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IDENTIFICATION OF BREEDING OBJECTIVES IN COMMUNITY-BASED GOAT BREEDING PROGRAMMES IN MALAWI

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ABSTRACT

A study was carried out to identify farmers' goat breeding objectives as a preparatory step towards the setting up of community based goat breeding programme in Mzimba and Nsanje Districts of Malawi. Participatory workshops were held with farmers to get a general idea of their goat breeding objectives. Farmers with more than 7 does were asked to select, with reasons, the best, average and worst does from their flocks. Productive, reproductive and morphometric data for the ranked does were recorded. There was some agreement between the farmers' ranking and the trait measurements taken on the goats that were ranked, suggesting that proper measurement of those traits will assist in meeting the farmer's objectives. The main breeding objective was to increase meat production, but the two sites had different pathways towards this objective. Farmers in Mzimba were more interested in higher growth rates and higher mature weights, while farmers in Nsanje were more interested in improving survival traits, which are more directly related to off-take rates. It is suggested that different selection strategies should be used for each of the sites in order to realise genetic gain that meets the needs of the farmers.

Key words: goats, goat breeding, breeding objectives, community-based breeding, Malawi, Africa

1 INTRODUCTION

Community based breeding programs (CBBP) attempt to achieve genetic improvement of livestock populations by direct involvement of farmers from the design of such programs to actual breeding actions. Effecting a CBBP is a process that requires a bottom-up approach (Mueller *et al.*, 2015), which necessitates that researchers and other development workers must fully understand the farmer's circumstances before the program is set up. The process typically leads to some changes in the farmers' farming management practices, and preferably transcends to a change in their attitudes towards animal breeding. Practically, the decisions farmers make about their animals are multifactorial (Tabbaa and Al-Atiyat, 2009), necessitating the adoption of a holistic approach that attempts to address all these factors (Abera, 2014; Getachew, 2008). One of the necessary steps in this process is the identification of the farmers' breeding objectives. A breeding objective defines the direction in which the farmer would like to go towards satisfying his demand for specific products and services from the animals (Sölkner *et al.*, 2008), which usually translates into increase of profit. Although such desired trajectories of improvement may be different between individual farmers, there is generally a lot of similarity among farmers subjected

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to similar production environments and market forces, so that it is possible to have an idea of the direction in which farmers in an area would like their animals to improve. In conventional livestock breeding programmes, relative values of traits are derived from economic values (Goddard, 1998). Where such determination cannot be made easily, analysis of farmers' preferred trait levels in the animals may be an indirect indication of what constitutes a good animal, the successful pursuit of which constitutes achievement of the breeding objectives (Duguma *et al.*, 2011). This can be done through farmer interviews, farmer workshops, or ranking of own or other people's animals (Wurzinger *et al.*, 2006; Mirkena, 2010). This study was carried out to identify farmers' goat breeding objectives as preparatory step towards the setting up of community based goat breeding programmes in Malawi.

2 MATERIALS AND METHODS

2.1 DESCRIPTION OF THE STUDY SITES

The study was carried out in CBBP sites Mzimba and Nsanje Districts of Malawi. Mzimba District is in Northern Malawi, and the CBBP site is located on latitude −11.356, longitude 33.650 at an altitude of 1150 m. The CBBP site in Nsanje District is located on latitude −16.544, longitude 35.010. The area is at 70 m, and receives relatively low rainfall of around 750 mm and is also prone to floods and droughts. Crop and livestock production are the most important economic activities in both sites. Based on a survey of production systems carried out prior to this study, goats are the most important livestock species, followed by chickens. Malawi had about 6,545,000 goats in 2015. The mean flock sizes in Mzimba and Nsanje are 12.9 and 9.0, respectively, and goats constitute 47 % and 38 % of the tropical livestock units (TLUs) in Mzimba and Nsanje, respectively. Goats in Nsanje are mostly kept for cash from live sales while in Mzimba the goats are kept for multipurpose reasons. Goats in the study areas are mostly of the small East African breed, managed in an extensive grazing system with tethering during the rainy season in some cases. Overall, mature bucks make up less than 10 % of the goat population, while does make up over 47 %, leading to a buck-doe ratio of no more 1 to 5. The number of young goats in both sites is lower than would be expected, indicating possible attrition due to high kid mortality or sales. Mortality rates are very high in both sites, especially in young and adult male animals. Over 80 % of the mortalities are due to diseases (diarrhoea, pneumonia and parasitic infestations). Nsanje has higher mortalities (35 %) than Mzimba (10 %). Majority (90 %) of the households do not control goat breeding, mostly because the animals graze together (89 %). As a result, cases of bucks mating with their mothers, daughters and sisters are very common. This kind of communal goat management is common in Southern Africa (Gwaze *et al.*, 2009). Goat off-take rates are very high, especially in Nsanje. On average, a farmer in Nsanje sells about 3.5 live goats per year, compared to 1.5 in Mzimba (against mean flock sizes of 9.0 and 12.9, respectively). Farmers in Nsanje rely heavily on the goats as a safety net through times of adversities such as floods and droughts, both of which occur nearly yearly. It has been demonstrated that the goat marketing value chain in Malawi has the potential to be very profitable (Maganga et al., 2015; Banda *et al.*, 2011), and if the goats are genetically improved, the farmers can get more money, as the demand for goat meat is projected to keep increasing (Banda, 2008).

