breeds that can cope with the harsh environmental stresses of seasonality in quality and quantity of available feeds, low managerial inputs and high incidences of diseases and parasites (Perry et al., 2002). Consequently, survival (e.g., pre-weaning, post-weaning and adult animal) and reproductive traits are important under this system (Kosgey et al., 2006b).

#### **2.1.3. Marketing structures**

Before the liberalisation of the dairy and meat industries in Kenya in 1987, the marketing of small ruminants and their products was controlled by the government through the LMD (GoK, 1987). Liberalisation led to diversified markets that were closer and with better opportunities for pricing. However, since the collapse of the KMC (currently being revived) and the disbanding of LMD, unreliable and exploitative middlemen have dominated the marketing of small ruminants and their products (GoK, 1987; Makokha, 2002; MLFD, 2003). Currently, most of the meat and mutton is sold in the retail markets or local butcherries.



Small ruminants and their products (especially meat) reach the consumers through four levels in the marketing channel (Otieno et al., 1993) (Figure 1). These include: (i) primary producers, (ii) assemblers, (iii) itinerant traders and (iv) retailers. Levels (i) and (ii) form the primary markets where production and re-sale are the main purposes. Levels (iii) and (iv) are the distributive and terminal markets where the main aim is re-sale of products to the consumer. At all the channel levels, the modes of transaction are by one-to-one bargaining.

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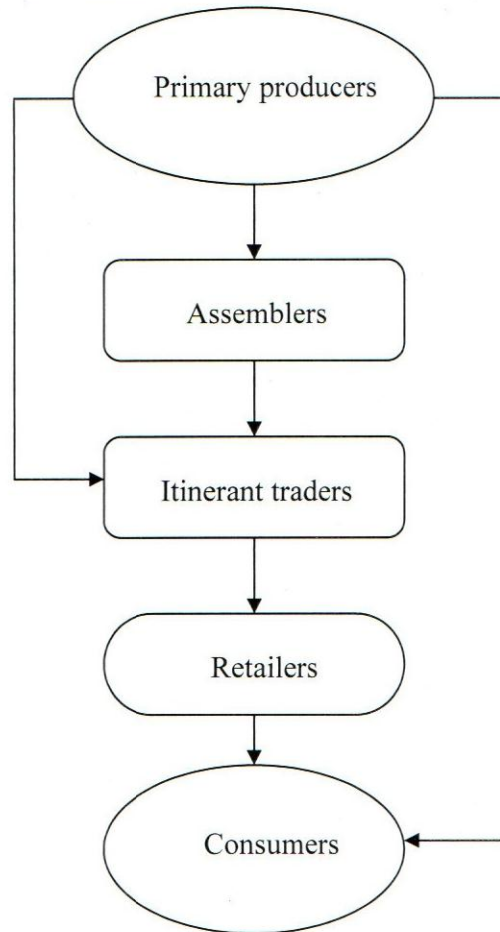


Figure 1. Small ruminant marketing channel levels

These marketing channels may be simple, where the farmer may sell directly to a buyer, or complex in which case the animals and/ or their products may be sold several times from the farmer through the sequence of middlemen to the final consumer (Ganteby, 1986; Arora et al., 2002; Makokha, 2002). For improved small ruminant marketing in northern Kenya, Chabari and Njiru (1991) made the following recommendations:



- Institutional support in developing competitive markets: small ruminant production is very price vulnerable. To protect producers from exploitation by the middlemen, a workable policy of floor prices for livestock of different species needs to be established.
- Development of export market: Kenya is strategically placed to take advantage of the Middle East meat market. No serious effort has been made to develop this market.
- Improvements in the marketing system: there is need to improve the marketing system to reduce seasonal fluctuations. The emphasis should be on sustaining flow of market stock from producer areas throughout the year. It is also essential to provide crushes, loading ramps and water at large markets. In addition, trek routes should be improved and secure overnight facilities for people and livestock established.
- Establishment of a price monitoring and dissemination service: this would provide traders and producers with useful information on prices, supply and demand of market stock at various markets.
- Improvement of truck and international road network: this is a capital-intensive investment that slows down all sectors of development in livestock producing areas. Poor roads are a major reason for high trucking costs for small ruminants.
- Provision of financing for the livestock trade: private and public savings and credit are limited for small ruminant traders. Consequently, a form of savings and credit facility could be instituted to especially assist small-scale traders in this business.

#### **2.1.4. Constraints to production**

##### **Nutritional factors**

This refers to availability and quality of feed material. In the smallholder production systems where milk animals are predominant, land is a limiting factor. Consequently, animals are stall-fed on crop residues and fodder pasture such as green napier grass (Adu and Lakpini, 1988). It is difficult for these feed resources to meet the nutritional requirements of the animals and therefore limit the production of the animals far below their potential. Concentrates which could be an alternative, are beyond the economic reach of these producers and their quality is highly variable (Agishi, 1988). In the pastoral systems, small ruminants are left to browse and graze on shrubs without any consideration by the herders of whether the feed resources meet their nutritional requirements (Kaufmann, 1998).

### **Breeding factors**

For sound breeding practices, a well-designed breeding programme is desirable (van Arendonk and Bijma, 2003). This is, however, lacking for the small ruminant sector at the national level in Kenya. Producers are therefore breeding their small ruminants without any designed selection criteria to meet their production objectives (Kahi et al., 2005). However, inbreeding is fastidiously avoided in many pastoral communities. In the smallholder system, availability of breeding material is a major hindrance to performance improvement (Kiwuwa, 1992). The desire of the producers to improve performance of their stocks has led to indiscriminate crossbreeding without consideration of breed proportions in the crossbred populations in relation to production environment (Kosgey, 2004). This has compromised the objective of crossbreeding of tapping the advantages of heterosis and breed complementarity.

### **Market factors**

This is in reference to small stock product marketing and accessibility to market information. For the case of dairy goat producers, marketing of their milk is subject to a variety of factors, ranging from limited acceptability and prejudice to establishment of a market niche, due to over-dominance of the dairy cow milk (Ayalew et al., 2003). Pastoral producers are faced with difficulty in accessing markets and market information because of infrastructural constraints that limit their mobility (Kaufmann, 1998). This leaves them in a situation where they have to be price takers and subjects of manipulation by the traders.

### **Infrastructural factors**

Small ruminant production areas are characterised by poor infrastructure and an unavailability of overhead facilities (Devendra, 1992). The absence of these facilities has led to low literacy levels and inaccessibility to reliable information sources, which predisposes the small ruminant keepers to manipulation. In addition, poor infrastructure deters service providers from reaching the production areas for fear of incurring high costs in their process of service delivery (Kilungo and Mghenyi, 2001). In the event where these services reach the producers, the high costs incurred in service delivery are transferred to the producers, a situation that strains profit margins (Ayalew et al., 2003).

### **Institutional factors**

The focus of most institutions involved in the livestock sector is large ruminants with little emphasis on small ruminants. The government involvement in livestock production,



especially goat improvement, is minimal (Mucuthi and Munei, 1996; Kosgey, 2004). Livestock policies within the region need to be able to guide the utilization and improvement of the various livestock species. Research in production and improved utilisation of the small ruminants is minimal, leading to a relatively slow rate of technology development compared to the large stock (Kahi et al., 2005). Consequently, there is inadequacy of extension practitioners to address the needs of small ruminant producers. A lot of crossbreeding has taken place and is increasingly becoming difficult to identify the pure indigenous small ruminant genotypes.

### **Unfounded prejudices**

The erroneous stigmatization of goats as the major culprits for environmental degradation is unfortunate because available evidence shows that when managed properly, especially in mixed species grazing, goats contribute to sustainable natural resource management (Schwartz, 1983; Rege and Agyemang, 1992). Pastoral flock structures are fragile, with most herders keeping a high proportion of reproductive stock that is difficult to restock commercially when range conditions improve. The reality is that poverty and demographic pressures on the land drive environmental degradation through deforestation, overgrazing, overstocking and indiscriminate exploitation of fragile marginal ecosystems (Makokha, 2002).

### **2.2. Indigenous small ruminant genetic resources**

Table 3 presents numbers of indigenous cattle, sheep and goat breeds in East Africa. The geographical distribution of breeds provides evidence that pastoralism is associated with a high degree of animal genetic diversity. Peripheral and remote areas, the typical habitat of pastoralists, have been noted to have disproportionately large numbers of breeds (Köhler-Rollefson, 2003). The indigenous SrGRs are a source of livelihood to the resource-limited livestock keepers. Arising from lack of adequate knowledge, the existing indigenous small ruminant genetic diversity is being eroded rapidly (Delgado et al., 1999). There is therefore an urgent need to address this problem.



Table 3. Numbers of indigenous cattle, sheep and goat breeds in eastern African countries

| Species | Country |          |       |         |       |          |        | Total |
|---------|---------|----------|-------|---------|-------|----------|--------|-------|
|         | Eritrea | Ethiopia | Kenya | Somalia | Sudan | Tanzania | Uganda |       |
| Cattle  | 4       | 24       | 15    | 6       | 11    | 15       | 11     | 86    |
| Sheep   | 3       | 6        | 4     | 1       | 7     | 5        | 1      | 27    |
| Goats   | 5       | 12       | 2     | 4       | 4     | 1        | 2      | 30    |
| Total   | 12      | 42       | 21    | 11      | 22    | 21       | 14     | 143   |

Source: DAGRIS (2003).

Table 4 shows the distribution of small ruminant genetic resources in East Africa. The seven eastern African countries provide home to a quarter and one-half of the indigenous African sheep and goat breeds, respectively. Correspondingly, seven sheep and two goat breed groups are known to exist. Data available (DAGRIS, 2003) indicate that documented breed characterisation information on these small ruminants is still very limited. More on-farm work is required in order to generate specific information on the status, production levels and specific adaptive attributes of the known breeds. Today, the status of most of the breeds is unknown (DAGRIS, 2003). Kenya is home to a number of small ruminant genetic resources which are described in the subsequent sections of this study.

Table 4. Distribution of small ruminant genetic resources in eastern Africa countries by breed groups

| Breed group              | Country  |           |          |          |          |          |          | Total     |
|--------------------------|----------|-----------|----------|----------|----------|----------|----------|-----------|
|                          | Eritrea  | Ethiopia  | Kenya    | Somalia  | Sudan    | Tanzania | Uganda   |           |
| <i>Sheep</i>             |          |           |          |          |          |          |          |           |
| Fat-tailed hair          | -        | 2         | 1        | -        | -        | 3        | 1        | 7         |
| Fat-tailed course wool   | 2        | 3         | -        | -        | -        | -        | -        | 5         |
| Fat-rumped hair          | -        | 1         | 1        | 1        | 1        | 1        | -        | 5         |
| Developed composite      | -        | -         | 1        | -        | 2        | 1        | -        | 4         |
| Thin-tailed hair         | -        | -         | -        | -        | 3        | -        | -        | 3         |
| Thin-tailed coarse wool  | 1        | -         | -        | -        | 1        | -        | -        | 2         |
| Fine wool                | -        | -         | 1        | -        | -        | -        | -        | 1         |
| <i>Total</i>             | <i>3</i> | <i>6</i>  | <i>4</i> | <i>1</i> | <i>7</i> | <i>5</i> | <i>1</i> | <i>27</i> |
| <i>Goats</i>             |          |           |          |          |          |          |          |           |
| Short-eared Small-horned | 3        | 11        | 2        | 3        | 1        | 1        | 2        | 23        |
| Lop-eared                | 2        | 1         | -        | 1        | 3        | -        | -        | 7         |
| <i>Total</i>             | <i>5</i> | <i>12</i> | <i>2</i> | <i>4</i> | <i>4</i> | <i>1</i> | <i>2</i> | <i>30</i> |

Source: DAGRIS (2003).

### 2.2.1. Blackhead Persian sheep

DAGRIS (2005) refers to the breed name Blackhead Persian as a synonym applied to the Blackhead Somali, a fat-rumped hair sheep which is commonly known in different areas under a number of further synonyms: Berbera Blackhead, Blackhead Ogaden, Toposa

(Sudan), Murle, Turkana, Gabbra, Boran, Adali (Afar blackhead), East African Blackheaded Persian (Uganda). According to DAGRIS (2005), Blackhead Persian refers to sheep of Blackhead Somali origin, which were transported to South Africa in 1869 and were henceforth genetically improved. The breed "Blackhead Persian" was registered in the South African stud book in 1906, and by 1930, there were registered studs with 4,000 animals. It has since been used to produce several recently developed breeds (Wilson, 1991). According to Epstein (1971), the South African breed name "Blackhead Persian" is misleading, as the breed did not apparently originate from Persia but from Somaliland, and developed through crossing with local domesticated stock and selective breeding (Epstein, 1971).

Wilson (1991) describes the most common features as the fat rump, the black colour of the head and neck, and the white of the body and limbs. Horns are absent (although scurs occur) and the ears are short to moderately long. According to DAGRIS (2005) it appears to be difficult to unambiguously attribute the Blackhead Somali to either the fat-rumped or the fat-tailed group of sheep. Its short, smooth coat is believed to indicate the breed having evolved from the crossbred progeny of fat-tailed and thin-tailed sheep. All western Asian fat-tailed sheep breeds have considerably longer hair than the Blackhead Somali sheep, while several East African fat-tailed breeds that have interbred with thin-tailed sheep bear the same short coat, which may therefore be inherited from the African ancestors. The distribution range of the Blackhead Somali sheep in East Africa includes Somalia, eastern Ethiopia, and northern Kenya. The risk status of the population is unknown and no population figures are available.

### **2.2.2. Red Maasai sheep**

The Red Maasai sheep is a fat-tailed hair sheep and is classified among the East African fat-tailed (EAFT) type. This type made their first appearance in Africa through Egypt at the beginning of the second millennium (DAGRIS, 2003). Waves of this sheep type probably entered Africa at various occasions through both the straits of Suez and Bab et Mandeb (Epstein, 1971). From Egypt, the population spread westwards into Libya, Tunisia and eastern Algeria, but did not extend to the south. The group that entered through Bab et Mandeb extended from Ethiopia into the lake region of Uganda, Kenya and Tanzania, but did not enter into Congo. The particular relevance of the fat deposit in the tail to pastoral communities as a source of energy-rich food might have contributed to the extensive replacement of the original thin-tailed sheep by the fat-tailed types. Currently, the fat-tailed hair sheep inhabit the whole of eastern and southern Africa from Ethiopia southwards. They



are very variable in tail form and in the extent of woolly undercoat. Fat-tailed breeds of sheep with hairy (carpet wool) fleece extend westwards as far as Tunisia while Algeria and Morocco have breeds with the same hairy fleece, but thin tails (Epstein, 1971).

In East Africa, the Red Maasai inhabits northern Tanzania and south-central Kenya and is principally owned by the Maasai pastoralists, but similar EAFT sheep are owned by many other tribes in Kenya (e.g., the Kamba, Kalenjin and Kikuyu), in northern and central Tanzania (e.g., the Gogo), and in the drier parts of Uganda (e.g., the Karamoja). They are found in altitudes ranging from 500 to 1500 m above the sea level and mostly in semi-arid areas with bimodal rainfall. The production systems are either agro-pastoral or pastoral (Wilson, 1991). The Red Maasai sheep has been found to be tolerant to one of the most notorious and devastating gastrointestinal parasites *Haemonchus contortus* (Baker et al., 2003), raising hopes for increased opportunities for crossbreeding with susceptible sheep breeds forming synthetic mutton genotypes for use in the humid tropics, where *H. contortus* ravages.

### **2.2.3. Small East African goat**

The Small East African goat (SEAG) is distributed throughout a wide and diverse range of environments in Kenya, Tanzania, Uganda and southwards through central Africa as far as Zaire, Angola and the north of Namibia. However, no detailed records on their distribution and population status are available from DAGRIS (2005). It is one of the most successful domestic stocks in the ASALs. According to DAGRIS (2005), the SEAG is widely known in different locations by the synonyms East African Dwarf, Sebei, Karamoja, Tanzania and Zambian. The breed belongs to the group of short-eared and small-horned goats. It is described as a diverse group of goats with variable type, conformation and body size, with an average height at withers of 60 cm. In addition, they are hardy animals, and both sexes wear horns of variable size up to 25 cm in length. Ears are prick and of moderate size, wattles are common and the coat is usually short, fine and smooth. The coat colour varies in colour type and pattern (Epstein, 1971). It ranges from pure white to pure black with various intermixes of roan and speckled brown. Males have pronounced manes running the full length of the back. Tassels are found in up to 30% of the breed. Adult males attain weights up to 35 kg and females 25-30 kg. According to Njoro (2003), the SEAG is superior to the Galla in fertility (89.4 vs. 75.5%), prolificacy (24% vs. 6%) and return to oestrus (short postpartum interval 9 days earlier than the Galla). They have slow growth rates with yearlings rarely exceeding 20 kg. The SEAG are kept mainly for meat, as their milk is rarely sufficient for



more than a single kid. However, potential exists for their selection and are therefore useful as a base in an upgrading programme. Their greatest asset is the ability to survive. The SEAG has more tolerance to trypanosomosis, internal parasites and pasteurellosis, as exemplified by their low kid mortality compared to the Galla.

