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Socio-economic factors influencing small ruminant breeding in Kenya

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Abstract

In order to design an effective small ruminant (i.e., goats and sheep) breeding program in Kenya and other areas with similar production circumstances, it is important to understand the socio-economic factors applying to the relevant production system. Information on these was obtained from a questionnaire carried out on both smallholders and pastoral/ extensive farmers in seven selected districts.

From the 458 responding households, 18% kept only goats, 34% kept only sheep, and 48% kept both species. Goats were generally ranked lower in popularity. The most represented breeds in the households were the indigenous East African goat and the Red Maasai sheep, and crossbred genotypes of goats and sheep. However, according to the farmers, the pure breeds were more popular than the crossbreeds. The households owned the majority of the used land for small ruminant production. In many cases, male household members were in control of the land. Animals were in most cases owned by the household head only or by both the household head and the spouse. The most important water source for animals was the river with the frequency of watering in the dry season in some cases being as low as once a day. Both males and females made most decisions in smallholder households. Women in the pastoral/ extensive systems participated less significantly in decision making than those in smallholder households, although they were responsible to many animal production related activities.

In general, it is important to take into consideration socio-economic factors that influence small ruminant breeding programs to enhance their success.

Keywords: Breeding, Kenya, small ruminants, socio-economic factors

Introduction

One of the first steps in designing sustainable community-based breeding programs in developing countries in the tropics is to understand the socio-economic factors that influence small ruminant (i.e., goats and sheep) breeding (Kosgey 2004). In the past, a number of livestock improvement programs have been implemented, with varying degrees of success. Reasons for failure of breeding programs designed by development agencies included not adequately understanding the needs and aspirations of the farmers. When farmers are not sufficiently involved in the design and implementation of a breeding program and when the breeding objectives of the breeding organizations are not in line with the farmers, the breeding program will often not be successful (Kosgey et al 2006a).

In Kenya, small ruminants are kept for both tangible (i.e., cash income from animal, milk and meat sales and for home consumption) and intangible benefits (e.g.savings, an insurance against

emergencies, cultural and ceremonial purposes) (Kosgey et al 2006a,b). A study conducted by Kosgey et al (2006b) ranked regular cash income as the most important purpose of small ruminants for both smallholders and pastoral/ extensive farmers. Furthermore, the socio-economic factors, including farmers' reasons (both tangible and intangible) to keep animals, the particular traits they consider important and their farm management practices were quantified. However, a number of other socio-economic factors are still unclear. Therefore, it is necessary to study some of the other socio-economic factors that could possibly influence small ruminant breeding. The aim of this study was to get a better understanding of the small ruminant production systems and breeding practices in Kenya.

Materials and methods

The socio-economic factors assessed of the household head/ decision-maker were: gender, ethnic affiliation, age and farming system (i.e., smallholder and pastoral/ extensive, and the goat-sheep farming systems). These factors could have an influence on the following variables: dependency ratio (i.e., number of people in the household depending on small ruminants), land ownership, animal ownership, farm size, source of animals, population trends in used breeds and crosses, flock management, preference for goats or sheep, household members responsible for goat and sheep activities, flock management, numbers of entries and exits within the previous 12 months of the survey and reasons for culling stock.

In the current study, the influence of the socio-economic factor "farming system" was studied on all variables while the influence of gender, age and ethnic affiliation of the household head/ decision maker was only studied on the variables that relate directly to animal breeding (i.e., preference for goats and sheep, and trends in breeds and crossbreds used).

To study the socio-economic factors possibly influencing small ruminant breeding in Kenya, a set of questionnaires developed by Rowlands et al (2003) and modified by Kosgey et al (2006b) were used. The household survey was used to obtain information about households by personally interviewing farmers. The questionnaires were administered to the farmers by teams of trained enumerators in selected districts in the central and western parts of Kenya. From each district, two divisions were picked and from every division two locations were selected. Most of the locations consisted of three or fewer sub-locations and all were sampled (CBS 1999). When a location consisted of more than three sub-locations, three were selected at random. At the end, the survey included 7 districts, 14 divisions, 28 locations and 68 sub-locations (see Kosgey et al 2006b for more details). The latter represented approximately 6% of all the sub-locations in the seven districts.

The household survey included three districts with predominantly mixed crop-livestock smallholder farmers (i.e., Nakuru, Nandi and Nyeri) and four districts with predominantly pastoral/ extensive farmers (i.e., Baringo, Laikipia, Narok and Trans-Mara). Not all districts were strictly smallholder or pastoral/ extensive farming districts: the divisions of Nyeri, Laikipia and Baringo districts contained areas inhabiting smallholders. In Nakuru district, one zone with pastoral/ extensive farmers was selected.

