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Smallholder Goat Breeding Systems in Humid, Sub-Humid and Semi Arid Agro-Ecological Zones of Uganda

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Abstract: A study was conducted in three districts (Arua, Soroti and Sembabule) in Uganda to characterise the goat breeding practices in Uganda. A set of detailed structured questionnaires was used to collect information from 160 goat owners in one-visit-interviews. Goats have multi-functional roles, though mainly kept as a regular income source in all the three districts. Goats were mainly acquired by buying while removal was by selling. Mating was generally natural and uncontrolled. In each village, less than 20% kept their own bucks. Breeding does were selected mainly because of performance, birth type and body size while bucks were chosen mainly on the basis of growth rate and body size across all districts. There seems to be a non quantifiable level of inbreeding depicted by the long duration (up to 4.0 years) buck owners take with their breeding bucks, coupled with the poor record keeping. Tolerance to disease was the only adaptive trait merely reported as a little considered trait, as they tended to consider such traits as naturally given to indigenous livestock. Although majority of the goats kept were indigenous, there appears a clear trend from pure indigenous towards cross-breeds. It can be concluded that, although from different ecological zones, goat keepers from Uganda seem to have similar realistic breeding strategies.

Key words: Selection Criteria · Goat Acquisition · Disposal · Mating system · Buck · Doe

INTRODUCTION

Goats (*Capra hircus*) are widely spread in the tropics and are important to the subsistence, economic and social livelihoods of a large human population in these areas [1-3]. The agricultural potential in the tropics varies and consequently, a wide array of livestock production systems with different production objectives and priorities, management strategies and practices are found [4]. The major ones in Uganda according to Mbuza [5] are the smallholders, found mainly in medium-to high-potential areas, who practice mixed crop-livestock farming. The pastoral farmers are found mainly in the medium to low-potential areas and rely on livestock as the main source of livelihood. Despite their importance, few studies have elaborated on sustainable improvement programmes for the goats in Uganda and the tropics at large. In a submission to increase livestock productivity and through experience, farmers have come to understand that the best results are obtained by crossing the best local goats with exotic breeds [6]. This has raised concern over the fate of Mubende and SEA types and efforts for their conservation for h present and future use. This concern is inspired by the fact that the genotypes of the improved indigenous breeds may be required to upgrade or replace low producing goats in harsh nomadic environments where exotic goats cannot survive. Another cause for concern is the fact that the directions of future demand cannot be predicted with any certainty. Therefore, improvement programmes are necessary to increase and sustain the productivity of these goat breeds to meet the demands of the human population. Most genetic improvement programs tend to focus on single market driven traits such as milk or meat production in isolation from environmental constraints and broader livestock system functions which livestock perform in developing countries [7]. In addition, the development of genetic improvement programmes for livestock will only be successful when accompanied by a good understanding of the production systems and when

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simultaneously addressing several constrains-e.g.; feeding, health control and management [8]. The production systems under which Mubende and the small east African goat breeds are kept vary in many aspects. The demand on the goats made by the livestock keepers also vary. This could be reflected in the differences in the selection and breeding criteria and breeding goals between the goat keepers. The study attempts to provide a better understanding of the breeding systems under which Ugandan are kept and complements previous studies [1, 9]. This will help in the documentation of indigenous knowledge with a focus on breeding aspects and to use such information to provide a basis on which subsequent sustainable breed improvement programme of these peculiar genetic resources might be achieved.