#### **2.2.4. Galla goat**

The Galla, also referred to as the Somali goat, goes by other synonyms Long-eared Somali, Large-White Somali, Digodi, Melebo, Boran Somali, Benadir and Gigwain. It belongs to the short-eared and small-horned group of goat breeds (DAGRIS, 2005). The goat also belongs to the group of domestic goats with scimitar-shaped horns, which descended from the Bezoar goat. The Somali goat is described as relatively large (70 to 75 cm in height and 31 to 42 kg weight) with a white and shiny coat, short and fine hair, and horizontal or semi-pendulous ears (Wilson, 1991). About 19 and 8% of the males and females, respectively, have been reported to be polled (FARM-Africa, 1996). The Somali goat is widely distributed throughout Somalia and northern Kenya. It is common with the Somali and Borana pastoralists in the ASALs under pastoral, agro-pastoral and agricultural production systems (Wilson, 1991; FARM-Africa, 1996). The Galla dams continue to breed and rear kids up to ten years of age. According to Njoro (2003), the breed has a strong dental system and is therefore rarely culled for teeth problems. The animals are docile, easy to handle and thrive best in low altitudes, preferably in acacia bushes. In addition, they have a remarkable power of compensatory growth after a long dry season. Their high height at withers and long bodies allow them to utilise browse that cannot be physically reached by the Small East African species. The females, on average, produce kids weighing 20 kg at weaning. They can lose up to 10 kg of their bodyweight during lactation but given the opportunity, will regain this loss in 2-3 months (Njoro, 2003). According to DAGRIS (2005), the risk status of the population is unknown and no population figures are given.

#### **2.2.5. Production characteristics of some indigenous small ruminant genetic resources**

Traditional producers follow broad production objectives that are driven more by their immediate subsistence needs rather than demand from the market. While monetary returns are the driving force in a high-input and free-market economy, biological survival and established cultural traditions may define the essential values of a subsistence community (Ørskov and Viglizzo, 1994). It is worth noting that the traditional rearing strategies of SrGRs are low-input and risk-averse, and the producers make rational decisions to maximise total

system output (de Ridder and Wagenaar, 1984; Behnke, 1985; Cossins, 1985; Scoones, 1992; Ørskov and Viglizzo, 1994; Devendra, 1999). Nevertheless, most traits such as birth weight, weaning weight, mature ewe live weight and consumable meat are essential production traits. Table 5 shows the reproductive, survival and productive performances of different small ruminant genotypes in the tropics.

Table 5. Reproductive, survival and productive performances of different sheep and goat genotypes in the tropics

| Genotype                  | Trait <sup>a</sup> |     |           |         |         |         |         |             | Country        | Source                        |
|---------------------------|--------------------|-----|-----------|---------|---------|---------|---------|-------------|----------------|-------------------------------|
|                           | KR/LR (%)          | PR  | KS/LS (%) | BW (kg) | WW (kg) | YW (kg) | MW (kg) | MY (kg/day) |                |                               |
| <i>Goats</i>              |                    |     |           |         |         |         |         |             |                |                               |
| Galla (G)                 | 89.0               | 1.1 | 85.0      | 2.9     | 12.7    | 20.7    | 70.0    | 0.5         | Kenya          | Okeyo et al. (1985)           |
| Small East African (SEAG) | 79.0               | 1.3 | 96.0      | 2.3     | 10.5    | 17.8    | 35.0    | 0.1         | „              | Agwenyi (1988)                |
| G x SEAG Creole           |                    | 2.3 | 89.0      | 2.7     | 10.5    | 19.4    |         |             | „              | „                             |
|                           |                    |     |           | 10.2    | 20.0    |         |         |             | Reunion Island | Kimmes (1992)                 |
| West African Dwarf        | 88.0               |     | 80.0      | 1.4     | 5.4     |         |         |             | Guinea         | Mourad et al. (2000)          |
| Anglo-Nubian (N) Creole   |                    | 1.6 |           |         |         |         | 70.0    | 0.9         | Kenya          | Mwandotto et al. (1990)       |
|                           | 90.0               | 2.1 | 84.0      | 1.8     | 8.2     |         |         |             | West indies    | Alexandre et al. (2000)       |
| <i>Sheep</i>              |                    |     |           |         |         |         |         |             |                |                               |
| Red Maasai                | 88.0               |     | 89.0      | 3.1     | 17.8    | 28.0    |         |             | Kenya          | Kiriroti (1994)               |
| Djallonké                 |                    |     | 72.0      | 2.0     | 10.0    | 20.8    |         |             | West Africa    | Mourad et al. (2000)          |
| D'man                     |                    | 1.8 |           |         |         |         |         |             | Egypt          | Lahlou-Kassi and Marie (1981) |

<sup>a</sup>KR, kidding rate; LR, lambing rate; PR, prolificacy; KS, kid survival; LS, lamb survival; BW, birth weight; WW, weaning weight; YW, yearling weight; MW, mature weight; MY, milk yield.

Compared to temperate breeds, there is scarcity of information on the performance of indigenous small ruminants in the tropics. When compared to the SEAG, the Galla goat has lower prolificacy (PR) and kid survival (KS) but higher productive performance (Table 5). Usually, performance is determined by the breed and the environment in which the breed is raised (Odenya et al., 1984; Angwenyi, 1988; Kimmes, 1992; Alexandre et al., 2000; Erasmus, 2000). A high rate of reproductive efficiency is often thought to be the most important prerequisite for the production of meat, milk, skins and breeding stock (Wilson, 1989). In a breeding flock, a higher reproductive rate permits greater selection intensity because of surplus breeding stock and this leads to an increase in the annual rate of genetic gain. The KS has been reported to be very high (96%) among the small ruminant genotypes



in the tropics. High rates of pre-weaning mortality have been reported to be a major constraint to improving productivity in traditional husbandry systems (Wilson et al., 1985; Sherman, 1987). High post-natal mortality rates have been associated with, among other factors, sex of the kid, multiple births, low birth weights and sub-optimal feeding levels during lactation, parity and age of dam, low milk production and season of birth (Osuagwuh, 1991; Gatongi et al., 1993; Gebrelul et al., 1994; Rattner et al., 1994).

It is evident that more prolific small breeds have relatively short kidding interval (KI) (Odenya et al., 1984; Okeyo et al., 1985). Lendau et al. (1996) showed that improved nutrition increases ovulation rate and the incidence of multiple births in small ruminants. The West African Dwarf has a high kidding rate (KR) but lowest KS compared to other tropical breeds (Mourad et al., 2000). It is worth noting that special problems arise in estimating parameters such as KI and KR, which, in many cases, are required for computing compound indices of reproductive performance. For instance, Baptist (1988) and Upton (1989) demonstrated failure to take into account fractions of temporarily non-reproductive as well as sterile females in the flock as sources of inconsistencies and errors in estimating KR and KI.

The overall mean live weights at birth ranged from 1.4 to 3.1 kg for all the breeds (Table 5). Usually, meat breeds (e.g., the SEAG) have a mature weight (MW) of about 35 kg at 18 months of age (Angwenyi, 1988). The large breeds like the Galla weigh 58 to 70 kg at the age of 18 months (Odenya et al., 1984; Okeyo et al., 1985). The Galla goat is superior in weaning weight (WW) when compared to other indigenous breeds. Growth parameters are essential in the development of breeding objectives for small ruminants. Generally, growth traits considered in a breeding objective are yearling and ewe live weights, and consumable meat. Live weight is the major determinant of carcass weight and yield of consumable meat (Kosgey et al., 2003). Generally, the marked differences in growth patterns across mating season groups may largely be explained on the basis of availability of pasture, particularly during the pre-weaning period. It is worthwhile to note that under harsher conditions, optimal production levels are achieved by maintaining reasonable levels of performance in the young animals, while limiting the drain on the resources of the breeding female.

#### **2.2.6. Special attributes of indigenous small ruminants**

Small ruminants can utilise a wide variety of plant species and are therefore complementary to other livestock like cattle and camels (Kiwuwa, 1992). They generally do not compete directly with these species for feed. For example, a mixture of animal species on semi-arid rangelands makes it possible to change the stocking rate from 26 hectares per TLU



(250 kg live weight equivalent) for cattle alone to 13 hectares per TLU when cattle and goats are reared together and to 10 hectares per TLU when camels are included (Schwartz, 1983). Goats are more effective at selective browsing than any other domestic livestock species (Winrock International, 1976).

Due to their short generation intervals and high reproductive rates, small ruminants have high production efficiency (Makokha, 2002). The small size and early maturity of small ruminants give them several distinct economic advantages in smallholder situations. They can efficiently utilise marginal and small plots of land (Njoro, 2003). The risk on investment is reduced by their small individual sizes, allowing more production units per unit of investment (Kosgey, 2004). They have a faster turnover of capital because of their early sexual maturity and are younger at slaughter (Winrock International, 1976). Smaller carcasses are easier to market and can be consumed in a short period of time. This is important as most rural areas lack proper storage facilities (Kosgey, 2004).

Small ruminants produce lower absolute quantities of milk than cattle. However, when their body weight is considered, their milk yield is higher than other species with the possible exception of camels (Wilson, 1991). During difficult periods of the year, these minor levels of output become significant (Coppock et al., 1982). Although regional and breed variations exist, small ruminants appear to withstand drought better than cattle (Campbell, 1978). Shafie (1992) has summarised the physical and physiological characteristics that enable small ruminants to survive in arid and saline environments. They include; body conformation (slim trunks and slender limbs), which provide a large proportional surface area, helping excess body heat to dissipate through non-evaporative cooling; and a respiratory system with a larger proportion of dead space to respiratory area. This structure facilitates heat dissipation via respiratory water vaporisation without the need for severe panting.

### **2.3. Characterisation of traditional breeding practices**

This is the distillation of all the information regarding the phenotypic and genetic characteristics of livestock, and environments and production systems under which they are kept. It also encompasses the people who keep them, the reasons why they keep them, and the extent of genetic diversity among and between various animal populations, breeds and strains within each species at molecular and functional genomic levels (Rege, 2003). Phenotypic characterisation of traditional breeding practices involves a broad range of exploratory research outcomes. These include the description of the origin of breeds, mating systems, castration, culling, pedigree recording, population size, structure, typical features



and phenotypic performances of these resources in defined management and climatic environments (Okeyo and Ayalew, 2004).

The traditional well-established community organizations are seen as suitable candidates to handle breeding schemes, provided that a sound market-oriented research and technical assistance integrates management, nutrition, health and transformation (Kahi et al., 2005). An open nucleus appears to fit community organizations and the integrated improvement approach better. Within this framework, community producers have also been considered for *in situ* germplasm conservation. This is true to the extent that new production alternatives or inappropriate programmes could eventually lead to erosion of genetic resources.

Village breeding programmes are predominant in the tropics, and are defined as those breeding programmes carried out by communities of smallholder farmers (villagers), often at subsistence level (Sölkner et al., 1998). Participation is the magic word for any sustainable development measure. This means, first of all, acknowledging and taking into consideration the farmers' perceptions and activities. With regard to animal breeding, local knowledge has mostly been ignored for whatever reasons (Köhler-Rollefson, 2003). Further on, herders have to be willing to genetically improve their animals and take an active part in the development and implementation of any measure from the very beginning. Experiences show that the success or failure of breeding projects in the tropics is largely determined by the producers, i.e., whether they were involved and considered in the design and running of the project or not (Fall, 2000; Tewolde, 2000; Philipsson, 2000; Kosgey et al., 2006a). In addition, a stable organisation is needed for the co-ordination and provision of basic services.

Genetic characterisation of traditional breeding practices reveals important information regarding phenotypic and genetic variability. Blood groups and protein polymorphisms have been used widely to determine genetic diversity (Ndamukong, 1995; Misohou et al., 1999; Deza et al., 2000; Mwacharo et al., 2002). Such an exercise identifies quantitative trait loci (QTLs) for traits such as adaptation to heat/ drought and disease tolerance that are expensive to measure using conventional methods or have low heritability but are essential in the low-input production systems (Rege and Gibson, 2003). The importance of phenotypic and genetic characterisation of livestock and the utilisation of the information that arise from characterisation are many and have been well articulated by Drucker and Gibson (2003). This includes identification of representative samples of breeds or strains that should be a priority for conservation on the account of the unique genes that they possess.



## 2.4. Conservation strategies for animal genetic resources

Animal genetic resources (AnGR) are a resource for future food production, and environmental and socio-economic stability. Major changes in production systems, caused by the world's growing population and demand for animal products, are to be expected (FAO, 2003). Maintaining animal genetic diversity in systems where intensification of production is to occur for increased food production is a tremendous challenge (Hammond and Leitch, 1995). The analysis of the emerging intensified animal production eco-systems and the valuation of AnGRs in less favourable environments are the first steps to conservation and utilisation (Wollny, 2003). In addition, the lifetime productivity and fitness traits measured in these tropical ecosystems will provide useful information about the biological potential for utilisation. The translation into socio-economic benefits for usually multipurpose livestock breeds is also needed. Instead of importing a genotype and attempting to modify the environment through increased input levels, indigenous breeds should be utilized, and where appropriate pre-evaluated exotic breeds (Köhler-Rollefson and McCorkle, 2000). The basis for comparing performance would be lifetime productivity (number of offspring per female), economic returns for the flock (vs. individual performance) and biological efficiency (output/input) (Restall, 1984).

The pastoral communities in high risk environments have played a major role in conserving animal germplasm by embedding socio-cultural and ecological knowledge systems in indigenous institutions (Köhler-Rollefson, 1997). In most cases, these institutions have come under stress due to weak policy incentives. The historical context of conservation of indigenous breeds demonstrates how elite patronage has proved inadequate in conserving indigenous breeds for long. The role of kinship and other socio-cultural networks remain important in this regard (Skea et al., 1990). They have followed their own breeding policies which lead to highly niche- and function-specific accumulation of characteristics among larger herds. The concern for conservation of livestock diversity is important because majority of rural and urban households depend directly on genetic, species and ecosystem biodiversity for their livelihoods (Okeyo and Ayalew, 2004). There is therefore need to urgently conserve indigenous breeds that are faced with genetic extinction. *In-situ* and *ex-situ* conservation schemes are complementary, but not mutually exclusive, with their application for a particular animal genetic resource depending on the farmers' current use of them and there comparative uniqueness (Rege, 1994).



#### **2.4.1. *In-situ* utilization and conservation**

The strategy for global *in-situ* activity emphasises wise use of indigenous SrGRs by establishing and implementing breeding goals and strategies for sustainable production systems. Infrastructure for small ruminant recording and breeding is well established in developed countries, but infrastructure appropriate to systems in developing countries remain scarce (Hammond and Leitch, 1995). Modalities for simplified animal recording, genetic development and dissemination are needed for each species for a range of national livestock structures in Kenya. Breeding of small ruminants at community level has been suggested as a viable option for the management of SrGRs. A sound utilization policy is particularly important, especially because of the high unit cost of animals and their long generation intervals. The development of competitive, sustainable production systems covering all environments will not warrant the use of all existing breeds in a particular time period (Wollny et al., 2002). Utilization will therefore not provide the universal solution for conservation of domestic animal diversity.

#### **2.4.2. *Ex-situ* conservation**

This is the storage of AnGRs that farmers are currently not interested in using. It includes cryogenic preservation and the maintenance of breeds from domesticated species as live-animal populations in parks, zoos and other locations away from the environment in which they are being developed (Hammond and Leitch, 1995). Managing live populations in isolated farms will most likely be the main component of conservation programmes for animals. This requires the same kind of infrastructure as a conventional breeding programme and a breeding plan. In addition, whilst semen and embryos of only a few of the 1,500 or so endangered breeds are now conserved, cryopreservation offers a viable alternative to live animal conservation where the latter is not feasible and practical cryopreservation is possible. Now that reversible DNA quiescence in mammalian somatic cells has been demonstrated (Rege et al., 2001), perhaps the sampling and storage of somatic cells such as hair follicles will be of higher utility. However, longer term cryopreservation of animal material can be high risk without sample duplication.