Data analyses

For the data analyses, the information obtained from the questionnaire was entered into a database in Microsoft Access. The structure of this database was the same as in Rowlands et al (2003). The farmers were divided into smallholder and pastoral/ extensive farming systems. Within these two farming systems, a sub-division of small ruminant species ownership was made (farmers owning only goats, only sheep or both species). The results are presented mainly in the form of descriptive tabular summaries. Chi-square (c^2) tests were carried out as appropriate to assess the statistical significance or otherwise of particular comparisons.

Results

Small ruminant species

In total, 459 respondents were interviewed including 218 smallholders and 241 pastoral/ extensive farmers. Of all respondents, 83 kept only goats (18%), 158 kept only sheep (34%) and 218 kept both sheep and goats (48%). Table 1 shows the percentage of households by farming system, gender, age and ethnic affiliation of the household heads.

Table 1. Percentages of households per farming system, gender, age and ethnic affiliation of the household head

Factors	Variables	Goats only	Sheep only	Both species	Total %
Farming system	Smallholder	18	48	33	47
	Pastoral/ extensive	18	22	60	53
Gender	Male	19	33	49	88
	Female	15	48	37	12
Ethnic affiliation	Kikuyu	19	49	32	40
	Kalenjin	24	27	49	31
	Maasai	8	18	74	25
	Other*	25	46	29	5
Age	<30	10	27	63	9
	31-40	18	29	53	21
	41-50	29	30	41	25
	51-60	16	37	47	20
	61-70	12	40	48	16
	>70	10	52	39	7
	Unknown	10	50	40	2
Total %		18	34	47	100

**included: Luhya, Luo, Kisii, Kamba, Somali, Kuria, Turkana, Njemphs and Teso*

In general, most households (47%) kept both small ruminants species. However, there were some differences between the households belonging to the different farming systems, gender, age and ethnic affiliation. Smallholders mainly kept sheep (48%), while pastoral/ extensive farmers mostly reared both species. There was also a difference between men and women, male farmers owned both species (49%) while female farmers kept sheep (48%) and both species (37%). However, the difference between the two species kept by women was not significant. The Kikuyu ethnic group was the largest group and the majority of them mainly possessed sheep (49%). The majority of the Kalenjin and Maasai ethnic groups kept both sheep and goats (49% and 74%, respectively). The other ethnic groups kept goats, sheep or both species in relatively equal proportions. However, the latter groups were not largely represented in the surveyed areas and the findings may not be absolute and should therefore be interpreted with caution.

The proportions of goats, sheep or both species kept might be a reflection of the farmers' preference for a particular species as he or she indicated in the questionnaire. The farmers' preference for a particular species was calculated separately for the goat farming system and the sheep farming system and expressed as the percentage of farmers who indicated that they preferred to keep only goats, only sheep or both species. The same question was asked to farmers in both the sheep and goat farming system. It was therefore possible that a farmer kept only one species but actually preferred to keep the other species for personal reasons. It was also possible that a farmer kept both species but preferred to keep only one. Households were considered to be in the goat farming system when they kept only goats or when they kept both sheep and goats. When both species were reared, only percentages for the goats were calculated in the goat farming system. This also applied for the sheep farming system. Households were considered to be in the latter farming system when they kept only sheep or when they kept both goats and sheep. When both species were reared, only

the percentages for the sheep were calculated in the sheep farming system.

From all the households, 31% preferred to keep only goats, 49% preferred to keep only sheep and 21% preferred to keep both species. In other words, 51% of all the households preferred not to keep only goats but sheep or both species instead. However, most farmers in the goat farming system indicated that goats were the most popular species in their opinion, although there were two exceptions. One remarkable fact was that from the household heads belonging to the Maasai ethnic group, only 22% preferred to keep goats, while 48% and 30% indicated that sheep or both species, respectively, were more popular. This difference was significant ($P < 0.01$). Household heads in the age class <30 years preferred to keep sheep (50%) more than goats (27%) or both species (23%) ($P < 0.10$). In the sheep farming system, 65% of the household heads preferred sheep, 18% both species and 16% preferred to keep only goats. There were no large differences in animal preference between the smallholder and pastoral/ extensive farming systems, gender, the age classes or the ethnic affiliations.