MATERIALS AND METHODS

Area of Study, Location and Climate: The study was conducted in the districts of Soroti, Arua and Sembabule (Fig. 1). According to FAO [10], Sembabule is located in the semi-arid area, Arua in the humid area, while Soroti is located in the sub-humid area. h Sembabule and Soroti districts form part of the cattle corridor [11, 12], Sembabule lies in the central part of Uganda at an altitude of 1,200m–1,500m and between latitude 31°25'E and longitude 0°. Soroti is located in the East-Northeast of the country at altitude of 1036-1127m, latitude 33°35'E and longitude 1°45'N while Arua lies in the North West of Uganda forming part of River Nile's basin at an altitude of 610-1388m and between latitude 31°15'E and longitude 2°55'N. All the three districts receive a bimodal rainfall and prolonged dry season from December to March [13]. The inhabitants of Sembabule mainly are the Baganda, Banyankole and Banyarwanda. Soroti is inhabited by the Iteso. While Arua is occupied by the Lugbara, Madi and Kakwa people. In all these areas, the communities are characterised as agro-pastoralists with production systems, characterized by minimal management inputs in terms of breeding, nutrition and disease control and are mainly traditional and subsistence oriented.

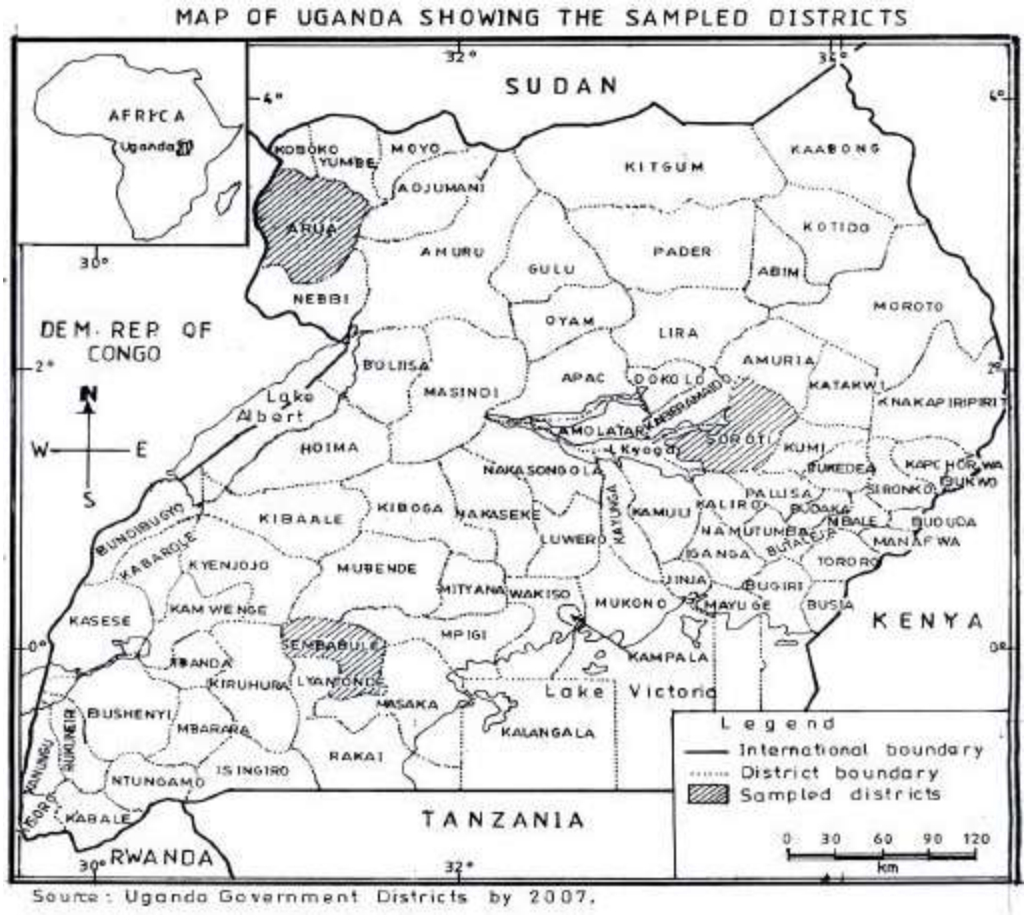

Fig. 1: The sampled districts for the study

Sampling and Questionnaire Methodology: A household survey was undertaken through questionnaire guided interviews with goat owners in selected districts of Soroti (SEA/Teso goat dominant), Arua (SEA/Lugware goat dominant) and Sembabule (Mubende goat dominant) in Uganda. The survey was carried out from May to July 2008. The survey areas within each district were replicated at 2 levels, i.e., two sub-counties and two villages per parish were picked in each district using prior information obtained from the field staff. A total of 6 sub-counties, 6 parishes and 12 villages were sampled in the three districts. This was based on ease of accessibility to the areas and flocks. Due to the limited number of buck keepers in these villages, all buck keepers were interviewed, while doe owners were selected at random. Interviewed households were picked from only those with goats during the sampling. A minimum of five households per village owning goats were sampled for the household survey. Some guiding data on households in the villages were obtained from local authorities. The exercise was conducted in the afternoon hours when farmers were from their fields.

Data Collection: All data were obtained from direct interviews and/or observations. A total of 160 households were interviewed using a set of structured questions which are a slight modification of those designed for livestock breed survey in the Southern African region [14]. They included 40 from the district of Sembabule, 60 from Soroti and 60 from Arua. Most questions were open ended. The answer given by the farmer was ticked against a prepared list in the questionnaire and then, where appropriate, ask the farmer to rank them. For some exceptions, the enumerator went through a list of predetermined traits one by one and asked the farmer to rank them. Personal observations considered to supplement the responses were recorded.