#### **2.4.3. Socio-ecological context of conservation**

Most of the important breeds of livestock have evolved in high risk environments. The animals play an extremely important role in the intra and inter-household coping

strategies apart from technological, management and cultural strategies to cope with stress. Livestock-based risk adjustment strategies include (Gupta, 1986; 1996 and 1997):

- Intra household: disposal, change in the composition of species, age and sex composition of the flock and modification in the patterns of consumption of different livestock products.
- Inter-household: exchange of animals, sharing of young ones of various species among keepers and owners of livestock, borrowing, gifts and various contracts.
- Group-based or communal: collective ownership of breeding bucks, rams of specified features, restrictions on use of any other bucks/ rams, obligation for sharing cost of management of breeding stock, replacement of bucks/ rams after two years to avoid in-breeding, group pasture management, fodder banks and collective processing of livestock products (flaying, tanning and dyeing).
- Breeding: missing breeding cycle in periods of stress, changing selection criteria in the wake of prolonged stress and collective selection of kids/ lambs to be reared as breeding stock.
- Feeding: changing farming systems due to change in flock composition and vice-versa, modifying feed and fodder processing, and proportions at different stages of breeding (male and female separately) and performance.
- Management: creating special arrangements, e.g., managing temperature tolerance, disease and pest management through quarantine, indigenous medicines, vaccination and branding, shifting flocks to different regions to overcome stress, changing species and age composition to improve chances of flock survival, and changing sex composition.
- Cultural mechanisms: folk rituals, worshipping, taboos to venerate various species, sacrificing to appease various gods and, in the process, evolving fattening and other selection criteria, management of flocks by temple authorities, special voluntary or religious feeding camps during drought or floods, marriages among specified kinship networks and therefore exchange of livestock only among these networks, therefore, defining the boundary of breeding population.

In general, important dimensions to be kept in view while evolving viable conservation strategies are: (a) the need for technological and institutional compatibility, (b) role of indigenous technological knowledge in understanding the interactions among site, specie, season and socio-cultural institutions around different breeds, (c) need to learn from



local thumb rules or indicators combined with evaluation criteria for breed performance. Indicators can also help in community-based eco-system health monitoring so that the linkage between habitat and breed conservation is not ruptured, (d) role of women's knowledge systems and participation and (e) role of consumer preferences for niche products and other attributes of local breeds to be moulded so as to generate commonality of interests among consumers, producers and conservators of germplasm.

## **2.5. Breeding small ruminants at community level**

The methods used for genetic modification in small ruminants are selection within breeds/ types and crossbreeding. Selection within indigenous breeds/ types is necessary to understand their potential (Naves et al., 2000). Only after the process of selection is completed and the need for further improvement justified should crossbreeding be undertaken. Before selection, knowledge of the heritabilities, repeatabilities, and genetic and phenotypic correlations among traits is essential in deciding whether or not a particular trait(s) should be included in the selection criteria and in the breeding objective.

While Kosgey (2004) presented views on small ruminant breeding in the tropics, Kiwuwa (1992) discussed breeding strategies for small ruminant productivity in Africa. There is as such no effective small ruminant breeding programme in Kenya. The breeding has largely been left to continue as it has always been done, traditionally (Mahmoud, 2003). Although there has been some effort by international organizations along with the national institutions to improve production and productivity of small ruminants in most countries, a concerted effort is required to formulate and implement a clear breeding programme and strategy for small ruminant production in view of their importance to the national economy. While considerable efforts are needed to increase productivity of small ruminants in Kenya through the development of an efficient selection and breeding programme along with improved animal husbandry practices, one has to keep in mind the country's agro-climatic and socio-economic aspects together with the various production constraints before formulating such strategies because these factors have an important bearing on the overall success of such programmes (van der Werf, 2000a).

Community-based organisations are owned and managed by farmers in a community with a common goal of improving livestock production through appropriate use of AnGRs. They allow participation of development partners such as breed societies and research institutions (Kahi et al., 2005). In CBOs, the breeding programme is communally controlled through formation of groups with a clear goal of improving small ruminant productivity

(Kiwuwa, 1992). In addition, the breeding material is acquired through selection from the existing flocks. Village breeders use simple methods like visual appraisal to select and maintain the most adapted local breeds in an endeavour to avoid genetic extinction (Kahi et al., 2005). The poor performing males are castrated and the females culled. Different socio-cultural regimes and structures manage SrGRs differently and result in different types of breeds.

Many indigenous people consciously 'shape' their animals according to their own specific breeding goals and utilisation patterns (Köhler-Rollefson, 2003). Male breeding animals are selected with great care following certain criteria, including preferences for certain colours, vitality and the performance of the female relatives (Njoro and Wanyama, 2000). Strategic planning for small ruminant breeding at the community level must consider a number of factors. These include the production system, the priority order of economic traits (i.e., meat, milk, fibre skins, etc.), the national flock structure and the socio-economic mix, including level of literacy, product consumption habits, market outlets and type of ownership (i.e., smallholder, pure or mixed ranching) (Kiwuwa, 1992; Kosgey et al., 2006a). Due to a number of constraints identified in livestock production in the tropics, Hodges (1990) and Jasiorowski (1990) recommended nucleus breeding structures as appropriate for genetic improvement especially in small ruminants production. Kahi et al. (2005) have illustrated how nucleus breeding systems can be used within the context of a CBO for the genetic improvement of livestock.

### **2.5.1. Nucleus breeding systems**

Genetic improvement is considered a national goal if genetic progress produced from a given flock is transferred to the entire population through appropriate breeding structures (Cunningham, 1980; Bondoc and Smith, 1993). Breeding systems usually utilise a small proportion of the population for genetic improvement and the gain is disseminated to the entire population (Osinowo and Abubakar, 1989). The whole structure resembles a pyramid (Rege et al., 2001). In these structures, genetic improvement is generated in a small fraction of the population (referred to as the nucleus). A nucleus breeding unit would require the pooling of superior animals with the highest genetic merit from many sources to form the foundation (Kiwuwa, 1992). Depending on the complexity and requirements of the breeding programme, a nucleus scheme can have different numbers of tiers and migration policies (Roden, 1994).



Selection decisions are made in the stud units, and other units are considered importers of genetic change. There are basically two types of nucleus breeding systems, i.e., open and closed. In open nucleus breeding systems, the replacement stock for the nucleus population is sourced from both the nucleus and commercial (base) populations, leading to a two-way flow of genes (Kiwuwa, 1992). The female nucleus replacements are selected from the nucleus and the base, but male replacements are only selected from the nucleus-born animals (Roden, 1994). Therefore, genes may migrate up the hierarchy as well as down, and selection policies in the base flocks can affect the ultimate rate of gain. These systems have higher costs due to the fact that there is recording and selection of males and females from commercial flocks, and the consequent costs of transferring individuals between flocks (Jones and Napier, 1980). The main advantage of the open nucleus structure is that it enables use of the best commercial sector females that would not have been utilised for breeding if the nucleus were closed. There is also increased selection intensity leading to higher genetic responses and decreased inbreeding (Jackson and Turner, 1972). An open nucleus structure can either be dispersed or centralised. The FAO has been considering the open nucleus breeding structure as a possibility of improving the organisation of the nucleus flocks in developing countries (Smith, 1998).

In closed nucleus systems, replacement stock for the nucleus flocks are only within the nucleus and no importation is done from the commercial populations, resulting in a one-way flow of genes (Kiwuwa, 1992). It requires high levels of organisation and expertise, and often the use of reproductive technologies (Cunningham, 1980). The system allows for concentration of selection decisions on a centralised manageable flock. Inbreeding is the main constraint because closely related animals tend to be selected due to their closeness in expressing a character of interest. Further, there is reduced selection intensity and the risk of not using commercial sector-born ewes in the nucleus (Jones and Napier, 1980). A closed nucleus system can either be geographically dispersed or centralised. Generally, nucleus breeding structures can be superimposed on community-based small ruminant breeding programmes (Jaitner et al., 2001)

### **2.5.2. Community-based breeding programmes for small ruminants**

For effective design of sustainable small ruminant genetic improvement programmes, the relative importance of the tangible and intangible benefits from small ruminants as well as environmental characteristics and limitations need to be clearly understood, and the genotypes to satisfy these roles correctly identified (Hammond, 2001; Kosgey et al., 2006a).



For very good reason, majority of the smallholder farmers are better off keeping the indigenous animals, and focus should mainly be on the improvement of these genotypes (Kosgey, 2004). Therefore, assessment of variation within the identified population, and the proportion of variation that is genetic and can be exploited by selection for traits of interest are necessary.

Breeding programmes can play an important role in promoting small ruminant production in the ASALs. Concurrent consideration of the production environment, production systems, market opportunities, producers' organization and participation, in addition to Government support, is decisive for establishing sound breeding programmes, which are not yet well developed in the Kenya (Kahi et al., 2005). Open nucleus structures apparently fit community breeding programmes well, provided that improvement of production is conceived as an integrated approach.

The consideration of basic aspects connected with the design and success of breeding programmes (Harris et al., 1984) could be helpful. These include; the production environment and systems, the available local genotypes, market demand and environmental potentials that define breeding objectives (Nimbkar, 2000). In addition, suitable approaches for establishing sustainable and pragmatic site specific breeding programmes, which allow a permanent evaluation of the improvement process, are important. The traditionally well-established community organizations are seen as suitable candidates to handle breeding schemes, provided that a sound market-oriented research and technical assistance integrate management, nutrition, health and transformation (Nimbkar et al., 2002). Within this framework, community producers can be considered for *in-situ* germplasm conservation. This is true to the extent that new production alternatives or inappropriate programmes could eventually lead to erosion of genetic resources. There is need to facilitate formation of, and to strengthen community-based self-reliance groups (Olivier et al., 2002). Kahi et al. (2005) have discussed issues pertaining to the establishment of sustainable CBOGIL in developing countries. Ahuya et al. (2003 and 2004) described some practical experiences and impacts of such organizations in Kenya, and how they can mobilise farmers to provide entry points for local leadership. Skea (1989) explicitly discussed creation of organizational structures on which support institutions and activities such as breed associations and sire rotations can be based.

Implementation of community-based small ruminant genetic improvement programmes must be participatory, right from the planning stages (Kosgey, 2004). Simpler farm data recording and animal scoring techniques can form part of the initial capacity-



building activities, to enable the farmers themselves to later do them. Participatory approaches (e.g., PRAs) should be used to establish breeding objectives and effective implementation of genetic improvement programmes. In the establishment of CBOs, the farmers and the collaborating institutions need to agree on their respective responsibilities as partners under a properly defined contract (FAO, 1988; ITC, 2003).

## CHAPTER THREE

### MATERIALS AND METHODS

#### 3.1. Characteristics of the study location

The study was carried out in Marsabit district of northern Kenya (Figure 2). The district lies between latitude 1° 15' north and longitude 36° 3' east and 38° 59' east (Republic of Kenya, 1997). Most of the district is an extensive plain lying between 300 and 900 m a.s.l. It experiences a bimodal rainfall regime with two peaks, in April and November. The rainfall is low, erratic and unreliable, especially in the low-lying areas, with an annual range of between 120 to 700 mm. The district has no permanent rivers and underground water resources are therefore important.

##### 3.1.1. Land resources

Marsabit district covers around 71,500 km<sup>2</sup> and is the largest in Kenya. It has unimproved rangeland utilised through mobile pastoral production for about 90.6% of the district (Kaufmann, 1998). About 5,500 km<sup>2</sup> are demarcated as national parks or reserves, and the Chalbi desert extends over the remaining 1,200 km<sup>2</sup>. The pastoral ethnic groups under study, the Rendille and the Gabra, inhabit two distinct parts of the district and utilise their range resources with virtually no overlap. They have lately adapted to new diets and nutrition (Fratkin et al., 1999), social organisation (Little et al., 1999), gender roles (Roth, 1991) and organization of labour time (Smith, 1998).

##### *The Rendille area*

The Rendille pastoralists inhabit Laisamis and Loiyangalani divisions of the district's administrative zones. This area covers about 11,000 km<sup>2</sup> between 2° and 3° north, and 37° and 38° east. Sedimentary plains at about 350 m a.s.l are the prevailing landform. The Rendille utilise the foot slopes of Mount Kulal to the west and Mount Marsabit to the east. Further to the south, the Rendille co-inhabit the footslopes of the Ndoto Mountains with the Samburu where intermarriages have formed the mixed Ariaal tribe (Spencer, 1973; Fratkin, 1991).



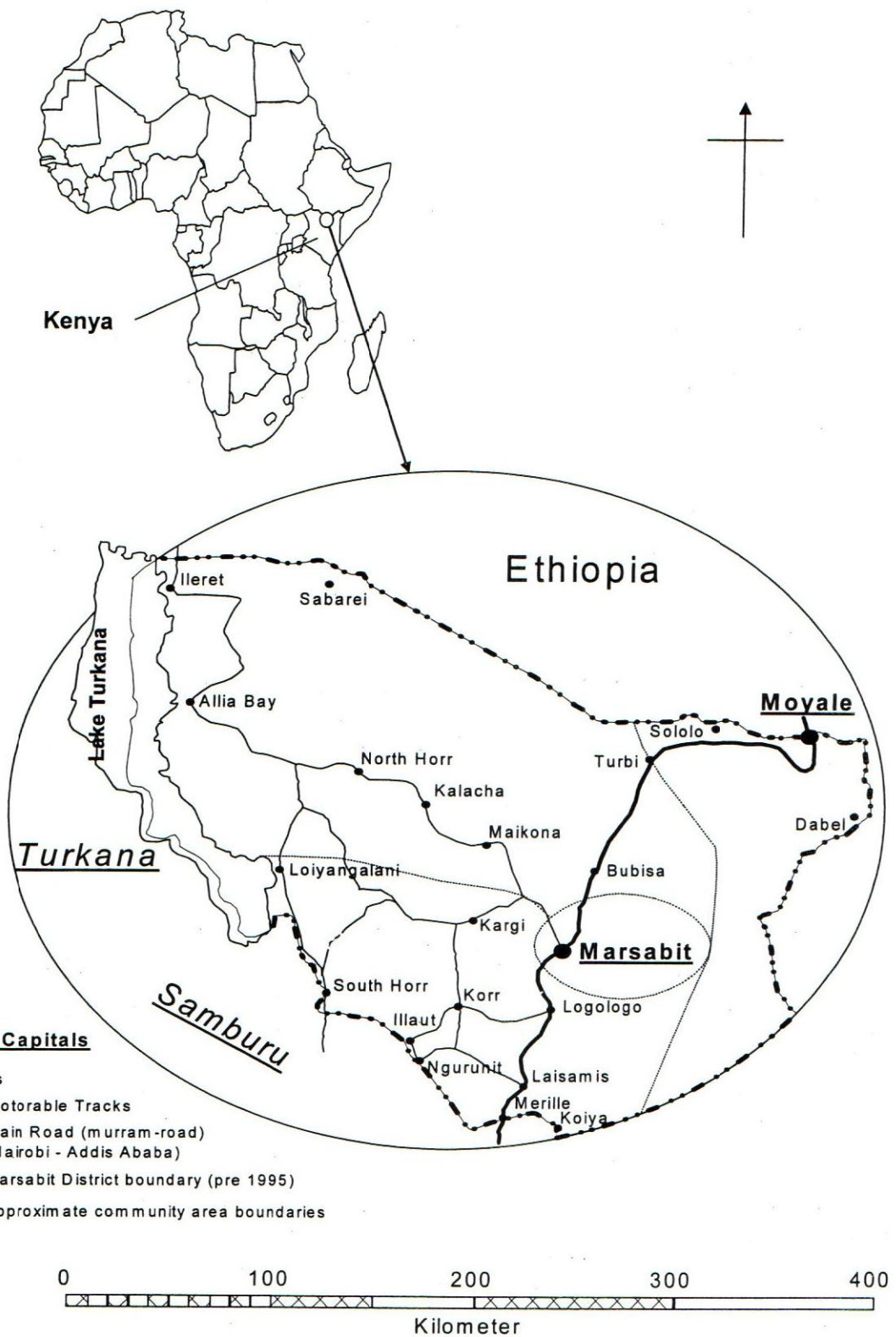


Figure 2. Map of the study area in Marsabit district

Source: Kaufmann, 1998

The northern borderline towards the Gabra area crosses the Chalbi desert, extending from Korole springs all through to North Horr. The Rendille are classified as Hamitic people. They have their ancestral origins among the Somali, but have their own language.

#### *The Gabra area*

The area inhabited by the Gabra stretches from the shores of Lake Turkana in the west to Bula Dera plain, east of the Marsabit-Moyale road (Torry, 1973; Lusigi, 1981). Administratively, this area occupies mainly the North Horr and South Horr divisions. To the north, it is bordered by the Magedo escarpments in Ethiopia and to the south by the Chalbi desert. The area is situated 3° and 4° north, and 36.5° and 38.5° east, and covers about 27,000 km<sup>2</sup>. The Gabra area is mainly of volcanic origin at an attitude of about 400 to 600 m above the sea level, with the slopes of Huri hills rising to 800 m a.s.l. Visitors who arrive in this area in the dry season cannot help thinking they have landed on a lunar landscape. The Gabra community originate from the Galla people of Ethiopia. They use the Galla language, which is also used by the Borana and some Somali clans in northern Kenya.