Breeds, origin and trends of breeds

The origin and trends of the pure breeds were studied in order to get information about where households obtained the different breeds and whether a particular breed was increasing, decreasing or stable in terms of popularity. The origin and trend of individual animals were not studied. The origins of all the crossbreds for both species were unknown because it was too complicated to determine the origins of all the possible breeds that could have been crossed with each other (e.g., an inherited animal is crossed with an animal from a different breed that is bought on the market). The most important goat breeds as indicated by smallholder farmers were the crossbreds (55%) and the indigenous East African goat (33%). Also the indigenous Galla goat or other pure goat breeds were kept, but in much smaller proportions. Smallholders inherited most of the pure goat breeds or bought them on the market (both 17%). For sheep, the most important breeds in the smallholders' perception were the crossbred (63%) and the indigenous Red Maasai (20%). Other pure sheep breeds such as the Corriedale, Dorper, Hampshire down, Merino and Romney Marsh were considered of less importance. The majority of the pure sheep breeds were inherited (8%) or bought on the market ($P < 0.005$).

The pastoral/ extensive farmers primarily kept the indigenous East African goat (69%) followed by the crossbreds (22%). The pure goat breeds in the possession of pastoral/ extensive farmers were inherited (33%) or bought on the market (27%). The differences between these sources were not significant. The most represented sheep breed in the pastoral/ extensive households was the indigenous Red Maasai sheep (49%) followed by the crossbreds (23%). The origins of the sheep breeds owned by the pastoral/ extensive farmers were the market (26%) and inheritance (30%). However, the difference was not significant. The majority of the smallholders and pastoral/ extensive farmers indicated that the pure goat and sheep breeds were increasing in popularity and therefore were considered as preferable compared to the crossbred genotypes.

Land ownership, animal ownership and dependency ratio

In Table 2, the percentages of landownership, land use, farm size and animal ownership are shown. Most of the households owned all the land they used. However, some households leased land or used another source of land. The latter included communal lands, group ranches or land of relatives. It is important to note that extensive farmers were not necessarily nomadic pastorlists. Instead, they were mostly sedentary with individual land ownership. This explains the high percentage (77%) of the pastoral/ extensive farmers owning the land they used, while 20% of them used another source of land, which included communal lands and group ranches.The difference between smallholders and pastoral/ extensive farmers using a different source of land was significant ($P<0.001$). The majority of the land that was owned by the households was in most cases controlled and owned by the men. There were only very few women owning land individually. There was a significant difference ($P<0.01$) in land ownership between women rearing only goats or both species (11%) and women keeping only sheep (16%). The majority of the land on the farm was used for grazing

(44% for smallholders and 55% for pastoral/ extensive) followed by the growing of crops (44% for smallholders and 31% for pastoral/ extensive). On average, the size of the farm was for smallholders 25 acres and for pastoral/ extensive farmers 74 acres.

The dependency ratio (i.e., number of people in the household depending on small ruminants) was on average seven for all smallholders and for pastoral/extensive farmers keeping only goats. On average, there were two males, two females and three children in these households. The number of people in pastoral/ extensive households keeping only sheep was on average one more, because these households had on average four children instead of three children. The pastoral/ extensive households keeping both species had on average five children, which gave them a dependency ratio of ten persons.

Table 2. Percentage of land ownership, land use and animal ownership per smallholder and pastoral/ extensive farming system

Activity	Smallholders	Pastoral/extensive
Land ownership		
Private land	93	77
Leased land	0	3
Other land	7	20
Total %	100	100
Land Use		
Grazing	44	55
Crops	44	31
Forest	5	9
Homestead	7	5
Total %	100	100
Animal ownership		
HH*	43	42
HH* and spouse	33	25
Sons	10	16
Spouse	8	6
Daughters	4	6
Others	2	5
Total %	100	100

** HH = Household Head*

Activities and decision making

In both smallholder and pastoral/ extensive farming systems, there were a number of activities that the household members were responsible for. An activity was considered important if the majority of the farmers answered "yes" to the question if there were household members responsible for that particular activity. The percentage of the households answering "yes" was then calculated.

The most important activities were herding and feeding for both smallholders and pastoral/ extensive farmers keeping goats (23% for both smallholders and pastoral/ extensive farmers) and sheep (27% for smallholders and 23% for pastoral/ extensive farmers). In smallholder households, herding and feeding was mainly the responsibility of females for households owning goats (35%) and sheep (35%). Also males in the smallholder households (22% for goats and 23% for sheep) and boys (21% for both goats and sheep) were responsible for herding and feeding but to a lesser extent.