Information were collected on general household characteristics, purposes of keeping, traits of importance, breeding management and selection criteria, disposal and acquisition of goats. To obtain credible information, goat keepers were asked to rank the above data in order of importance. The degree of importance decreased with increasing rank i.e. 1 was most important reason or way.

Data Analysis: Data were analyzed using the Statistical Package for Social Sciences [15] statistical software where means values were generated. The level of agreement between respondents of the same district was assessed using Kendall's coefficient (W^2). The reason for keeping goats, selection criterion, way of acquisition and removal were expressed as an average rank. According to the average rank of each trait, a hierarchical order was then made within each region. Results were presented in the form of descriptive tabular summaries.

RESULTS AND DISCUSSION

Reason for Goat Keeping: Table 1 presents reason of keeping goats and the ranking of these purposes by breed type. Indigenous goat breeds serve several functions that differ across and within districts. The results have stressed the relative importance of tangible benefits of farming goats (i.e. regular cash income, meat, skins and manure) versus intangible benefits (i.e. Wealthy accumulation, customary norms and insurance against emergencies). Majority of the goat keepers in all study areas consider the primary reason for keeping goats to generate income from the sales of the animals. There was a significant ($p < 0.0001$) high level of agreement (0.83, 78 and 72) in Sembabule, Soroti and Arua, respectively observed among respondents for the ranks. Similar findings have been reported [1].

In all the districts, goats are a direct source of income, which is realized by exchange for cash. However, disposal of goats when in money crisis indicates most farmers sell goats with outs initial or proper planning and thus are likely not to benefit much from sales. Meat production is very important and was ranked between 3.45 and 5.08. Meat production was generally ranked third and/or below provision of regular cash income. This indicates the importance of inclusion of meat production traits in any breeding programme aimed at goats in these areas.

Milk production was least important, with average ranking between 7.83 and 7.97 among the goat farmers across the three breed types. This unpopularity could be attributed to tradition were only cow milk is considered important.

Insurance, customary norm and wealth accumulation were highly ranked emphasizing the goats' role of intangible functions. Insurance plays a vital role especially among SEA/Soroti (average rank, 1.95) and SEA/Arua (average rank, 2.02) goat keepers. In Sembabule, it ranked relatively (average rank, 4.38) lower.