#### **3.1.2. Water resources**

The land is furrowed with sandy and stony watercourses known as *lagas*, some short and steep, others long and broad. The most important of these are the *Laga Balal* which carries water from the Tertale mountains in southern Ethiopia down to the Chalbi desert, and the *Laga Walde-Burburo-Afgudud* which passes east of Turbi hills to end up in the Lorian swamp. But a *Laga*, by definition, only has water during the rainy season. There is not a single permanent river (*galaana*) in the whole area. Majority of surface springs, which constitute the core of the natural water system, are found at the perimeter of the Chalbi desert (Kaufmann, 1998). During the dry seasons, these water sources are supplemented by water-holes dug in and close to the seasonal watercourses. Boreholes normally yield more than shallow wells. However, they are frequently non-operative due lack of fuel or mechanical breakdowns.



### 3.1.3. Vegetation and biomass production

In the Rendille area, the dominant vegetation is "bushed grassland", with a tree- and shrub-coverage of less than 10 percent (Schwartz et al., 1991). Either *Acacia melifera*/ *Acacia reficiens*- or *Acacia-Cappera*-associations are found. The latter prevails in the central area, where it is mixed with "dwarf-shrub/ annual-grassland". From the central area towards the Chalbi desert, dwarf-shrub becomes predominant. Deciduous shrublands, either open or with thickets, are found in other parts. Evergreen bushland is only found at the slopes of the mountains. The area around Korr has been degraded during the past 20 years, leading to stretches of barren land between *Commiphora-Acacia* bushed grassland.

Most of the land in the Gabra area is barren with stretches of "bushed grassland" or "dwarf-shrub/ annual-grassland". The sparse vegetation is not regarded as a result of human impact (Schwartz et al., 1991). "Bushed grassland" is dominant on the foot slopes and ridges of the Hurri hills around Kalacha and Maikona. Bushland and perennial grassland is found higher on the Hurri hills. Natural pasture prevails throughout the lowland parts of the district as the climate is too dry and variable to invest in crop farming or pasture improvement measures. The overall production potential is low. The average annual dry matter biomass production for the Rendille and Gabra range areas are given in Table 6.

Table 6. Average annual biomass production in kg dry matter per hectare (Kg DM/ha)

| Biomass (kg DM/ha) | Area     |       |
|--------------------|----------|-------|
|                    | Rendille | Gabra |
| Herbal layer       | 1,190    | 1,301 |
| Shrub layer        | 469      | 534   |
| Total              | 1,659    | 1,835 |

Source: Schwarts and Walsh (1991).

Table 6 must be interpreted with caution, as rainfall varies greatly both temporally and spatially, and therefore a temporal heterogeneity and large spatial in vegetation results. However, being averages over several years, they can serve as indicators of forage availability if it is borne in mind that biomass can fall critically short of this average in drought years (Kaufmann, 1998). For the Rendille area, during the years 1980–1994, the median annual rainfall across the different range units varied from 200 to 380 mm, whereby two thirds fell during the long rains and one third during the short rains. Across the range

units, herb layer forage biomass production, correspondingly, ranged from 293 to 702 kg/ha and 608 to 1332 kg/ha following the short and the long rains. Shrub layer forage biomass production ranged from 57 to 298 kg/ha and 242 to 668 kg/ha after the short and the long rains, respectively (Schwartz et al., 1991). Access to forage is in some areas further constrained by land surface structure (e.g., surface stones and boulders) and soil (e.g., muddiness of clay soil areas during the rainy seasons). The proportions of rangeland with restricted accessibility among the Rendille and the Gabra are presented in Table 7.

Table 7. Rangeland area with restricted access to livestock because of constraints in the two communities

|                                                                                                    | Rendille | Gabra |
|----------------------------------------------------------------------------------------------------|----------|-------|
| Maximum distance to permanent water sources (km)                                                   | >15      | >15   |
| Proportion of rangeland with permanent restrictions in accessibility due to landforms and soil (%) |          |       |
| Severely restricted                                                                                | 10       | 40    |
| Medium restricted                                                                                  | 30       | 30    |
| Not restricted                                                                                     | 60       | 30    |
| Total                                                                                              | 100      | 100   |

Source: Schwartz et al. (1991); Kaufmann (1998).

#### 3.1.4. Genetic resources

Two breeds or types of goats are usually distinguished in northern Kenya. The Rendille keep the SEAG while the Gabra pastoralists keep the famous Galla goat. The Galla goat is superior to the SEAG in terms of productivity and market value. The Rendille herders will always appeal for the upgrading of their breed to march with the Galla goat because they almost share similar environmental conditions. The Galla breed is big in size, has a solid physique, hardier and better adapted to feed and water stress than the SEAG. Both the Rendille and the Gabra and possess the Black Head Persian sheep, which have the same productive and adaptive performances in these defined environmental and management conditions. In northern Kenya, the Boran cattle constitute the largest proportion of *Bos indicus* breeds. They are primarily for milk and beef production to supplement the small ruminants' productivity. The Rendille and Gabra areas are endowed with large populations of dromedary camels (*Camellus dromedarius*). Among the Rendilles, four different types of camel ecotypes can be distinguished; Dabach, Godan, Coitte and Aithimaso. The Gabra differentiate their four ecotypes as Qorti, Mirgissa, Baku and Ajun. All these classifications are based on milk productivity and drought tolerance. Camels provide meat and milk, and are



also used as pack animals. The dominant donkey species found in northern Kenya is the domesticated *Equus asinus*. Donkeys are also used as pack animals. However, they are kept in low populations to avoid competition for the limited pastures and water resources with the other livestock species.

### **3.1.5. Settlement characteristics**

The Rendille culture allows large-scale co-operation between households (Spencer, 1973; O'Leary and Palsson, 1992) while the Gabra promotes greater acceptance of independent action. This social-cultural contrast is reflected in settlement patterns. The average size of a Rendille camp is 24 households, and some camps have up to 70 households (O'Leary and Palsson, 1992). This is approximately four times larger than a typical Gabra camp. Smaller camps of the Gabra are more mobile than those of the Rendille. There is a clear division of responsibilities, which are carried out with great freedom and individuality, and with sufficient time for repose. In each village, there is a place that is rather like the physical symbol of the atmosphere of freedom and relaxation. The Gabra will call such places, *gaassa*, the 'shade' of some tree or dry branches. In the long, hot afternoons, it is there that the men gather to rest, to chat, to play the endless pebble game *saddeeqa*, to tranquilly carve the many fine wooden objects they make for their homes while the women are in the comfort of their houses. Most of the interviews in this study were carried out at this particular time.

### **3.1.6. Infrastructure**

The infrastructure of the district is poor. There is only one main "all weather road" connecting Isiolo and Moyale, which was completed in 1974 after ten years of work. Others are less important but well travelled; others are scrape across the landscape used only rarely and mainly by the government and police vehicles; still others are just tracks used by traders who are familiar with the area. Road signs are totally absent. There are two airstrips in Marsabit district. The main one is located close to the town while the second, known as Segel, is located some 20 km on the road to Maikona, used when the cloud cover makes it impossible for planes to land at the main airstrip. There is a regular weekly air service between Nairobi and Marsabit, which is operated by the MAF. There are several radio networks linking hospitals and clinics to AMREF in Nairobi, and the police, among others. Poor infrastructure is one of the major constraints to market access (Chabari and Njiru, 1991).

### 3.1.7. Market outlets

The major restrictions to livestock marketing in Marsabit district include poor quality roads, frequent quarantine restrictions, cumbersome transport and movement regulations, lack of reliable market information, scarcity of handling facilities, stock rustling and general insecurity, poor terms of trade, absence of consistent marketing policies, and hence dependency on private traders (Chabari and Njiru, 1991). There are always more animals on offer than in demand, strengthening the position of the traders (Kaufmann, 1998). In addition, the terms of trade are unfavourable to the pastoralists, i.e., high prices of household consumables coming into the area, and low prices for their livestock.

### 3.1.8. Overall production conditions

The Rendille and Gabra communities face different production conditions. Recently, tribal conflicts over the control of natural and economic resources were evident. The Rendille are nowadays virtually settled around trading centres whereas the Gabra live more dispersed over their rangeland areas. Table 8 summarises the major differences in production conditions between the two communities.

Table 8. Production conditions in the study area

|                          | Rendille  | Gabra     |
|--------------------------|-----------|-----------|
| Vegetation               | Scarce    | Scarce    |
| Drought risk             | High      | High      |
| Size of settlement       | Large     | Small     |
| Population concentration | Near town | Scattered |
| Market access            | Medium    | Poor      |

Source: Schwartz et al. (1991)

## 3.2. Scope of the study

This study first identified sheep and goat breeds kept by the pastoralists in the Rendille and the Gabra area, and chose the specific study locations, one in each area. The Rendille have settled in several small towns including Merille, Korr, Laisamis, Kargi and Karare. The latter is a highland settlement where the people practice agro-pastoralism. Merille, Laisamis and Logologo lie on the main Isiolo - Moyale highway and host many immigrant business people. They are also liable to a host of influences from travellers and immigrants from outside the district. The Rendille site with sub-populations of sheep and goats (referred to as "Rendille" goats), which were considered to have only limited contact with outside herds were considered. Korr, Kargi, Ngurunit, Illaut and Farakoren are located away from the highway. Open discussions with the Rendille elders in Farakoren confirmed



these statements. Farakoren was therefore selected as the study site for the Rendille area. The SrGRs kept at Farakoren are mainly sub-populations of animals corresponding to descriptions in the scientific literature and in breed databases of SEAG and East African Black headed Persian sheep.

In the Gabra region, Elboru Magado area was initially selected based on key informant interviews with butchers, traders and local chiefs, and cross verified by open discussions with the elders. However, due to the lack of school going children and high illiteracy levels among other age groups at Elboru Magado, Malabot was finally chosen as the Gabra site, as literacy criteria are important when aiming at community-based animal recording schemes (Chagunda and Wollny, 2000). The SrGRs kept at Malabot correspond to breed descriptions of Somali (Galla) goats (a so-called “short type”) and the Blackhead Somali (Blackhead Persian) sheep. The two areas, i.e., Farakoren and Malabot were deemed to best represent the research hypotheses.

### **3.3. Data collection**

#### **3.3.1. Questionnaires**

A sociological inquiry in the form of a survey was used, with structured and semi-structured set of questionnaires being employed as the primary data collection instruments. General household information in a production system context in northern Kenya was captured, and included communities (i.e., the Rendille and the Gabra), major household decision maker, number of persons residing in a household, livestock activity, sources of income, livestock kept and livestock production category. The structured and semi-structured set of questionnaires used is presented in Appendix I. Source of breeding ram/ buck used in the flock, age at selecting breeding ram/ buck are other components included in this study. Important targeted characteristics of the new breeding ram's/ buck's dam and sire are some of the important attributes captured. In addition, important characteristics of the new breeding ram/ buck from a group of several rams were included in the questionnaires. Breeding decisions and management, selection practices, and social regimes are essential elements in the development of genetic improvement programmes (Jaitner et al., 2001). A protocol was constructed to capture the actual selection practices that involved confronting the herder with his/ her breeding ram and/ or buck (Appendix II). Physical environmental factors, precipitation, permanent herd effects and socio-cultural factors affecting selection practices for a breeding ram/ buck were highlighted (Appendix I).

Cognitive processes are important components in the provision of a good genetic package to the resource-poor livestock keepers (Lokhit Pashu-Palak and Köhler-Rollefson, 2005). Pastoral animal identification modes and their reliability were tested in this study. It included parentage, memory (recall system), simple recording using paper and pen. Identification may also be associated with the calendar system, seasons and events (Appendix I). A field trial was undertaken. A sample of 30 herders with large flocks was chosen. Five percent of the milking animals were chosen at random from each of the 30 herders, resulting in a sample of 574 milking animals. The pastoralists were asked to identify a given number of milking animals and their kids. The kids and their dams were then clearly identified. Subsequently, before the kid was released to the mother at milking, the herder was requested to identify the same goat with its kid. This exercise was repeated three times in different days and the results recorded. The strength of this approach hinges on the fact that there is imprinting created during birth that leads to the acceptance of the kid by the mother. In totality, these questions generated all the data that were needed to address the research objectives and questions.

### **3.3.2. Selection of households**

The sampling frames in the two localities were obtained from a list of relief food beneficiaries usually monitored by the Food for the Hungry International (FHI) in Marsabit. Clusters of households within a given radius were formed. A simple systematic random sampling procedure was used to choose the  $n^{\text{th}}$  herder to be interviewed. In the Rendille area, a sample size of 100 households was selected from a sampling framework of 900 pastoralists. Here the sampling interval was 9, i.e.,  $900/100$  (Mugenda and Mugenda, 1999). This was followed by randomly selecting a random start number that was to be between 1 and 9, from a table of random numbers. From four, which was the number selected, every ninth person was selected for interviewing from the list of household heads.

In the Gabra area, a sample size of 100 households was selected from a sampling frame of 1,312 pastoralists. The sample interval was 13.12. A start number that was between 1 and 14 was randomly selected from a table of random numbers. From eleven, which was the number selected, every fourteenth person was selected for interviewing from the list of household heads. Different herders come from different clans and have different status in the community and different reputations in animal management and breeding practices. Focus was directed towards the ability of the herder to identify his/ her animal and the IK to specific



breeding goal and emerging utilisation patterns. A total of 200 questionnaires were administered in both areas.

### **3.3.3. Selection of interpreters**

Most of the herders lack formal education. Due to a language barrier, members of the pastoral communities were chosen and trained to help in the gathering of information. They had to be respected elders of the community, possess their own flocks of sheep and goats, quick in mind and be able to speak and/ or write Kiswahili and/ or English, as suggested by Swift (1981). An interpreter meeting the above qualifications was found in each community. The 200 questionnaires were administered with the help of the interpreters. In the Rendille and the Gabra areas, correspondingly, 13 and 7% of the respondents were literate, and were interviewed directly. The response among this group was highly related with indirect interviews using interpreters, and as such, the issues of unbiased interpreters did not arise. During the interviews, 'out of topic' discussions were also included as a form of relaxation, especially when the respondent seemed fatigued. In certain cases, this was also accompanied by the chewing of tobacco by the participants.

### **3.4. Data processing and analyses**

Data were analysed using the SPSS software. This involved a ranking exercise for the different variables captured in the questionnaires. The survey responses were numerically coded for the purpose of computer entry and for the subsequent quantitative analyses. In addition, a spread-sheet programme in MS Excel 5.0 was used to calculate the indices according to the formula,  $\text{index} = \frac{\text{sum of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for a particular variable}}{\text{total sum of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all variables in question}}$ . In this case, indices represent weighted averages of all rankings of a particular variable. Ranks were based on the first three choices of priority variables in order of importance by the respondent. For instance, in Table 16, index of body size for the rams' sire in the Rendille area was computed as,  $\frac{\text{sum of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for body size based on 100 respondents}}{\text{sum [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all traits of the rams' sire based on 100 respondents}}$ , thus index for body size =  $(141/601) = 0.235$ . Where it seemed appropriate and justified, frequencies of different answers given to a question were calculated as a percentage of the number of answers. Chi-square ( $\chi^2$ ) analyses were performed where deemed essential to establish the association

between different attributes studied, e.g., to determine the associations between characteristics used as selection criteria and the community.

### **3.5. Limitations of the study**

#### **3.5.1. Language**

Low levels of literacy in the area meant that majority of the people could not speak or write Kiswahili and/ or English. This effectively resulted in a language barrier. Under the circumstances, an interpreter was used. This indirect exchange through an interpreter may have the distorted questions asked and the responses made. However, the interpreters were trained before the commencement of the survey to interpret as accurately as possible to reduce on distortions during the interviews. This was confirmed by the direct interviews with literate respondents.

#### **3.5.2. Self-reported information**

Self-reported information carries some level of personal bias (Mugenda and Mugenda, 1999). This was seen as a limitation with the methodology used in this study in which respondents reported their personal experiences. To counter this problem, the researcher, in addition to the structured questionnaires, formulated a small group discussion guideline, based on the PRA tool of pairwise ranking. This was used with key informants in focus group settings for triangulation of the information collected using the structured questionnaires. Participatory research methods have been found to have a comparative advantage in understanding complex problems, facilitating local identification and prioritisation of key issues for development, and developmental research among vulnerable populations like low income pastoralists (Smith et al., 2000).



## CHAPTER FOUR

### RESULTS

#### 4.1. Pastoral animal identification systems

Table 9 shows the records kept by the pastoralists and identification modes used to ensure smooth management of their flocks. The effect of community was ignored since the variation was insignificant, and therefore records and identification systems are not related to community. The two communities were basically the same. It was evident that they used their memory system to keep most of their management regimes with respect to their livestock. Those variables mentioned in first, second or third places were considered most important. Those mentioned thereafter were considered less important. The index of respondents who mentioned the respective characteristics in first, second or third ranks are shown. The sum of rank 1, 2 and 3 is given.