In pastoral/ extensive households, goats were herded and fed by all household members but not to the same extent. Boys (27%) herded and fed the animals more frequently ($P < 0.001$) than males (16%) and girls (16%), but not more frequently than females (20%) and hired labour (21%). Also, boys herded sheep more often than males and girls ($P < 0.01$) but not more often than females and hired labour.

Other important activities were the purchasing, slaughtering, milking of animals and decision making about animal breeding and health. Shearing, making dairy products and selling them were not important activities. Breeding decisions were made mainly by the male members of the households owning goats (56% for smallholder males and 79% for pastoral/ extensive males) and sheep (62% for smallholder males and 76% pastoral/ extensive males). In the pastoral/ extensive households, animal health was also the responsibility of the male, but not in smallholder households where the decisions concerning animal health were not made significantly more by males than by females. The men decided on purchasing and slaughtering of animals while milking the animals was a women's task.

Women in the smallholder households participated more in decision-making than those in pastoral/ extensive systems, especially in the sheep farming system. Also, they participated more in the purchasing of animals (38% vs. 26%, $P < 0.005$), making breeding decisions (35% vs. 20%, $P < 0.001$), selling and slaughtering (37% vs. 25%, $P < 0.001$) and in making decisions about animal health (39% vs. 26%, $P < 0.10$). In the goat farming system, women in smallholder households only participated more than those in pastoral/ extensive systems in making breeding decisions about goats (37% vs. 18%, $P < 0.05$).

Flock management

In general, Kenyan farmers use two methods to provide water to their small ruminants, i.e., providing water at the household or taking animals to a water source at a certain distance from the farm. Majority of the smallholder farmers (65% for goats and 76% for sheep) provided water to the animals while the pastoral/ extensivefarmers brought their animals to their water source (77% for goats and 72% for sheep). A small percentage of the households used both watering methods (4% of all households). The difference in watering methods between dry and wet seasons was not significant. Most of the smallholders used river water as a major source of water during the dry season (44%) while they used both the river and rainwater in the wet season (26% each). For the majority of the pastoral/ extensive farmers, the river was the main source of water during the dry and wet seasons (44% in both seasons).

The distance to the farthest watering point in the dry season for most of the smallholders owning goats was less than 1 kilometer (39%) while most smallholders owning sheep had the source of water at their farmyards (43%). Pastoral/ extensive farmers had to travel between 1 and 5 km to reach their farthest watering point (52% for goats and 49% for sheep). In the wet season, the majority of all households keeping goats had the farthest water source less than 1 km from their farm yards (43% of both smallholders and pastoral/ extensive farmers). For most of the smallholders owning sheep, the water source was located directly at their farmyards (55%). However, pastoral/ extensive farmers had to travel between less than 1 and up to 5 km to their farthest watering point (73%). None of the households, in both dry and wet seasons had to travel farther than 10 km to reach the farthest watering point.

The frequency of watering in the dry season was for most households once a day (44% of all households) with the exception of smallholders owning sheep (43%) where water was freely available. This seems logical because these farmers had the watering source at their farmyard. In the wet season most of the animals owned by smallholders were watered freely (50% for goats and54% for sheep) while most animals owned by pastoral/ extensive farmers were watered once a day (44% for goats and 41% for sheep).

The water quality was judged by the enumerator as being good/ clear, muddy, salty or smelly. The quality of the water for most of the households was good in both dry season (78% of all households) and wet season (79% of all households).

Entries and exits of small ruminants

Most of the animals were born on the farm (90% for goats and 91% for sheep). If the animals were

not born on the farm, they were bought in many cases (7% for goats and 6% for sheep). Households bought mainly adult females for both goats and sheep (41% and 34%, respectively). Entries in the form of donations were for both goats and sheep 2%. Female weaner goats (35%) and male weaner sheep (32%) were the most popular donations. Only 1% of both goats and sheep were exchanged.

The majority of the animal exits were in the form of sales (43% for goats and 53% for sheep). Secondly, both goats and sheep exited through death (20% and 17%, respectively) and slaughtering (21% and 15%, respectively). Other exits were donations (7% for goats and 8% for sheep), exchange (5% for goats and 3% for sheep) or animals were stolen (4% for goats and 3% for sheep). Adult females were the animals that exited most (34% for goats and 35% sheep) followed by the adult males (22% for goats and 26% for sheep).