The use of indigenous goat breeds as a source of manure was only much reported in Soroti and Arua districts. This could be explained by the fact that majority of the farmers in there were involved in h crop and livestock farming and recognized the importance of manure as a fertilizer. The manure from cattle was

Table 1: Reasons for keeping goats as ranked by respondents

	Rank (mean rank)[1]		
Reason	Sembabule (n = 40)	Soroti (n = 60)	Arua (n = 60)
Regular cash income	1 (1.00)	1 (1.66)	1 (1.90)
Wealth accumulation	2 (1.90)	4 (3.98)	5 (5.04)
Meat	3 (3.45)	3 (3.08)	3 (2.98)
Customary norm	4 (4.21)	5 (5.06)	4 (4.06)
Insurance	5 (4.38)	2 (1.95)	2 (2.02)
Skins	6 (6.03)	7 (7.02)	6 (6.06)
Manure	7 (7.10)	6 (5.90)	7 (6.96)
Milk	8 (7.83)	8 (7.97)	8 (7.94)
Kendall's coefficient (W)[2]	0.83**	0.78**	0.74**

[1]Means of rankings (the lower the rank the greater the importance) of the reason for keeping goats

[2]W ranges from 0 (no agreement) to 1 (Total agreement) and the higher the value the higher the level of agreement between respondents in a district

**P < 0.0001

Table 2: Ways of acquiring goats as ranked by owners.

	Rank (mean rank)[1]		
Way of acquiring	Sembabule (n = 40)	Soroti (n = 60)	Arua (n = 60)
Born	1 (1.14)	1 (1.00)	1 (1.00)
Bought	2 (1.66)	2 (2.00)	2 (2.00)
Inheritance	3 (3.00)	3 (3.00)	3 (3.04)
Bride price	4 (4.00)	5 (5.00)	4 (4.00)
Exchange for food crops	5 (5.00)	6 (6.00)	6 (5.96)
Exchange for other livestock	6 (6.00)	4 (4.00)	5 (5.00)
Caring for others	7 (7.00)	7 (7.00)	7 (7.00)
Gifts	8 (8.41)	8 (8.11)	8 (8.02)
Loans	9 (8.85)	9 (8.89)	9 (8.98)
Kendall's coefficient (W)[2]	0.64**	0.48**	0.55**

[1]Means of rankings (the lower the rank the greater the importance) of the way of acquiring goats.

[2]W ranges from 0 (no agreement) to 1 (Total agreement) and the higher the value the higher the level of agreement between respondents in a district.

** P < 0.0001

the favourite as house construction material and as fuel. In Sembabule district goat manure was not important compared to cattle manure since their cattle herd sizes were relatively larger to provide enough manure for h construction and fuel. This may be due to the fact that the farmers in Sembabule are not much engaged in crop production and hence there is no competition between activities (Construction / fuel vs. fertiliser).

The use of indigenous goat breeds as multipurpose animals is a common phenomenon in East Africa. This has arisen from the need to extract more than just meat and milk, in the quest to maximise output from these animals that can survive and reproduce under the harsh environmental conditions of the tropics. The development of specialized single purpose breeds, for the exclusive production of either meat or milk, is not a suitable option for the study areas or for other areas where indigenous goats are popular. Such livestock development strategies targeted solely either milk or meat production while ignoring the farmers' primary interest in livestock as providers of several functions may not attract committed farmer participation. Duo-purpose objectives other than those with single purpose (meat) have been reported to give higher profits in breeding Programmes in cattle [16]. The functions required of indigenous animals, influence the traits desired by farmers from the viewpoint of genetic improvement. Therefore, the component traits/attributes need to be identified carefully before deciding what breeding or livestock development objectives should be adopted.

Goat Acquisition and Disposal: Knowledge about ways of acquisition of breeding stock and disposal is important in assessing the breeding practices of farmers. Methods used to acquire goats included; new born, buying, inheritance, exchange of other livestock or food crop, dowry and gifts (Table 2). Generally the ways were similar in all districts except for exchange of other food crop and dowry which were more done in Soroti and Arua. Similar ways of acquisition have been reported among

Table 3: Way of removal of goats from the farm as ranked by owners

	Rank (mean rank)[1]		
Way of removal	Sembabule (n = 40)	Soroti (n = 60)	Arua (n = 60)
Sold	1 (1.00)	1 (1.00)	1 (1.00)
Died	2 (2.20)	2 (2.06)	2 (2.06)
Slaughtered for ceremonies	3 (3.00)	5 (5.00)	6 (6.96)
Bride price	4 (4.03)	3 (3.00)	3 (3.00)
Exchange	5 (4.97)	4 (4.00)	4 (4.00)
Stolen	6 (6.17)	7 (6.56)	7 (6.68)
Slaughtered for home use	7 (6.86)	6 (6.08)	5 (6.00)
Given out as gifts	8 (7.97)	8 (8.00)	8 (7.80)
Kendall's coefficient (W)[2]	0.61**	0.53**	0.60**

[1]Means of rankings (the lower the rank the greater the importance) of the way of removal of goats.