Table 9. Ranking of records and identification systems of the Rendille and the Gabra pastoral communities

| Item                      | Rank (%) |      |      |             | Index  |
|---------------------------|----------|------|------|-------------|--------|
|                           | 1        | 2    | 3    | Sum (1,2,3) |        |
| Records                   |          |      |      |             |        |
| Date of birth             | 24.5     | 14.5 | 8.5  | 47.5        | 0.1881 |
| Date of weaning           | 4.5      | 2.5  | 4.5  | 11.5        | 0.0389 |
| Castration                | 19.0     | 22.0 | 31.0 | 72.0        | 0.2237 |
| Culling                   | 1.5      | 4.0  | 3.0  | 8.5         | 0.0262 |
| Performance               | 16.0     | 12.5 | 5.0  | 33.5        | 0.1322 |
| Health                    | 1.0      | 10.5 | 19.0 | 30.5        | 0.0728 |
| Entries                   | 23.0     | 14.5 | 11.0 | 48.5        | 0.1847 |
| Exits                     | 9.0      | 18.0 | 15.5 | 42.5        | 0.1330 |
| Identification system     |          |      |      |             |        |
| Matrilineal naming system | 16.5     | 0.5  | 9.0  | 26.0        | 0.1007 |
| Colour                    | 10.5     | 8.0  | 45.5 | 64.0        | 0.1498 |
| Recall system             | 6.5      | 9.0  | 17.5 | 33.0        | 0.0923 |
| Ear notching              | 64.0     | 24.5 | 5.0  | 93.5        | 0.4093 |
| Branding                  | 2.5      | 58.0 | 23.0 | 83.5        | 0.2479 |

The most important records kept by the pastoralists are dates of birth of their animals, castration records and entries into the flock from outside (Table 9). Other records like dates of weaning, culling, performances, health and exits are also kept but ranked lower. In an endeavour to differentiate within and without flocks, the most important identification system included branding (Figure 3), ear notching and coat colour of the animal. Matrilineal naming

and recall system is also used but ranked lower. It was clear that whatever system used, the herders are able to identify a particular animal throughout its lifespan.



Figure 3. A herder inserting an identification mark on his young stock

#### **4.1.1. Names of different age and sex classes**

The pastoralists have their own practice of classifying animals, mainly based on age and sex classes. This has been seen to have a major impact on the management regimes of the small stock, and therefore, improved productivity of the animals. For example, among the Rendille community, each animal, depending on its sex, age and possible additional criteria, belongs to a distinct animal class (Table 10). Animals of different categories or classes usually fulfil different roles and functions within a production system.



Table 10. Vernacular terms for sheep and goats of different age and sex classes as distinguished by the Rendille pastoralists

| Animal Class                  | Rendille Sheep                       | Rendille Goats    |
|-------------------------------|--------------------------------------|-------------------|
| Very young pre-weaned         | Lukuo Kunini                         | Lukuo Kunini      |
| Middle aged pre-weaned        | Lukuo Puusi                          | Kotiti            |
| Old pre-weaners               | Lukuo Botoro                         | Lukuo Botoro      |
| Weaners                       | Guus                                 | Karat             |
| Sub-adult female              | Sipen/ Leeker                        | Sipen/ Lekinne    |
| Mature females                | Riiyo                                | Onno              |
| Sub-adult males (uncastrated) | Lepukutorege                         | Lepukutorege      |
| Castrates/ wethers            | 1st Grade: Loro Lentare Uni Ilarecha | Loro lentare      |
|                               | 2nd Grade: Lorolesipen               | Lorolesipen       |
|                               | 3rd Grade: Loro lentare tare         | Loro lentare tare |
| Bucks/ rams                   | Lmerigesh                            | Orgei             |

#### 4.1.2. Assessment of actual animal identification

Table 11 shows the results of the field animal identification trials. A milking animal and kid was identified in trial one. Correct identification called for “yes” tick in the marksheet. A wrong identification of the animal in question was marked “no” in the marksheet. The process was repeated for the second and third trials on different dates and responses recorded accordingly. The frequencies and percentages of answers given are shown in Table 11. In the three trials [Trial 1, (99.3%); trial 2, (97.4%) and trial 3, (98.4%)], the herders could correctly identify the animals in question. This confirmed that they knew their animals individually.

Table 11. Frequency of the animal identification undertaken (n = 574) for the goats

| Trial | Response | Frequency | Percent |
|-------|----------|-----------|---------|
| 1     | Yes      | 570       | 99.3    |
|       | No       | 4         | 0.7     |
| 2     | Yes      | 559       | 97.4    |
|       | No       | 15        | 2.6     |
| 3     | Yes      | 565       | 98.4    |
|       | No       | 9         | 1.6     |

#### 4.2. Indigenous breeding practices of sheep and goats

##### 4.2.1. Selection criteria for the buck’s dam and sire

Table 12 presents the ranked characteristics of the new buck’s dam considered in selection by the Rendille and the Gabra. Only characteristics mentioned in first, second or third places were considered. Characteristics with sum of rank  $\leq 1$  are not included and these included temperament, meat quality, mohair, skin, milk problems and lack of dystocia in both

communities, and prolificacy among the Gabra. There was a significant association between the characteristics and community ( $\chi^2 = 54.666$ , 11 df,  $P < 0.001$ ).

Table 12. Ranked characteristics considered in the selection of the new buck's dam by the Rendille and the Gabra pastoralists (n = 100 respondents each)

| Characteristic    | Rendille  |           |           |      |       | Gabra     |           |           |      |       |
|-------------------|-----------|-----------|-----------|------|-------|-----------|-----------|-----------|------|-------|
|                   | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index |
| Big body size     | 29.0      | 27.0      | 14.0      | 70.0 | 0.260 | 29.0      | 24.0      | 16.0      | 69.0 | 0.251 |
| Conformation      | 7.0       | 5.0       | 2.0       | 14.0 | 0.055 | 7.0       | 5.0       | 5.0       | 17.0 | 0.060 |
| Coat colour       | 3.0       | 2.0       | 2.0       | 7.0  | 0.026 | 2.0       | -         | 2.0       | 4.0  | 0.013 |
| Good health       | 7.0       | 11.0      | 3.0       | 21.0 | 0.077 | -         | 2.0       | -         | 2.0  | 0.007 |
| Drought tolerance | 12.0      | 10.0      | 7.0       | 29.0 | 0.106 | 25.0      | 21.0      | 19.0      | 65.0 | 0.226 |
| Fertility         | 1.0       | -         | 1.0       | 2.0  | 0.007 | 2.0       | 1.0       | 4.0       | 7.0  | 0.020 |
| Prolificacy       | 5.0       | -         | 2.0       | 7.0  | 0.032 | -         | -         | -         | -    | -     |
| Horns             | 1.0       | 3.0       | 5.0       | 9.0  | 0.023 | 2.0       | 3.0       | -         | 5.0  | 0.020 |
| Milk yield        | 16.0      | 26.0      | 23.0      | 65.0 | 0.206 | 12.0      | 24.0      | 22.0      | 58.0 | 0.176 |
| Mothering ability | 3.0       | 4.0       | 7.0       | 14.0 | 0.040 | 1.0       | 3.0       | 3.0       | 7.0  | 0.020 |
| Offspring quality | 14.0      | 9.0       | 33.0      | 56.0 | 0.156 | 28.3      | 26.7      | 45.0      | 100  | 0.183 |
| Udder             | 1.0       | -         | 2.0       | 3.0  | 0.003 | 4.0       | -         | 1.0       | 5.0  | 0.023 |

$$(\chi^2 = 54.666, 11 \text{ df}, P < 0.001)$$

The most important characteristics of the new breeding buck's dam were big body size, milk yield, and offspring quality for the Rendille pastoralists. Other characteristics like body conformation, coat colour, health, drought tolerance, fertility, horns, mothering ability, and prolificacy were also considered by many herders but were ranked lower. For the Gabra, big body size, drought tolerance and offspring quality were considered most important. Characteristics like body conformation, coat colour, good health, fertility, milk production, udder size and mothering ability were also considered but ranked lower. The ranked characteristics of the new buck's sire considered by the Rendille and the Gabra in selection are given in Table 13. There was also a significant association between the characteristics and community ( $\chi^2 = 50.928$ , 11 df,  $P < 0.001$ ). For the Rendille, important characteristics of the new breeding buck's sire were big body size, offspring quality and mating ability. Other characteristics, e.g., being muscular/ strong fighter, coat colour, drought tolerance, disease resistance, temperament, fertility, beauty, mating ability and overall visual assessment were considered but ranked lower.

The Gabra mentioned big body size, offspring quality and drought resistance as the most preferred traits. Other characteristics, e.g., being muscular/ strong fighter, drought tolerance, disease resistance, beauty, mating ability, fertility and overall visual assessment were considered but ranked lower. Other characteristics with sum of rank  $\leq 1$  included coat colour, temperament in both communities, and meat quality among the Gabra.



Table 13. Ranked characteristics considered in the selection of the new buck's sire by the Rendille and the Gabra pastoralists (n = 100 respondents each)

| Characteristic          | Rendille  |           |           |      |       | Gabra     |           |           |      |       |
|-------------------------|-----------|-----------|-----------|------|-------|-----------|-----------|-----------|------|-------|
|                         | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index |
| Big body size           | 23.0      | 40.0      | 10.0      | 73.0 | 0.264 | 27.0      | 26.0      | 14.0      | 67.0 | 0.245 |
| Muscular/strong fighter | 13.0      | 11.0      | 13.0      | 37.0 | 0.123 | 15.0      | 5.0       | 5.0       | 25.0 | 0.100 |
| Coat colour             | 5.0       | 1.0       | 6.0       | 12.0 | 0.038 |           |           |           |      |       |
| Offspring quality       | 31.0      | 24.0      | 11.0      | 66.0 | 0.252 | 28.0      | 30.0      | 15.0      | 73.0 | 0.265 |
| Drought tolerance       | 2.0       | 5.0       | 8.0       | 15.0 | 0.040 | 14.0      | 10.0      | 11.0      | 35.0 | 0.121 |
| Disease resistance      | 1.0       | -         | 4.0       | 5.0  | 0.012 | -         | 1.0       | 2.0       | 3.0  | 0.007 |
| Temperament             | 2.0       | -         | -         | 2.0  | 0.010 |           |           |           |      |       |
| Meat quality            | -         | 1.0       | 1.0       | 2.0  | 0.005 |           |           |           |      |       |
| Beauty                  | 2.0       | -         | 3.0       | 5.0  | 0.015 | 4.0       | 5.0       | 8.0       | 17.0 | 0.050 |
| Mating ability          | 20.0      | 13.0      | 32.0      | 65.0 | 0.196 | 7.0       | 11.0      | 23.0      | 41.0 | 0.110 |
| Fertility               | 1.0       | 1.0       | 4.0       | 6.0  | 0.015 | 1.0       | 1.0       | 1.0       | 3.0  | 0.010 |
| Visual assessment       | 2.0       | 3.0       | 7.0       | 12.0 | 0.032 | 5.0       | 10.0      | 19.0      | 34.0 | 0.090 |

$$(\chi^2 = 50.928, 11 \text{ df}, P < 0.001)$$

#### 4.2.2. Selection criteria for a potential new breeding buck

Table 14 gives the ranked characteristics of a potential new breeding buck considered by the Rendille and the Gabra in selection. There was also a significant association between the characteristics and community ( $\chi^2 = 73.054$ , 10 df,  $P < 0.001$ ). Big body size, being stronger than others and the parents' history were the most preferred criteria by the Rendille. Coat colour, being more playful than others, beauty, good health, hardiness and overall visual assessment were also considered but ranked lower.

Table 14. Ranked characteristics considered in the selection of a potential new buck by Rendille and the Gabra pastoralists (n = 100 respondents each)

| Characteristic                     | Rendille  |           |           |      |       | Gabra     |           |           |      |       |
|------------------------------------|-----------|-----------|-----------|------|-------|-----------|-----------|-----------|------|-------|
|                                    | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index |
| Big body size                      | 29.0      | 29.0      | 12.0      | 70.0 | 0.262 | 29.0      | 25.0      | 17.0      | 71.0 | 0.255 |
| Stronger than others               | 10.0      | 21.0      | 2.0       | 33.0 | 0.124 | 3.0       | 6.0       | 1.0       | 10.0 | 0.036 |
| Coat colour                        | 7.0       | 5.0       | 22.0      | 34.0 | 0.088 | 5.0       | 9.0       | 9.0       | 23.0 | 0.070 |
| Ability to suckle soon after birth | 1.0       | 1.0       | 1.0       | 3.0  | 0.010 |           |           |           |      |       |
| Drought tolerance                  |           |           |           |      |       | 2.0       | 2.0       | 2.0       | 6.0  | 0.020 |
| Good health                        | 4.0       | 7.0       | 13.0      | 24.0 | 0.065 | 1.0       | -         | 1.0       | 2.0  | 0.007 |
| Being more playful than others     | 9.0       | 8.0       | 6.0       | 23.0 | 0.082 | 5.0       | 5.0       | 4.0       | 14.0 | 0.048 |
| Parents' history                   | 29.0      | 24.0      | 22.0      | 75.0 | 0.262 | 33.0      | 33.0      | 18.0      | 84.0 | 0.303 |
| Beauty                             | 1.0       | 2.0       | 4.0       | 7.0  | 0.018 | 3.0       | 6.0       | 4.0       | 13.0 | 0.041 |
| Visual assessment                  | 2.0       | -         | 3.0       | 5.0  | 0.015 | 5.0       | 13.0      | 15.0      | 33.0 | 0.093 |
| Hardiness                          | 6.0       | 3.0       | 15.0      | 24.0 | 0.065 | 15.0      | 2.0       | 27.0      | 44.0 | 0.126 |

$$(\chi^2 = 73.054, 10 \text{ df}, P < 0.001)$$

The Gabra preferred big body size, parents' history and hardiness as important characteristics for selecting a new breeding buck for the flock. Other traits like being stronger than others, coat colour, being more playful than others, beauty, good health, drought tolerance and overall visual assessment were also considered but ranked lower. Characteristics with sum of rank  $\leq 1$  included clear eyes and tight prepuce sheath in both communities, drought resistance among the Rendille, and ability to suckle soon after birth among the Gabra.

#### 4.2.3. Selection criteria for the ram's dam and sire

The ranked characteristics of the new ram's dam considered by the Rendille and the Gabra in selection are presented in Table 15. Not shown in the table are characteristics with sum of rank  $\leq 1$  which included temperament, meat quality, mohair and skin, in both communities, and prolificacy among the Gabra. There was also a significant association between the characteristics and community ( $\chi^2 = 34.798$ , 9 df,  $P < 0.001$ ). The most important characteristics of the new breeding ram's dam were big body size, fat deposition and offspring quality for the Rendille. Characteristics like body conformation, coat colour, good health, drought tolerance, fertility and prolificacy were also considered by many herders but ranked lower. The most important characteristics for the Gabra were big body size, drought tolerance and offspring quality. Characteristics like body conformation, coat colour, good health, fertility, milk production and fat deposition were also considered but ranked lower.

Table 15. Ranked characteristics considered in the selection of the new ram's dam by the Rendille and the Gabra pastoralists (n = 100 respondents each)

| Characteristic      | Rendille  |           |           |      |       | Gabra     |           |           |      |       |
|---------------------|-----------|-----------|-----------|------|-------|-----------|-----------|-----------|------|-------|
|                     | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index |
| Big body size       | 25.0      | 29.0      | 15.0      | 69.0 | 0.246 | 18.0      | 29.0      | 18.0      | 65.0 | 0.216 |
| Conformation/ shape | 6.0       | 9.0       | 3.0       | 18.0 | 0.065 | 10.0      | 10.0      | 5.0       | 25.0 | 0.092 |
| Coat colour         | 3.0       | 4.0       | 4.0       | 11.0 | 0.035 | 4.0       | 2.0       | -         | 6.0  | 0.027 |
| Good health         | 1.0       | 6.0       | 17.0      | 24.0 | 0.053 | 3.0       | -         | -         | 3.0  | 0.015 |
| Drought tolerance   | 15.0      | 21.0      | 15.0      | 51.0 | 0.169 | 31.0      | 20.0      | 16.0      | 67.0 | 0.248 |
| Fertility           | -         | 1.0       | 2.0       | 3.0  | 0.007 | 3.0       | 8.0       | 6.0       | 17.0 | 0.052 |
| Milk production     | 18.0      | 18.0      | 17.0      | 53.0 | 0.173 | 16.0      | 13.0      | 25.0      | 54.0 | 0.165 |
| Fat deposition      | 30.0      | 13.0      | 24.0      | 67.0 | 0.233 | 15.0      | 19.0      | 28.0      | 62.0 | 0.185 |
| Offspring quality   | 20.0      | 22.0      | 14.0      | 56.0 | 0.200 | 24.0      | 22.0      | 19.0      | 65.0 | 0.235 |
| Prolificacy         | 1.0       | 1.0       | 1.0       | 3.0  | 0.010 |           |           |           |      |       |

$$(\chi^2 = 34.798, 9 \text{ df}, P < 0.001)$$

Table 16 shows the important characteristics of the new born breeding ram's sire considered by both communities. The association between these characteristics and



community was significant ( $\chi^2 = 70.584$ , 10 df,  $P < 0.001$ ). Important characteristics of the new breeding ram's sire mentioned by the Rendille were big body size, offspring quality and fat deposition. Characteristics like being muscular/ strong fighter, coat colour, drought tolerance, disease resistance, beauty, mating ability and visual assessment were considered but ranked lower.