Reasons for culling

The main reasons for culling for both goats and sheep, and for both smallholders and pastoral/ extensive farmers were age of the animals (28%) followed by fertility (21%), small size (19%), health (13%), performance and temperament (both 3%). Other reasons included feed scarcity, overpopulation, drought, and prevention of inbreeding (2%), and conformation, colour and condition of the animal (1%).

Discussion

Socio-economic factors have an effect on animal and farm management, decision-making and the general perception of breed and species of the farmers. These factors will therefore affect the design and implementation of a breeding program. Without a good understanding of these factors, it would be very difficult to persuade the local farmers to fully participate and cooperate in a breeding program (Kosgey 2004). The factors, e.g., land ownership, farm size and animal ownership do not seem to be related to animal breeding directly, but are an important source of information on general household characteristics.

Land is required for the grazing of animals or for production of fodder. The concept of land tenure, however, might be a constrain to small ruminant production, and consequently also to small ruminant breeding. Tenure refers to the right that individuals have over their land and allows the holder to make management decisions about the use of the land (ILRI 1995). Lack of access to land is of particular importance to pastoral/ extensive farmers. The development of nature conservation areas, expanding agricultural areas and other land reformation projects have excluded pastoralists from their traditional grazing lands, causing them to move further away or to overgraze areas where they still have access (Quinn et al 2003). To solve the problem of overgrazing, many areas have been converted into private property of the farmers because it is being assumed that this is the most efficient and sustainable form of land use (Upton 2004). However, this does not always need to be the best solution because individual tenure could deny farmers extensive rangelands (ILRI 1995). According to the Upton (2004), the concept of communal lands has existed for many generations and allows all members of the community to share equally in the productive use of the resource. Communal lands could be sustainable when non-members are excluded, rights are clearly defined and understood, and when there is cooperation between members living in a common area.

Only half of the land owned by the households was used for grazing while most of the remaining land was used for growing crops for household consumption. A small percentage of the land was forest, which was mainly used by women to collect fuel wood, medicinal plants and foodstuffs. Men used forests for building materials and income generating activities such as charcoal making (Quinn et al 2003). However, without sufficient land, grazing possibilities for animals might not be adequate. This problem will increase when, through genetic improvement, the size or number of animals on the farm increase.

Information on animal ownership is of importance in a genetic improvement program. If the person

who keeps these animals is not the decision-maker about the animal, it will be difficult to include the animals in a breeding program because the caretaker cannot decide on mating of the animals and on allowing the animals to be performance recorded. Factors such as flock management are important to detect the major constraints to animal production and breeding. Low watering frequencies might be a cause of health problems or reduced growth rate. These problems should be solved first if the production of the animals has to be improved.

The factor dependency ratio might be of importance to policy makers because the dependency ratio of the household members might be related to the average farm and flock sizes. A study by Sellen (2003) showed that the domestic flock size was predicted by the number of adult people in the household, and was positively associated with household consumption needs. It was also found that all household livestock: human ratios were positively associated with flock size, irrespective of whether the domestic flock was owned by the household or not. It seems therefore natural that pastoral/ extensive households with larger dependency ratios than the smallholders also have larger flock and farm sizes.

In the current study, some differences were found in the management and perception of the farmers between the smallholder and pastoral/ extensive farming systems, households keeping goats or sheep, the different ethnic groups, the age classes and gender. These differences have to be considered as much as possible when designing a breeding program in order to involve the farmers and to increase the chance of successful genetic improvement. Of course, it is not possible to include all the different factors at the same time, especially when the deviating group is a minority. But factors that apply for the majority of the households should be included in the breeding program. For instance, younger farmers tended to keep more pure breeds than mixed crosses compared to older farmers who kept the mixed crosses in equal or higher proportions. Consequently, it can be concluded that the popularity of the pure breeds (primarily the indigenous East African goat and the Red Maasai sheep) is increasing in the perception of younger farmers. This can be confirmed by the fact that the majority of the farmers indicated an increasing trend for the indigenous pure breeds. A breeding program could aim at improving these breeds in both smallholder and pastoral/ extensive farming systems. Also, when a group with common preferences and perceptions live in the same area, a breeding program could be designed to take advantage of these. This applies for the different ethnic groups, who traditionally share a common area. Smallholders share common areas (i.e., Nakuru, Nandi and Nyeri districts), which is different from the pastoral/ extensive farmers (i.e., Baringo, Laikipia, Narok and Trans-Mara districts) due to differences in the potential of the land. These geographical separations make the design of different breeding programs possible, based on the different socio-economic needs of the different ethnic groups or the smallholders and the pastoral/ extensive farming systems. A phenomenon that should be taken into account when animals have to perform in different environments (the medium-high potential areas of the smallholders and the low-medium potential areas of the pastoral/ extensive farmers) is genotype by environment interaction (G x E interaction). In case of G x E interaction, different genotypes have a different sensitivity to changes in the environment. This means that a genotype that performs best in a smallholder environment might not be the most suitable animal in a pastoral/ extensive environment.