[2]W ranges from 0 (no agreement) to 1 (Total agreement) and the higher the value the higher the level of agreement between respondents in a district.

** P < 0.0001

goat keepers in Uganda [9]. Across all study areas most households (72% on average) generally reported goat sales within 12 months preceding the interview. Significantly ($p < 0.0001$) high and positive degree of agreement (0.64, 48 and 55) in Sembabule, Teso and Arua, were seen among the respondents for their ranks, respectively.

Disposal (Table 3) was by sales, slaughter, deaths, exchange for other livestock and crops, thefts and donations in that order. Donations were generally ranked low in terms of either acquisition and/or removal in all districts. Variations among districts were on slaughter which was more in Sembabule, while Soroti and Arua superseded Sembabule on dowry. Goats were disposed in form of sales, slaughter, deaths, donations, thefts and exchange. The mode of expenditure across all districts was similar. Goats are sold any time when the household is in a money crisis and/or when in need of a substantial amount of money for expenses such as medical bills, school dues and food. Level of agreement was significant ($p< 0.0001$) and positive i.e. (0.61, 53 and 60) in Sembabule, Soroti and Arua, for the ranks, respectively.

Breeding and Mating Systems: Households owning indigenous breeds were predominant across all the study areas, followed by their crosses. The pure exotic were the least in number. At the time of the survey, the main practiced breeding systems were pure indigenous across all the districts. Soroti and Arua dominated the picture with 95.56 and 87.88% respectively, while Sembabule district had the lowest percentage for pure indigenous (43.86%).

Cross breeding was most practiced in Sembabule district (41.86%) which was far greater than for Arua and Soroti districts (12.12 and 4.44%, respectively). Pure exotic breeding system was not popular as was only noticed in Sembabule district, with only 14.5% of the respondents. Results on prospects for future breeding systems indicated a likely shift from pure indigenous to crossbreeding. Sembabule farmers topped the list with 87.18, Arua with 66.67 and 53.33% for Soroti district. This means that crossbreeding is likely to increase twice as much in Sembabule district, 12 times for Soroti and 10 times for Arua goat farmers.

In all the three districts the number for pure indigenous breeding system was surpassed. Given the high levels of uncontrolled mating this might expose the indigenous breeds to genetic erosion or even extinction. The low level for adoption of pure exotic breeding system is explained by their poor adaptability to the harsh environment and hence not easy to manage.

Uncontrolled natural mating was the predominant mating system (100%) among goat keepers. Uncontrolled mating was therefore, associated with the parturition distributed throughout the year. An advantage of natural uncontrolled mating is that it allows for all year round breeding. Communal/uncontrolled mating was ranked second in all the districts (67.7, 84.4 and 78.8%) for Sembabule, Soroti and Arua districts respectively while, AI was very unpopular or nonexistent. For natural controlled mating, the breeding bucks used were mainly owned individually for pure indigenous, while bucks used for crossbreeding were owned by the relatively rich category and/or group bucks rotated among the resource poor farmers. Uncontrolled mating, small herd sizes together with poor record keeping on pedigree is expected to result in severe inbreeding in these flocks [17]. Equally important to note is the fact that bucks were kept up to 4 years. Communal grazing which is an affordable remedy for in breeding [14] was rarely practiced by farmers in the survey.