Table 16. Ranked characteristics considered in the selection of the new ram's sire by the Rendille and the Gabra pastoralists (n = 100 respondents each)

| Characteristic          | Rendille  |           |           |      |       | Gabra     |           |           |      |       |
|-------------------------|-----------|-----------|-----------|------|-------|-----------|-----------|-----------|------|-------|
|                         | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index |
| Big body size           | 23.0      | 31.0      | 10.0      | 64.0 | 0.235 | 23.0      | 26.0      | 19.0      | 68.0 | 0.233 |
| Muscular/strong fighter | 11.0      | 13.0      | 15.0      | 39.0 | 0.123 | 10.0      | 5.0       | 6.0       | 21.0 | 0.077 |
| Coat colour             | 1.0       | 1.0       | 7.0       | 9.0  | 0.020 |           |           |           |      |       |
| Offspring quality       | 21.0      | 22.0      | 13.0      | 56.0 | 0.200 | 27.0      | 22.0      | 16.0      | 65.0 | 0.235 |
| Drought tolerance       | 3.0       | 2.0       | 5.0       | 10.0 | 0.030 | 9.0       | 11.0      | 13.0      | 33.0 | 0.103 |
| Disease resistance      | 1.0       | -         | 3.0       | 4.0  | 0.010 |           |           |           |      |       |
| Beauty                  | 1.0       | 1.0       | 1.0       | 3.0  | 0.010 | 3.0       | 3.0       | 1.0       | 7.0  | 0.027 |
| Mating ability          | 14.0      | 14.0      | 21.0      | 49.0 | 0.151 | 4.0       | 6.0       | 3.0       | 13.0 | 0.045 |
| Fertility               |           |           |           |      |       | -         | 2.0       | 9.0       | 11.0 | 0.022 |
| Fat deposition          | 23.0      | 14.0      | 25.0      | 62.0 | 0.203 | 23.0      | 19.0      | 25.0      | 67.0 | 0.220 |
| Visual assessment       | 1.0       | 1.0       | 1.0       | 3.0  | 0.010 | 1.0       | 5.0       | 6.0       | 12.0 | 0.032 |

$$(\chi^2 = 70.584, 10 \text{ df}, P < 0.001)$$

The Gabra herders mentioned big body size, offspring quality and fat deposition as the most preferred traits. Characteristics like being muscular/ strong fighter, drought resistance, beauty, mating ability and visual assessment featured but ranked lower. Other less important characteristics included meat quality and temperament in both communities, fertility among the Rendille, and coat colour and disease resistance among the Gabra.

#### 4.2.4. Selection criteria for a potential new breeding ram

Table 17 gives the ranked characteristics of a potential new ram considered in selection by the Rendille and the Gabra. It should be noted that characteristics with sum of rank  $\leq 1$  are not included, and these were clear eyes and ability to suckle soon after birth in both communities, and drought resistance among the Gabra. Generally, there was a significant association between these characteristics and community ( $\chi^2 = 49.108$ , 9 df,  $P < 0.001$ ).

Big body size and parents' history were the most preferred traits by the Rendille. Being stronger than others, coat colour, being more playful than others, beauty, good health and fat deposition were also considered but ranked lower. The Gabra preferred big body size, parents' history and fat deposition as important characteristics for selecting a new breeding ram for the flock. Traits like being stronger than others, coat colour, more playful than others,

beauty, good health and overall visual assessment were also considered by both communities but ranked lower.

Table 17. Ranked characteristics considered in the selection of a potential new ram by the Rendille and the Gabra pastoralists (n = 100 respondents each)

| Characteristic           | Rendille  |           |           |      |       | Gabra     |           |           |      |       |
|--------------------------|-----------|-----------|-----------|------|-------|-----------|-----------|-----------|------|-------|
|                          | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index | Rank<br>1 | Rank<br>2 | Rank<br>3 | Sum  | Index |
| Big body size            | 19.0      | 28.0      | 23.0      | 70.0 | 0.227 | 18.0      | 27.0      | 18.0      | 63.0 | 0.210 |
| Stronger than others     | 11.0      | 15.0      | 4.0       | 30.0 | 0.112 | 7.0       | 7.0       | 4.0       | 18.0 | 0.065 |
| Coat colour              | 2.0       | 1.0       | 6.0       | 9.0  | 0.023 | 4.0       | 3.0       | 3.0       | 10.0 | 0.035 |
| Drought resistance       | 2.0       | -         | 3.0       | 5.0  | 0.015 |           |           |           |      |       |
| More playful than others | 8.0       | 7.0       | 5.0       | 20.0 | 0.072 | 11.0      | 7.0       | 6.0       | 24.0 | 0.088 |
| Parents' history         | 29.0      | 25.0      | 23.0      | 77.0 | 0.268 | 25.0      | 26.0      | 26.0      | 77.0 | 0.255 |
| Beauty                   | 2.0       | 2.0       | 1.0       | 5.0  | 0.018 | 1.0       | 2.0       | 5.0       | 8.0  | 0.020 |
| Good body health         | 7.0       | 14.0      | 11.0      | 32.0 | 0.100 | 1.0       | 2.0       | 1.0       | 4.0  | 0.013 |
| Visual assessment        | 1.0       | 2.0       | 2.0       | 5.0  | 0.015 | 5.0       | 9.0       | 11.0      | 25.0 | 0.073 |
| Fat deposition           | 18.0      | 6.0       | 23.0      | 47.0 | 0.149 | 28.0      | 18.0      | 24.0      | 70.0 | 0.240 |

$$(\chi^2 = 49.108, 9 \text{ df}, P < 0.001)$$

### 4.3. Factors affecting actual and theoretical selection practices

Table 18 presents the factors that cause differences between the actual and theoretical selection practices among the Rendille and the Gabra. Here actual selection practices refer to the observed attributes exhibited by these animals while theoretical practices are those characteristics which are targeted or anticipated by the pastoralists through the whole process of selection. It was evident that drought outbreaks (see Figure 4), diseases and parasites, and social cultural beliefs were major causes for the differences in two selection practices among the Rendille. The Gabra considered drought outbreaks, genetic composition, and diseases and parasites as main contributors of the differences.

Table 18. Factors that cause differences between the actual and theoretical selection practices among the Rendille and the Gabra (n = 200 respondents) in selection.

| Factor                                            | Frequencies (%) |       |
|---------------------------------------------------|-----------------|-------|
|                                                   | Rendille        | Gabra |
| Recurrent drought outbreak                        | 94.0            | 98.0  |
| Diseases and parasites                            | 80.0            | 72.0  |
| Lack of healthcare                                | 53.0            | 53.0  |
| Social cultural beliefs among the pastoral people | 85.0            | 58.0  |
| Genetic composition of breeds                     | 56.0            | 96.0  |





Figure 4. Sheep and goats advancing in the Gabra rangelands in search of pastures

## **CHAPTER FIVE**

### **GENERAL DISCUSSION AND CONCLUSIONS**

#### **5.1. Rationale for the study**

Over millennia, pastoralists have created a vast range of breeds, each with specific characteristics and adapted to the prevailing conditions. While scientists can quantify many aspects of indigenous breeds, it is the communities who are familiar with the traits that are important for survival and subsistence in harsh environments. This knowledge should form the basis of all community-based breeding programmes that require efficient and sustainable breeding systems and schemes. Conventionally, the design of efficient breeding strategies involves definition of the breeding system and identification of schemes, but knowledge of traditional breeding practices forms the initial stage. It becomes important to understand IK on animal breeds and breeding practices which is structured differently from scientific knowledge and take skills to make visible. This study focused on characterisation of such knowledge in an endeavour to determine and assess the pastoral animal identification systems, which correspond to the conventional herd books. In addition, an analysis of the actual and theoretical pastoral selection practices for breeding bucks/ rams, and the causes of the differences between the actual and theoretical selection practices were undertaken.

#### **5.2. Pastoral animal identification systems**

This study showed that in the pastoral production systems, most of the animal identification is done through ear notching, branding and colour of the animals (Table 9 and Figure 3). Ear notching and branding follow certain matrilineal lineages. For example, a notch in the left ear of the entire flock may represent a given lineage group of a certain clan while a notch in the right ear represents the specific identity of a given household. This exercise is done at the age of between two and three months before the pre-weaners are released to the main flock. It is worth noting that different flocks generally exhibit different colours, and the identity of a given flock can be pegged on the colour. Matrilineal naming of goats and recall system are widely used in the flocks but are not conclusive in case of disputes arising from theft and counter raids.

As shown in this study (Table 9), it was clear that the pastoralists kept castration records, and entries and exits from the flock with much attention. This implies that the issue of inbreeding is usually avoided in the systems as selection for the breeding stock is done early enough following certain criteria and the rest of the males castrated. Wealth status in



these systems is measured by the number of head of livestock owned by the herder. The number of animals that have joined or left the flock is very crucial as it determines the flock sizes. Animals joined the flock through birth; and others were bought, donated or even acquired through forceful means silently referred to as 'raiding'. Exits of small ruminants from the flock may be through the culling of aged animals, killing by predator's, e.g., lions and hyenas; disease outbreaks, prolonged droughts, or use in social cultural ceremonies. For instance, among the Rendille, traditional ceremonies include the childbirth (*Morr*), marriage (*Lkitiwen*), traditional court for owning a wife (*Lokoret*), circumcision (*Muratere*) and stage of warriorship (*Lmuget*). A particular age and sex of animal (Table 10) is used for a specific ceremony.

Other records, e.g., dates of weaning, culling, performance and health status of the animals are also kept by the herders although not much attention is paid to them (Table 9). Generally, records are used primarily to improve management and feeding of animals on the farms. In the long term, analysis of such records enables genetic evaluation of animal populations to be done. For most indigenous populations, this activity can contribute to value addition of the farmers' animals. Whatever the purpose of keeping records, there is need for a cost-efficient, cost-effective and simple system that provides an adequate degree of coverage and accuracy. Different recording systems are required depending on the production system, their purpose, the type of farms and advisory as well as government services involved. Records and identification systems were not related to the community and therefore the two communities were basically the same. This implies that pedigree and performance recording has been practiced through own intricate knowledge. If this knowledge is harnessed, it could be an avenue to successful community-based genetic improvement initiatives. However, all the above records and modes of identification in these systems are kept through memory. They are even linked to certain events and calamities, e.g., massacres and severe droughts.

One aspect of indigenous AnGR management that parallels the herd book societies is mental record keeping of the animals' pedigrees. In general, pastoralists attach great importance to the ancestry of their animals and memorize it in great detail. For example, the practices of camel pastoralists have been documented in great detail (Köhler-Rollefson, 1995). According to Galaty (1989), the Maasai conceive their cattle herds as being composed of matrilineages; all animals descended from one particular cow are grouped together and given the same name. This is the same scenario with the herders in northern Kenya. It was clear that whatever is system used, the herders could remember the particular animal throughout its lifespan. Assessment of the reliability of the system used to identify a



particular animal showed that over 97% of the herders knew their animals individually, which is important in pedigree keeping (Table 11).

Different communities have strong attachment to various identification modes, which do not infringe on their traditional norms and cultures. Ear notching and branding were the major identification systems among the pastoral communities. This implies that there is no need to use ear-tags, banding, or any other artificial identification markers that conflict with the traditional beliefs of these pastoral people. Recognising the names herders give to animal populations is important because the “herder-named population” is the unit that pastoralists manage and use as bases for selection decisions. The name or description of a population as used by the herder may not only be related to physical characteristic(s), but could also relate to the original source of the breeding material. Both names and traits which define these names may also be related to the biological performance, e.g., body size, shape, colour, milk yield or quality and aspects of adaptation. Herders perceive these attributes at various stages of the animal’s growth and development. Clearly, the set of traits which farmers use to identify a ‘breed’ may be complex and are always deeply embedded in the culture and tradition of the community. Any attempt aimed at ‘improving’ or conserving the breed has to understand these complexities and must take them into account when developing intervention strategies.

### **5.3. Actual and theoretical and selection practices**

Sheep and goat keepers in northern Kenya have a clear vision of the ideal traits or characteristics of their respective flocks. In the selection of the breeding stock, they are normally guided by both individual and family information. From the parents’ side, it appeared that growth rate, size of the body and qualities of the offspring were traits considered important by almost all the respondents (Tables 12, 13, 15 and 16). In addition, the Rendille respondents considered milk yield and fat deposition among the sheep as important attributes. The Gabra herders would consider drought tolerance as an important quality of the parents when selecting for breeding. This generally implies that both the productive and adaptive traits are very important in the pastoral systems. The animal should produce what is enough for the family’s use and for the kid. In addition, it should be able to survive periods of droughts in the prevailing harsh environment. In case several potential breeding stock of equal ancestral quality was available, the pastoralists across both communities would select for big body size and the parents’ history. Being stronger than



others was emphasised by the Rendille while the animal's hardiness was considered as important by the Gabra community (Table 14 and 17).

The fertility traits were considered to play a role but were not mentioned in the higher ranks of importance. It becomes clear that the use of some of these terms are overlapping, e.g., big body size, fighting ability, playfulness and being stronger than others are either used as individual characteristics or a part of the composed trait "strength". Milk yield and growth are traits that are relatively easily observed, and have a comparatively high degree of heritability, and therefore exhibit high breeding progress. Measurement of milk yield is a complex process in the pastoral systems. The herders milk their small stock using a single container for all animals. The milk supply in this case is only influenced by the demand at that particular time, which is pegged on subsistence use and just enough milk for the kid. The significant relationship between the majority of the traits perceived to be important and the community (Table 12, 13, 14, 15, 16 and 17) ascertains the fact that qualitative traits form the backbone of any breeding 'goal' initiatives in these pastoral communities.

In the run up to the survey, it was evident that some variations existed between what characteristics/ qualities the pastoralists expected or targeted (theoretical) and the observed characteristics (actual) on their flock. For some of the characteristics (e.g., big body size), it was not clear how they were measured among the pastoral community. The Black head Persian sheep of the Rendille herders had a relatively smaller body size compared to the same breed of the Gabra although they share almost similar environmental conditions. Further discussions with the pastoralists depicted that the Rendille flock succumbed to helminthosis more than their counterparts in the Gabra community. These communities share common markets and therefore the larger breeds will attract higher prices than their inferior breeds. The Galla goat is superior to the SEAG in terms of body size and milk yield. The Rendille herders are always inclined to upgrade their local SEAG with the Galla goat. Nevertheless, in both communities, after a series of generations there appeared a good coat colour, which appeases the owner. The herders have a strong attachment with the colour of their flocks.

The ability of the animals to scavenge in the arid areas was evident (Figure 4). The flocks advance in the terrains and volcanic lavas from morning to evening in search of pastures. Their good health ascertains this. Fat deposition among the sheep was also evident in the actual selection process. It is worth noting that the pastoral communities rarely purchased the commercial fat products. In view of this, they harvest fat from their sheep for home consumption. The actual selection criterion was obtained through confronting the herder with the selected breeding buck and ram. However, during the interviews, majority of



the selected breeding males did not have their parents in the *manyatta* flock. The parents were either culled, sold, exchanged or even at the satellite camps (*fora*) and therefore their actual information could not be obtained. It therefore became difficult to perform any meaningful analyses to show the relationship between the theoretical and the actual selection processes in the pastoral systems.

With respect to breeding management, it appears reasonable for development organizations to start by trying to understand the present practices rather than prescribing a breeding scheme top-down. Unfortunately, traditional breeding practices have not been described to any great extent in the literature. This is in contrast to commercial breeding plans or, to a lesser degree, the animal breeding practices of smallholder farmers. Some pastoralists keep flocks that are so large that they can select breeding stock from within the flock and often favour particular breeds (Köhler-Rollefson, 2003). As people “who keep animals on natural graze and for whom animal breeding is economically and culturally dominant”, pastoralists usually have a highly complex indigenous knowledge system with regard to animal breeding. They inhabit marginal areas characterized by low and unreliable rainfall. The elaborate breeding strategies of pastoralists result in animals that are not only able to survive and reproduce in hostile environments, but are also fairly productive under the given constraints. These animals largely present closed gene pools, they can be very distinct and their distribution range corresponds with that of the ethnic groups. Since pastoralists keep animals under conditions very close to those obtaining in the wild, and without much protection against the weather elements and climatic extremes, their breeds may carry fitness traits of potential interest for maintaining the vitality of high performance breeds.