Further research is needed to understand why one animal species is more preferred to the other. The number of households owning only goats was significantly lower than the number of households owning only sheep or both species. In addition, one remarkable fact is that 51% of the households in the goat farming system preferred not to keep only goats but sheep or both species instead, indicating low acceptance to own goats. It can therefore be concluded that sheep is the most popular species. The reason for this did not become clear in this study. However, a possible reason that goats are kept although sheep are preferred might be that sheep are slow movers and goats are kept to encourage the sheep to move faster (Williamson 1949; Mbuku 2006). Fast movement of animals is especially important for pastoral/ extensive farmers who cover large distances with their flocks in search of water. According to Morand-Fehr et al (2003 2004), another reason which favours the keeping of goats is the fact that they are capable of eating bushes, shrubs and range vegetation which can not be eaten by sheep or cattle. Therefore, the feed demands of goats are not competitive

with that of sheep and cattle, which is an advantage to the resource-poor farmers. A reason why goats are less popular than sheep could be that they are difficult to keep inside fenced paddocks and are frequently accused of destroying crops, which gives them a bad image (e.g., Kiwuwa 1992). The reasons for animal preference should be investigated further because it may have an influence on the implementation of a breeding program. Farmers who are not satisfied with their animals might not be willing to put effort in improving those animals.

Especially in the smallholder farming system, women played a remarkable role in decision-making. Although this survey does not clarify if women perceptions and preferences were different from those of men (except that for an unknown reason, women tended to keep mixed crosses while men mostly kept pure breeds), women should be involved in a breeding program. In other countries, women are owners of small ruminants. For instance, Jaitner et al (2001) showed that in The Gambia, women owned large numbers of small ruminants, and that they were the majority of the goat owners. However, the men owned the majority of the sheep. The current study showed that Kenyan women also owned small ruminants, but their number was much lower than that of the men. Unlike The Gambian women, Kenyan women mainly kept sheep or both species. According to Kosgey (2004), women could be trained on animal production techniques. Children of the household could also be involved and trained because they are responsible for tasks like herding and feeding, and therefore have good knowledge about their animals, which could be useful in improving the overall management of small ruminants.

Conclusions

- The majority of the surveyed households indicated that the indigenous East African goat and the Red Maasai sheep, and the crossbred goats and sheep were the most popular genotypes. A breeding program should therefore focus on improving these breeds according to farmers' preferences. A large percentage of the farmers had to travel up to 5 km to water their animals. This, coupled with the normally high disease incidence and low availability of high quality feed, requires serious thought on the traits to focus on in genetic improvement. Therefore, important traits that should be included in the breeding program are disease resistance, the ability to cope with poor quality water and nutrition and productivity traits. Another important trait is fertility because farmers have indicated that fertility problems are an important reason for the culling of animals.

- Several other factors might be of importance when designing a small ruminant breeding program. When small ruminant productivity has to be improved, it should be taken into consideration that a relatively high number of the pastoral farmers do not own all of the land they are using, that access and use of land might be a problem, and that food and water are not always available in sufficient quantities. Also, the activities and decisions-making processes relating to small ruminant production and breeding might influence a small ruminant breeding program. Because women were involved in many small ruminant production activities and decision-making, they should also be encouraged to play a more significant role in small ruminant breeding.

- Selective breeding of small ruminants is not (yet) applied effectively in Kenya. A forerunner of the current study indicated that both the smallholder and the pastoral/ extensive farmers ranked breeding purposes of animals lowly. The mating of animals in these systems is largely uncontrolled (see Kosgey et al 2006b for details), and prevention of inbreeding was not mentioned as an important reason for culling animals. In order to genetically improve animals and to prevent inbreeding, superior animals should be selected and proper mating schemes designed. Due to deficient infrastructure in many places in Kenya and because of different socio-economic preferences between different farming systems, ethnic groups and gender, it would be difficult to design large-scale breeding programs. Consequently, it is better to unite the households of a community in a local, small-scale community-based small ruminant breeding organization, seriously paying attention to socio-economic factors to enhance

success of genetic improvement programs.

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