Table 4: Selection criteria for a breeding buck

	Rank (mean rank)[1]		
Trait	Sembabule (n = 40)	Soroti (n = 60)	Arua (n = 60)
Body size	1 (1.17)	1 (1.00)	1 (1.02)
Growth rate	2 (1.97)	3 (2.73)	3 (3.09)
Fertility	3 (2.86)	2 (2.31)	2 (2.08)
Temperament	4 (4.07)	7 (7.05)	5 (4.96)
Color	5 (5.00)	4 (4.06)	4 (4.08)
Body conformation	6 (6.00)	5 (4.92)	6 (6.04)
Tolerance to diseases/parasites	7 (6.84)	7 (6.05)	7 (6.92)
Horns	8 (7.95)	8 (7.94)	8 (8.00)
Kendall's coefficient (W)[2]	0.86**	0.68**	0.74**

[1]Means of rankings (the lower the rank the greater the importance) of the reason for keeping goats.
[2]W ranges from 0 (no agreement) to 1 (Total agreement) and the higher the value the higher the level of agreement between respondents in a district.
** P < 0.0001Table 2

Table 5: Selection criteria for breeding does as ranked by owners of goats

	Rank (mean rank)[1]		
Trait	Sembabule (n = 40)	Soroti (n = 60)	Arua (n = 60)
Body size	1 (1.14)	1 (1.08)	1 (1.00)
Fertility	3 (2.86)	3 (2.92)	2 (2.22)
Birth type	2 (2.03)	2 (2.00)	3 (2.00)
Growth rate	4 (4.24)	4 (4.05)	4 (4.06)
Colour	5 (4.97)	5 (4.95)	5 (4.94)
Horns	7 (7.55)	9 (8.73)	9 (9.00)
Tolerance to diseases/parasites	6 (6.34)	7 (7.02)	7 (7.04)
Body conformation	7 (7.79)	8 (8.02)	6 (6.00)
Temperament	9 (8.34)	6 (6.24)	9 (9.00)
Kendall's coefficient (W)[2]	0.67**	0.71**	0.84**

[1]Means of rankings (the lower the rank the greater the importance) of the reason for keeping goats.
[2]W ranges from 0 (no agreement) to 1 (Total agreement) and the higher the value the higher the level of agreement between respondents in a district.
** P < 0.0001

The most common breeding system in all sampled districts was pure breeding, though a high incidence of cross breeding was reported in Sembabule district. Cross-breeding was between the exotic Boer and indigenous Mubende and/or SEA breeds and it was undertaken to improve meat production. Cross-breeding was unplanned and uncontrolled and therefore a threat to the indigenous animal genetic resources [18]. The study indicated that most farmers hope to carry out crossbreeding across all the three districts, this coupled with their great anticipation to receive improved goats from national programmes further jeopardizes status of indigenous goats. The indigenous goat breeds under the present study have most probably had gene introgressions from other indigenous types and even between themselves. These would have occurred over time through indiscriminate crossbreeding, trade, social exchange and migrations. Because of the possibilities of between and within type gene introgression in the past generations, the indigenous goat populations of the study areas are thought to have many alleles in common.

The study revealed that most farmers in all districts (above 60%) owned their breeding bucks, though in some cases borrowed from neighbours and/ or used communal group bucks especially those given by extension workers and NGOs. Farmers who kept pure exotic and/or their crosses practiced controlled mating (group mating) in which a group of does is left with one or more bucks to mate for a given period of time or taken to the buck centre at oestrus. The slightly fewer breeding buck keepers in Sembabule and Soroti districts were due to the much selective nature of the keepers and the fact that young bucks were sold to solve financial problems and/or castrated. Indigenous bucks were mainly selected from own flock, but the pure and crossbred bucks were bought from commercial farms or acquired from government organizations and NGOs.

Selection Criteria: Selection criteria for goats are shown in Tables 4 and 5. Production traits i.e. body size, growth and reproductive performance, were ranked higher than adaptive traits. Major criteria for selection of breeding

bucks were (Table 4) body size, fast growth rate, fertility and temperament in that order with very little variation between districts and/or breed types. Body size was the most highly ranked, with values ranging between 9.24 and 9.55. Body size and ability to sire twins have been reported as main criteria for selecting breeding bucks in rural goat production [9]. Breeding does were selected (Table 5) mainly basing on body size, birth type, fertility and kid survival.