#### **5.4. Causes of differences between actual and theoretical selection practices**

Various factors contribute to the variation between the targeted and the observed characteristics within and without the flocks (Table 18). Pastoralists in northern Kenya regularly confront climatic shocks that plunge them into massive flock die-offs and loss of scarce wealth. Drought is perceived to be a major contributor to this effect. Definitions of drought are enormously complicated, not least because of the huge variety of climatic, geographical, socio-economic and cultural contexts within which it occurs. Nevertheless, drought is a protracted period of deficient precipitation resulting in extensive loss to livestock populations. This has led to animals that have small body sizes and poor health due to lack of essential pastures and water. At this period, animals walk very long distances in search of basic needs and at the end will be emaciated, leading to death. Converting any significant



share of the ASAL pastoralists' livestock mortality losses into sales could avert widespread and acute human suffering, and by conserving local wealth, might accelerate both flock recapitalization once range conditions improve, and more broadly, economic growth.

Access to veterinary and extension services in most pastoral areas remains very limited (Kosgey, 2004). This has also contributed to the loss of animals and even impaired growth and development of small ruminants, which affects the overall flock size, age and sex structure. Diseases and parasites are factors that have also affected the growth of animal populations (Table 18). Diseases, e.g., sudden deaths (*kang*) and neurosis (*siriko*) are prominent in these areas and affect growth of animal populations. Traditionally, the various pastoral communities and clans conducted raids and counter raids as an organized and governed survival mechanism, especially during periods of severe drought. For example, the Gabra herders would raid their Rendille counterparts, leading to indiscriminate crossbreeding between the Galla goat and SEAG. This may affect the genetic composition of the entire flock over several generations.

Socio-cultural beliefs also cause differences between the actual and theoretical selection practices (Table 18). As mentioned earlier, pastoral people are bound and protected by a tight web of traditions and rituals, which are rooted in a sober and basic traditional wisdom. A herder will not select a breeding stock with a spot at the belly because it is suspected to be a source of bad omen which kills the household head. A conspicuous white colour in the flock is believed to symbolise a large population of small ruminants and attract evil eyes that would lead to the death of animals in the flock. A black animal is a symbol of weakness. This implies that an ideal breeding stock that qualifies for selection, i.e., with big body size and being stronger than others may be culled on the basis of the traditional beliefs. In addition, a hornless breeding stock will not be selected for breeding. It is believed to produce similar offspring's that might neither be strong fighters nor attract higher prices in the market.

### **5.5. Design of sustainable breeding programmes for small ruminants**

A breeding programme is an organized structure that is used to genetically improve livestock populations. The first step in designing a breeding program is the definition of the breeding objective (Harris et al., 1984). The breeding objective is the direction in which the population has to be improved, and it includes all the traits and the relative weight given to each trait. Breeding objectives differ between populations, depending on the traits that have to be improved, and therefore also affect the structure of the breeding programme (Nimbkar

et al., 2002). A breeding programme consists of several components. The first component is data recording and collection. To select the best animals, the breeding values have to be estimated and that requires phenotypic data on selection candidates. The second component is breeding value estimation using the collected pedigree and performance data. The breeding value of an individual is its genetic value for a trait (or a combination of traits) that can be transmitted to its offspring (Falconer and Mackay, 1996). The third component is selection and mating. When information about the breeding values is available, the best animals can be selected, which implies that the parents to produce the next generation are chosen. After the selection process, only the chosen sires and dams are mated. The last component is the dissemination of genetic progress. This means that the genetic improvement achieved in the breeding population has to be disseminated into the production population (Olivier et al., 2002).

#### **5.5.1. Requirements for sustainable genetic improvement programmes**

For effective design of sustainable small ruminant genetic improvement programmes, the relative importance of the tangible and intangible benefits from small ruminants as well as environmental characteristics and limitations need to be clearly understood, and the genotypes to satisfy these roles correctly identified. For very good reason, majority of the pastoralists are better off keeping the indigenous animals, and focus should mainly be on the improvement of these genotypes (Kosgey, 2004). Therefore, assessment of variation within the identified population, and the proportion of variation that is genetic and can be exploited by selection for traits of interest are necessary. It is also crucial to recognize the importance and magnitude of genotype-by-environment interaction (Holst, 1999).

One of the greatest bottlenecks in genetic improvement programmes, especially under pastoral production systems in developing countries, is how to organize herders at the village level to effectively participate in breeding schemes (Jaitner et al., 2001). To reduce costs and ensure sustainability, genetic improvement initiatives must be practical, embrace the small ruminant keepers themselves, employ realistic approaches and use appropriate genotypes (Holst, 1999; Ahuya et al., 2004; Pitchford and Rege, 2005; Kosgey et al., 2006a).

#### **5.5.2. Community-based breeding organizations**

##### **Role of the organization**

The most important characteristic of a community-based breeding programme is that it is owned and controlled by the local community itself (Kahi et al., 2005). This means that



decisions are made collectively and that responsibilities are shared within the community. The overall function of a community-based breeding programme is the improvement of livestock genetic resources using scientifically based principles. This organization should also be able to recruit members, form collaborations with essential partners and organize for local financing of their activities. Specific tasks related to breeding include definition of the breeding objectives, design and facilitation of a performance recording system, including data recording and transfer to a central database, design of a system of selection and mating, provision of technical knowledge to farmers, importation of genetic material from other locations/ communities to prevent inbreeding and capacity building. The organization should possess the space (offices for computers), necessary materials, technology and knowledge to breed high quality small ruminants (Kahi et al., 2005).

An advantage of a community-based breeding programme is that resources, costs and benefits of the breeding programme are shared. For the farmers, this will reduce the risks of adapting a new breeding programme because an individual does not take the responsibility. By uniting farmers in a community, a larger animal gene pool for selection is created, which reduces the risk of inbreeding and enhances genetic improvement because of the resultant high selection intensity and accuracy. Being part of an organization allows the members to influence policy makers and have bargaining power over their resources. In addition, an efficient organization attracts more attention from development partners.

The advantages for the farmers as individuals include more knowledge of their animals' performance and of the performance of other farmers' animals because the organization will record the performance of all animals. This allows them to compare and to select the best animals for genetic improvement. In addition, individual membership in the organization gives one higher social status of being a registered breeder and assures the use of superior breeding stock (Kosgey et al., 2006a). Finally, farmers can receive a higher price and increase their livelihoods by sales of improved breeding stock. The fact that farmers themselves own the organization does not mean that there are no development partners, national extension services, donors, government agencies and other stakeholders involved. These stakeholders could play a role in ensuring long-term follow-up activities, providing advisory services to the organization, revising of present and future improvement strategies and human capacity building. However, the organization should not be over-dependent on partners outside the community but should gradually build its own capacity (Kahi et al., 2005).

## **Recruitment of members**

To form a community-based breeding programme, it is important that the members of the community are willing to join the organization. Criteria for membership of the organization could be the willingness to record animals and to use males from other flocks for mating, willingness to be organized, to work in a team and contribute financially to the organization (Hagmann and Drew, 2001; Kahi et al., 2005). To recruit members, farmers should be made aware of the advantages of being a member of the organization. Another way to attract members is by providing extension services to all members of the organization; especially veterinary services are highly appreciated by herders but are usually lacking in livestock improvement programmes. In Malawi (Wollny et al., 2002) and Kenya (Kosgey et al., 2006a), lack of extension services was considered to be a major constraint to livestock production programmes. Farmers in both countries ranked veterinary services as the most important.

Another way in which farmers' participation could be assured is by offering them incentives. Farmers have been proven to be more willing to co-operate if free medication, concentrates or semen is offered in return for participation in the organization and the recording of the animals (Faruque, 2000). Moreover, the supply of medication and nutrition not only persuades the farmers in joining the organization, but also works as a tool for the management of the farm by improving the health and productive conditions of the animals. To reduce the 'dependency syndrome' farmers should be encouraged to own and take an active role in the activities of the breeding programmes at the nascent stages. Data recording contributes to an overall improvement of the understanding of the different production systems (van der Werf, 2000a; Kosgey et al., 2006a). The recorded data provide information about the production and health status of the animals, and support the farmer in making management and culling decisions.

## **General structure of the organization**

The breeding organization could consist of two groups. In the nucleus group, farmers keep animals mainly for tangible benefits. The nucleus group is responsible for the selection of animals, and consequently for the rate of genetic progress achieved in the breeding flock. Therefore, they should possess sufficient technical knowledge and be able to identify genetically superior animals by performance recording. In the commercial group, farmers keep their animals for both tangible and intangible benefits. This group is dependent on outside sources (i.e., the nucleus group) for breeding material (Kahi et al., 2005). The nucleus



group should be responsible for the identification of newborn animals, collection of production data, and the transfer and keeping of information in a central database for production and pedigree certificates (Georgoudis and Baltas, 1998). In the commercial group there is hardly, if any, pedigree and performance recording. The organizations' staff should therefore provide the recording equipment and knowledge. In order for the nucleus group to provide the commercial sector with high quality breeding stock, members of the nucleus should make investments in obtaining superior breeding males. In the starting phase, credit could be provided by an NGO, government or other sponsor to purchase superior animals from outside the community. Another simpler and cheaper possibility is to screen the population for superior animals present in the community and to include the owners of these animals in the nucleus group. It is important to base the breeding program on the farmers' needs and on the available genetic material. Consequently, all economic groups of the community should be represented in the organization. Besides, improvement of animals should not be limited to just one or a few flocks because the industry-wide impact of genetic improvement depends on the dissemination of breeding animals (van der Werf, 2000b). There could be exchange of experiences and knowledge or animals between communities to improve the effectiveness of the organization and to have access to more superior genetic material.

The community-based breeding organization should consider both short- and long-term objectives. The short-term objectives are to genetically improve livestock for family needs, to provide sufficient nutrition and to increase the standards of living of the families in the community. The long-term objectives are the conservation of SrGRs and to increase the livelihood of the community as a whole. In most attempted efforts to set up community-based breeding programmes, women have been sidelined (Jaitner et al., 2001). For enhanced success, they should be involved at the initial stages of the breeding programmes.

### **The involvement of women**

In many traditional societies in tropical countries, including Kenya, women, children and the aged are the most vulnerable members of the society (Kosgey, 2004). Many women in these traditional societies are more likely than men to be credit constrained, have limited access to the wage labour market and their influence in household decision making is insignificant (Pitt et al., 2003). However, these women have a number of tasks and duties for which they are responsible, including specific animal tasks like herding, watering and

milking. Generally, they are responsible for most animal activities. It is therefore important to understand the role of gender in small ruminant breeding and production.

Women's priorities are usually different from those of men. First, men and women tend to keep different species. Larger animals such as cattle and camels are the responsibility of men while smaller animals such as small ruminants belong to women. Second, women are traditionally more aware of the nutritional aspects of their family's diet and small ruminants are used to secure food, protein, milk and cash (Bravo-Bauman, 2000). In contrast to women, men do not always use small ruminant products to increase their families' nutritional status (Sellen, 2003). Consequently, increasing the income of women will benefit the welfare of the family, especially of the children and the aged.

Women have many tasks and responsibilities with regard to small ruminants, and therefore will largely determine the success of the breeding programme. They should therefore be involved in training, education and other extension services. However, many extension services by development organizations target men, while women receive less than 5% of the worldwide extension services (Bravo-Bauman, 2000; Ingevall et al., 2002). Because of the traditional roles of men and women, men are seen as providers and decision makers while women are homemakers and nurturers (Quinn et al., 2003). Many projects have failed because information and training is given to men by extension agents and do not reach the women who have to execute these tasks. In addition, women should represent a fair share of the breeding organizations' staff and extension workers. It is important to make the male participants aware of the need for women to join the breeding organization and to improve their financial position. In the end, this will be beneficial for the community.

A village-based sheep production project in Togo was very successful because of the involvement of women's groups (FAO, 1988). These women had a relatively low status, did not own animals and were not taking part in decision-making. Uniting these women into a women's breeding group increased small ruminant productivity and family income. For pastoral/ extensive households in Kenya, where women are relatively subordinate in decision-making, the formation of separate women groups could be considered. In many smallholder families, women own animals (individually or together with their husbands) and are already participating in household decision-making (Kosgey, 2004). In that case, the women could be part of the general breeding organization.



### 5.5.3. Indigenous breeding practices versus conventional breeding

Pastoralists have very valuable knowledge about animal management and desirable traits but less knowledge on how genes are transmitted to the next generation and how to use information from relatives. Their elaborate breeding strategies result in animals that are not only able to survive and reproduce in hostile environments, but are also fairly productive under the given constraints. The present study investigated criteria used in the selection of breeding rams and bucks in pastoral communities in Kenya. Conventionally, the criteria investigated were for the selection pathways dams to breed sires (DS) and sires to breed sires (SS). In breeding programmes for most species, animals in DS and SS selection pathways are selected very intensely with a higher accuracy than in the other selection pathways, i.e., sires to breed dams (SD) and dams to breed dams (DD). Selection is based on breeding values estimated using either selection index methodology or best linear unbiased procedures (BLUP). Depending on the traits under considerations, these procedures require information on the performance of the individual and its relatives. Such procedures are too complex for the pastoralists to apply but this should not be misconstrued to mean that they do not consider the performance of the individual and its relatives when selecting animals to be parents of the next generation.

The pastoral communities involved in this study predominantly did individual and family selection, with much attention paid to the latter. Body size, offspring quality, milk yield, fat deposition and drought resistance were important qualities of the potential new buck's and ram's dam (DS). On the sires' side of potential breeding stock (SS), body size, offspring quality, mating ability, fat deposition and drought resistance ranked highly. Usually, genetic progress will be high for measurable traits (e.g., milk yield and body size) that have high heritabilities (Sölkner et al., 1998). However, selection for some of those traits may lead to animals that are more susceptible to the effects of prolonged droughts. Horst (1983) introduced the concept of "productive adaptability" to circumvent this problem. In the present case, it still remains to be shown how pastoralists measure performance in their breeding stock.

In this study, attempts have been made to predict genetic gain in traits perceived by the pastoralists to be important, namely, milk yield and body size using conventional methods (Table 19). At this level, it becomes important to establish whether use of indigenous intricate knowledge results in genetic improvement within their flocks. A selection index was therefore constructed. The traits in the breeding goal and selection criteria are the same and

included milk yield (MY) and live weight at 12 months (LW). These traits are of economic importance in the pastoral systems and therefore ranked highly in the selection criteria. The relevant economic parameters assumed among the breeding goal were obtained from recent literature (Kosgey, 2004). In this study, two selection pathways (SS and DS) were assumed with a population structure of 10 and 400 males and females, respectively. In SS and DS pathways, 2 males out of 10 and 100 females out of 400 were selected for breeding. The selection intensities for the two pathways were calculated from the proportion of selected animals and adjusted for small population size using the equation provided by Burrow (1972). The generation interval was assumed to be 2.5 years for both males and females. Usually under pastoral management, selection and culling decisions are made at juvenile age and it is difficult to quantify individual characteristics of the breeding males and female. Therefore, individuals were assumed to be selected based on pedigree information. In both pathways, information sources included records of LW in the sire and dam, and of MY in the dam.

Table 19. Genetic responses per year for traits in the breeding goal

| Selection pathways             | Milk yield (kg) | Live weight (kg) |
|--------------------------------|-----------------|------------------|
| SS                             | 0.32            | 0.21             |
| DS                             | 0.22            | 0.15             |
| Total gain across the pathways | 0.54            | 0.36             |

Genetic gains in both traits were higher in the SS than in the DS pathway (Table 19). Males have high selection intensities because only a few are required for breeding at any given time due to their high reproductive rate. However, improving LW could be difficult because marked seasonal changes in the trait may occur due to feeding. In addition, unpredictable date of animal disposal and fluctuations in animal markets may affect their prices (Seleka, 2001). Improvement of MY may be essential in influencing the number of animals available as replacement stock and for slaughter. The conventional method used ascertains that the use of these criteria would help the pastoralist achieve his breeding goal. It therefore becomes essential to include the herders at the initial stages of planning and executing any community-based small ruminant genetic improvement initiative where conventional methods will be applied.

## 5.6. Conclusions

It was evident that the pastoralists had elaborate animal identification systems. These included coat colours, ear notching and branding, with most of the information concerning



their animals kept through memory. This should not be regarded as backward or primitive but build on in the establishment of a community-based genetic improvement initiative. This study showed that pastoralists have deliberate breeding practices under the prevailing harsh environmental conditions of their environments. Selection was applied only on the male side, with only a few criteria, namely, body size and milk yield being predominantly considered. However, further longitudinal in-depth studies would be useful to shed light on how the animals' characteristics reflected in the selection criteria are actually observed or measured and compared, and how actual selection and culling decisions are made. There was a large variation between the targeted and observed characteristics within the pastoralists' flocks. This is largely attributed to the changes in climatic conditions. For instance, recurrent droughts have led to loss of animals in masses, thereby affecting their productivity overtime.

Interdisciplinary research validating IK through systematic documentation of the breeding practices and strategies for particular communities, and priority traits of their breeds should be encouraged. Genetic impact statements based on surveys of local breed concepts and existing breeding institutions (such as community breeding bucks and rams) should be a standard component of all rural development practices. Special breeds should be given official recognition as national assets. Breeding programmes that ignore these aspects are doomed to fail. It is possible to build on IK and use it as a starting point for community-based genetic improvement initiatives. Projects that do so have the potential to generate large benefits for the pastoral communities, and consequently sustainable utilisation of marginal environments.

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## APPENDICES

### Appendix I

#### CHARACTERISATION OF THE BREEDING PRACTICES OF SHEEP AND GOAT KEEPERS IN NORTHERN KENYA

Universität Hohenheim/Göttingen University/Egerton University/ ILRI-BMZ Collaborative  
Project

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### QUESTIONNAIRE

#### Sheep and Goats Survey – Northern Kenya

Questionnaire No.

Date of interview / /2005

1. Division Name \_\_\_\_\_ Code no.
2. Location Name \_\_\_\_\_ Code no.
3. Manyatta Name \_\_\_\_\_ Code no.
4. Village Name \_\_\_\_\_ Code no.
5. GPS reading \_\_\_\_\_ (to be filled in later)
6. Wealth category 

|      |        |      |                |
|------|--------|------|----------------|
| rich | medium | poor | not classified |
|------|--------|------|----------------|

 (tick one)

**The overall objective of the survey** is to characterise breeding practices for integration in community-based genetic improvement programmes.

**The specific objectives include:**

- To determine and assess pastoral animal identification systems,
- To determine actual and theoretical selection practices for breeding buck/ ram,
- To identify causes of the differences between the actual and theoretical selection practices,
- To establish where do farmers access their breeding rams and bucks.

**The activity is funded** by The German Federal Ministry for Economic Co-operation and Development (BMZ).

**The survey is being conducted** by the Universität Hohenheim/ Egerton University/ ILRI- Kenya.

# HOUSEHOLD

## General Information

1. Interviewee \_\_\_\_\_

2. Household head

Position in household

|                   |                          |
|-------------------|--------------------------|
| 1. Household head | <input type="checkbox"/> |
| 2. Spouse of head | <input type="checkbox"/> |
| 3. Brother        | <input type="checkbox"/> |
| 4. Sister         | <input type="checkbox"/> |
| 5. Son            | <input type="checkbox"/> |
| 6. Daughter       | <input type="checkbox"/> |
| Other (specify)   |                          |
| 7. _____          | <input type="checkbox"/> |

Gender

|        |                          |
|--------|--------------------------|
| Male   | <input type="checkbox"/> |
| Female | <input type="checkbox"/> |

Age (yrs)

|           |                          |
|-----------|--------------------------|
| ≤ 30      | <input type="checkbox"/> |
| 31-40     | <input type="checkbox"/> |
| 41-50     | <input type="checkbox"/> |
| 51-60     | <input type="checkbox"/> |
| 61-70     | <input type="checkbox"/> |
| > 70      | <input type="checkbox"/> |
| Not known | <input type="checkbox"/> |

3. Ethnic affiliation

Name \_\_\_\_\_

Code ☐

4. Number of people residing in household

|                   |                          |
|-------------------|--------------------------|
| Males             | <input type="checkbox"/> |
| Females           | <input type="checkbox"/> |
| Children < 15 yrs | <input type="checkbox"/> |

5. Land ownership

(Tick one or more)

|          |                          |                 |
|----------|--------------------------|-----------------|
| Own      | <input type="checkbox"/> | (specify) _____ |
| communal | <input type="checkbox"/> |                 |
| Other    | <input type="checkbox"/> |                 |

8. Livestock kept

(enter numbers in first column)

Most important species (rank up to 3: (1,2,3))

Numbers

(1,2,3)

|               |                          |                          |
|---------------|--------------------------|--------------------------|
| 1. Cattle     | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Sheep      | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Goats      | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Chickens † | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Camels     | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Donkeys    | <input type="checkbox"/> | <input type="checkbox"/> |

Other (specify)

|          |                          |                          |
|----------|--------------------------|--------------------------|
| 7. _____ | <input type="checkbox"/> | <input type="checkbox"/> |
|----------|--------------------------|--------------------------|

† Adult birds only

6. Livestock activity

Is livestock the major activity on your farm?

Yes ☐ No ☐

7. Sources of livelihood

(Tick first column as appropriate, rank level of source of livelihood in second column – 1 highest.)

|                           |                          |                          |
|---------------------------|--------------------------|--------------------------|
| 1. Livestock and products | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Remittances            | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Salary/ wages          | <input type="checkbox"/> | <input type="checkbox"/> |

Other (specify)

|          |                          |                          |
|----------|--------------------------|--------------------------|
| 4. _____ | <input type="checkbox"/> | <input type="checkbox"/> |
|----------|--------------------------|--------------------------|

|           |                          |                          |                          |
|-----------|--------------------------|--------------------------|--------------------------|
| 1. Cattle | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Sheep  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Goats  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



1. Do you keep records? (Tick one)

Yes

No

2. If yes, what kind of records do you keep?

(Ask an open question and tick any form of record kept in the first half of the box, and then rank the top three by writing in the second half of the box).

1. Date of birth
2. Weaning date
3. Castration
4. Culling
5. Performance
6. Health
7. Entries
8. Exits
- Other (Specify)
10. \_\_\_\_\_

| Record | Rank |
|--------|------|
|        |      |
|        |      |
|        |      |
|        |      |
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|        |      |
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3. How do you record the above characters?  
(Tick one or more)

1. Memory

2. Use of pen and paper

3. Calendar system

4. Matrilineal

5. Calamities

6. Events

Other (specify)

7. \_\_\_\_\_

| Record | Rank |
|--------|------|
|        |      |
|        |      |
|        |      |
|        |      |
|        |      |
|        |      |
|        |      |

4. How do you differentiate your animals from those of neighbours?

(Ask an open question and tick any system given in the first half of the box. Then rank top three by writing in the second half of the box 1 for first system, 2 for second, 3 for third).

1. Matrilineal naming system
2. Colour
3. Memory (Recall system)
4. Ear notching
5. Branding
6. Tattooing
7. Banding
- Other (specify)
8. \_\_\_\_\_

| I/d | Rank |
|-----|------|
|     |      |
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5. For how long do you recognize your animal?

(Ask each question and for each system, tick one box).

1. Names

2. Colour

3. Memory (Recall system)

4. Ear notching

5. Branding

6. Tattooing

Other (specify)

7. \_\_\_\_\_

| ≥ 1<br>Year | ≥ 3<br>Years | ≥ 5<br>Years | Over 5<br>Years |
|-------------|--------------|--------------|-----------------|
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|             |              |              |                 |
|             |              |              |                 |

6. Data sheet for the determination of actual animal identification

(A field experimental work will be undertaken on a data sheet of random numbers, tick Y if correct and N if no proper identification of the animal in question).

| Random number | Control | Trial 1 | Trial 2 | Trial 3 |
|---------------|---------|---------|---------|---------|
| 386428        |         |         |         |         |
| 847292        |         |         |         |         |
| 746209        |         |         |         |         |
| 329650        |         |         |         |         |
| 029542        |         |         |         |         |
| 785342        |         |         |         |         |
| 736540        |         |         |         |         |
| 903719        |         |         |         |         |
| 398823        |         |         |         |         |
| 567399        |         |         |         |         |
| 985993        |         |         |         |         |
| 846616        |         |         |         |         |
| 364883        |         |         |         |         |
| 548820        |         |         |         |         |
| 629747        |         |         |         |         |
| 827484        |         |         |         |         |
| 294774        |         |         |         |         |
| 497675        |         |         |         |         |
| 946648        |         |         |         |         |
| 676836        |         |         |         |         |
| 863981        |         |         |         |         |
| 934679        |         |         |         |         |
| 574788        |         |         |         |         |
| 357889        |         |         |         |         |
| 297854        |         |         |         |         |
| 386586        |         |         |         |         |
| 877722        |         |         |         |         |
| 683872        |         |         |         |         |
| 937674        |         |         |         |         |
| 238468        |         |         |         |         |

SHEEP AND GOATS    Breeding and selection practices

1. Primary reason for keeping ram/ buck

(Tick one)

1. Breeding

2. Socio-cultural

Other (specify)

3. \_\_\_\_\_

Ram(s)

Buck(s)

|  |  |
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|  |  |

2. Source and breed(s) of rams used in the flock

(Specify Breed name(s) if known, tick one or more boxes)

1. Own ram (bred)

2. Own ram (bought)

3. Ram donated

4. Ram borrowed

5. Communal area ram

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Common name

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**3. Source and breed(s) of bucks used in the flock**  
(Specify breed name(s) if known, tick one or more boxes)

|                       |
|-----------------------|
| 1. Own buck (bred)    |
| 2. Own buck (bought)  |
| 3. Buck donated       |
| 4. Buck borrowed      |
| 5. Communal area buck |

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Common name

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**4. At what age do you select a new breeding ram \_\_\_\_\_ and buck? \_\_\_\_\_**

**5. When selecting a new ram for breeding, what are the most important characteristics of the new breeding ram's mother? (Tick one or more and rank them)**

| Characteristic                                   |
|--------------------------------------------------|
| Big body size                                    |
| Conformation/ shape                              |
| Coat colour                                      |
| Good health                                      |
| Ability to scavenge                              |
| Taking a lot of water at once but less regularly |
| Temperament                                      |
| Meat quality                                     |
| Hair                                             |
| Skin                                             |
| Fertility                                        |
| Prolificacy                                      |
| Other (specify)                                  |

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**6. When selecting a new ram for breeding, what are the most important characteristics of the new breeding ram's father? (Tick one or more and rank them)**

| Characteristic           |
|--------------------------|
| Big body size            |
| Muscular/ strong fighter |
| Coat colour              |
| Offspring quality        |
| Drought resistance       |
| Disease resistance       |
| Temperament              |
| Meat quality             |
| Beauty                   |
| Mating ability           |
| Fertility                |
| Visual assessment        |
| Other (specify)          |

| Tick |
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**7. What are the most important characteristics of the new breeding ram from a group of several rams (age mates)? (Tick one or more and rank them)**

| Characteristic                     |
|------------------------------------|
| Big body size                      |
| Stronger than others               |
| Coat colour                        |
| Ability to suckle soon after birth |

| Tick |
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| Comment |
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|--------------------------------|--|--|--|
| Drought resistance             |  |  |  |
| Disease resistance             |  |  |  |
| Being more playful than others |  |  |  |
| Parents' history               |  |  |  |
| Beauty                         |  |  |  |
| Good health                    |  |  |  |
| Overall visual assessment      |  |  |  |
| Clear eyes                     |  |  |  |
| Other (specify)                |  |  |  |

**8. When selecting a new buck for breeding, what are the most important characteristics of the new breeding buck's mother?** *(Tick one or more and rank them)*

| <i>Characteristic</i>                            | <i>Tick</i> | <i>Rank</i> | <i>Comment</i> |
|--------------------------------------------------|-------------|-------------|----------------|
| Big body size                                    |             |             |                |
| Conformation/ shape                              |             |             |                |
| Coat colour                                      |             |             |                |
| Good body health                                 |             |             |                |
| Ability to scavenge                              |             |             |                |
| Taking a lot of water at once but less regularly |             |             |                |
| Temperament                                      |             |             |                |
| Meat quality                                     |             |             |                |
| Hair                                             |             |             |                |
| Skin                                             |             |             |                |
| Fertility                                        |             |             |                |
| Prolificacy                                      |             |             |                |
| Horns                                            |             |             |                |
| Milk yield                                       |             |             |                |
| Milking problems                                 |             |             |                |
| Mothering ability                                |             |             |                |
| Quality of offspring                             |             |             |                |
| Lack of dystocia                                 |             |             |                |
| Udder (size, shape, teat placement)              |             |             |                |
| Other (specify)                                  |             |             |                |

**9. When selecting a new buck for breeding, what are the most important characteristics of the new breeding buck's father?** *(Tick one or more and rank them)*

| <i>Characteristic</i>     | <i>Tick</i> | <i>Rank</i> | <i>Comment</i> |
|---------------------------|-------------|-------------|----------------|
| Big body size             |             |             |                |
| Muscular/ strong fighter  |             |             |                |
| Coat colour               |             |             |                |
| Offspring quality         |             |             |                |
| Ability to scavenge       |             |             |                |
| Disease resistance        |             |             |                |
| Temperament               |             |             |                |
| Meat quality              |             |             |                |
| Beauty                    |             |             |                |
| Mating ability            |             |             |                |
| Fertility                 |             |             |                |
| Overall visual assessment |             |             |                |
| Prepuce sheath            |             |             |                |
| Cannot tell               |             |             |                |



10. What are the most important characteristics of the new breeding buck from a group of several bucks (age mates)? (Tick one or more and rank them)

| Characteristic                     | Tick | Rank | Comment |
|------------------------------------|------|------|---------|
| Big body size                      |      |      |         |
| Stronger than others               |      |      |         |
| Coat colour                        |      |      |         |
| Ability to suckle soon after birth |      |      |         |
| Drought resistance                 |      |      |         |
| Disease resistance                 |      |      |         |
| Being more playful than others     |      |      |         |
| Parents' history                   |      |      |         |
| Beauty                             |      |      |         |
| Good health                        |      |      |         |
| Overall visual assessment          |      |      |         |
| Clear eyes                         |      |      |         |
| Tight prepuce sheath               |      |      |         |
| Hardiness                          |      |      |         |
| Others (specify)                   |      |      |         |

SHEEP AND GOATS selection practices/ factors

1. Are there differences between the theoretical and actual selection practices? (Theoretical is the target value while actual is practically what takes place on the ground, Tick one)

|     |    |
|-----|----|
| Yes | No |
|     |    |

2. What are the physical environmental factors affecting selection of a breeding ram/buck?

- 1. Vegetation
- 2. Soils
- 3. Land terrain
- 4. Availability (no factor)

| Rams   |      |
|--------|------|
| Factor | Rank |
|        |      |
|        |      |
|        |      |
|        |      |

| Bucks  |      |
|--------|------|
| Factor | Rank |
|        |      |
|        |      |
|        |      |
|        |      |

Other (specify)

5. \_\_\_\_\_

|  |  |
|--|--|
|  |  |
|--|--|

|  |  |
|--|--|
|  |  |
|--|--|

3. What are the precipitations factors affecting selection of a breeding ram/buck?

- 1. Rainfall
- 2. Temperature
- 3. Wind
- 4. Availability (no factor)

| Rams   |      |
|--------|------|
| Factor | Rank |
|        |      |
|        |      |
|        |      |
|        |      |

| Bucks  |      |
|--------|------|
| Factor | Rank |
|        |      |
|        |      |
|        |      |
|        |      |

Other (specify)

8. \_\_\_\_\_

|  |  |
|--|--|
|  |  |
|--|--|

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|--|--|

4. What are the management factors which affect selection of a breeding ram/buck?

- 1. Feeding
- 2. Watering
- 3. Access to veterinary care
- 4. Housing
- 5. Supplementation
- 6. Recording
- 7. Availability (no factor)

Other (specify)

8. \_\_\_\_\_

| Rams   |      |
|--------|------|
| Factor | Rank |
|        |      |
|        |      |
|        |      |
|        |      |
|        |      |
|        |      |
|        |      |

| Bucks  |      |
|--------|------|
| Factor | Rank |
|        |      |
|        |      |
|        |      |
|        |      |
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NOTES (briefly indicate any additional useful information in this section)

May God bless you!!

Asante Sana



Appendix II

Protocol for the actual selection practices

1. What quality of traits made you select this breeding ram/buck?

*Buck*

| Trait | Rank |
|-------|------|
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |

*Ram*

| Trait | Rank |
|-------|------|
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |

2. What made you select breeding buck/ram from this mother?

*Buck's mother*

| Trait | Rank |
|-------|------|
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |

*Ram's mother*

| Trait | Rank |
|-------|------|
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |

3. What made you select breeding buck/ram from this father?

*Buck's father*

| Trait | Rank |
|-------|------|
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |

*Ram's father*

| Trait | Rank |
|-------|------|
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
|       |      |
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