The breeding practices especially selection criteria generally for does and bucks, was parallel across all districts and systems. As can be seen in Tables 4 & 5, production (quantitative) traits were more important. Beauty-related and adaptation traits were considered less important in selection of breeding stock. Adaptation traits were considered as given for indigenous goats thus the little consideration when selecting breeding stock. Across all districts size and performance in terms of fertility were preferred in all sexes. Larger animals in particular were preferred as they, fetched better market prices, had better growth rates and reached market weights sooner.

Selection of breeding stock by farmers is through using their indigenous knowledge. They depended on information about the performance of potential buck/doe dams and growth performance, information from relatives/ancestor and assessment of young buck and/or doe. There were no records on performance of individuals and their pedigree. Identification was mainly by phenotypic appearance. Lack of animal records and identification has very serious implications, as no effective selection and breeding programmes can be applied in the absence of records. In addition some owners of breeding bucks kept them up to 2.5 years for Sembabule, 3 years for Soroti and 4.5 years by farmers in Arua. Such long duration suggests a high though non quantifiable level of inbreeding in the study areas. The finding are in line with Ssewannyana *et al*. [9] who reported that rural goat farmers in Uganda kept breeding bucks between 3-5years.

The majority of farmers, in all the districts, indicated that they obtained their breeding material from their own farms with selection of h male and female animals being practiced by a majority of farmers in Sembabule, Soroti and Arua districts. While the farmers practice selection of breeding animals, they do not keep records, other than those of numbers, which are committed to memory.

Introduction of high grade exotic meat goats was highly favoured by majority of the farmers in this study in hareas who had the plan of introducing crossbred goats as a means of improving the performance of their goats, rather than through feed improvement. Such attempts would be impeded by the previous observations that pure exotic and crossbreds are poorly adapted to the low-input traditional production systems of the tropics [19, 20].

CONCLUSIONS AND RECOMMENDATIONS

Good knowledge of production and the relative breeding practices of the different areas is essential prior to initiating any sustainable genetic improvement programme [8]. The objectives of this study were to understand the production system and selection criteria to identify cattle breeding goals and practices of breeders in Sembabule, Soroti and Arua districts in Uganda as the first step towards developing a sustainable breed improvement programme. The importance of indigenous knowledge is widely recognized [21]. In the past most genetic improvement programs have tended to be focused on single market driven traits such as milk or meat production in isolation from environmental constraints and broader livestock system functions which cattle perform in developing countries [3]. It is quite indispensable that farmers get involved early in the process of breed improvement, in order to ensure that their breeding perceptions are taken into account and that they provide the support needed for the programme to work.

The information has indicated that generally, goat production in the surveyed areas is by far still at subsistence level and opens to improvement. The results further reveal that though dealing with animals from different districts, the farmers have relatively similar production and breeding objectives. The results showed that in the surveyed areas of Soroti and Arua goat production falls under the definition of a typical smallholder system where as in Sembabule production is towards the extensive.

Breeding practices of goat producers in the surveyed areas reflect the importance of multi-functional roles that goats play in these systems. In a number of cases, the traditional selection criteria were realistic and unswerving with what commercial goat keepers would prefer.

The differences in performance of goats in Sembabule (Mubende goats) vis-à-vis Soroti and Arua (SEA) could be on the genetic basis as the management practices were not very different. This means that goats in Sembabule are genetically superior.

Effective breeding strategies and policies targeting goat keepers in the study areas will be more effective when incorporating the multi-functional roles and indigenous knowledge of the traditional choice attributes of goats as a basis for selection criteria in their production systems. The role of a wide basis for breeding decisions is central in the formulation of effective and sustainable livestock policies aimed at improving the livelihoods of farmers (especially the resource poor) and catering for the interests of consumers of livestock products. This data will be useful in understanding the peoples, breeding practices as a first step in designing a sustainable breeding programme.

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