2.2 STUDY DESIGN

Participatory farmer workshops were conducted to find out the farmers' goat production objectives in each site. The researchers then visited individual farmers with more than 7 does in the morning when the goats were still in the pens. The total number of such farmers was 25 (14 in Nsanje and 11 in Mzimba). The farmers were asked to rank their does in terms of superiority for achieving their objectives in goat production. They were asked to identify, with reasons, their best, average and worst does. Morphometric measurements were taken on the identified does. The measurements included doe body size measurements (length, heart girth and heights at withers and rump) and body weights. Historical records were also taken for reproduction (number of kids born, number of times the doe kidded and number of kids weaned, from which twinning rate, litter size and survivability were calculated); health (body condition scores, disease incidence); production (milk yield) and economic values (the amount of money the farmer would be willing to pay for each of the identified does if the farmer wanted to buy the doe for breeding purposes).

2.3 DATA ANALYSIS

Non-parametric statistics were used to describe the relationships between most qualitative phenotypes and trait level preferences. The morphometric measurements and quantitative traits of importance (twinning rate, litter size and kid survivability) were analysed using the general linear model procedure in IBM SPSS (IBM Corporation, 2013) using a model with parity, rank and site

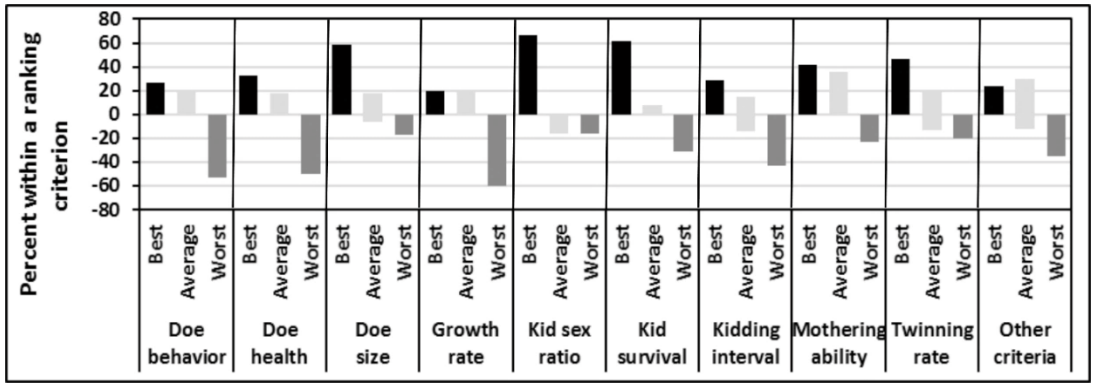

Figure 1: *Percentages of positive and negative rankings within ranking criteria by group of doe*

as the explanatory variables. For survivability, the model also included the twinning rate as a covariate. This model assumed that the rigor of ranking was the same between the farmers.

3 RESULTS AND DISCUSSION

3.1 BREEDING OBJECTIVE FROM A BROADER PERSPECTIVE

Farmers in Nsanje indicated that they were mostly interested in getting more money when they sell live animals. The farmers wanted animals that grow fast, with higher mature weight, and preferably with high twinning rate (in order to sell more animals per year). Farmers in Mzimba indicated that one of their major challenges is that goat body sizes have been getting smaller over the decades, and according to them, smaller animals implied less meat and money from live sales, so they were very keen to select for bigger animals, especially because the goats are also important for consumption in this area, compared to Nsanje where goats are almost exclusively used as moving banks.

3.2 DOE RANKING AND SELECTION CRITERIA

Does were categorized as best or average mostly for their good mothering ability and high kid survival; big size, high twinning rate, kid sex ratio skewed towards females and ability to remain in good health condition throughout the year (Fig. 1). Kid sex ratio was not captured in this study. Worst does were those with poor body condition and health and those that were troublesome in terms of management (such as by constantly wandering away from the rest of the flock). Other reasons for categorizing a doe in the worst category were poor mothering ability and low kid survival and single births (low twinning rate).

The criteria for ranking does were different by site. Farmers in Nsanje were more interested in doe behavior, doe health, kid sex ration, kid survival, kidding intervals and mothering ability, while farmers in Mzimba were more interested in doe size and growth rate (Fig. 2). Doe behavior was especially important in Nsanje, where about 24.1 % of the farmers do not have goat pens, compared to Mzimba where the percentage of such farmers is 1.7 %. Having goats that are easy to manage is therefore important for these farmers.

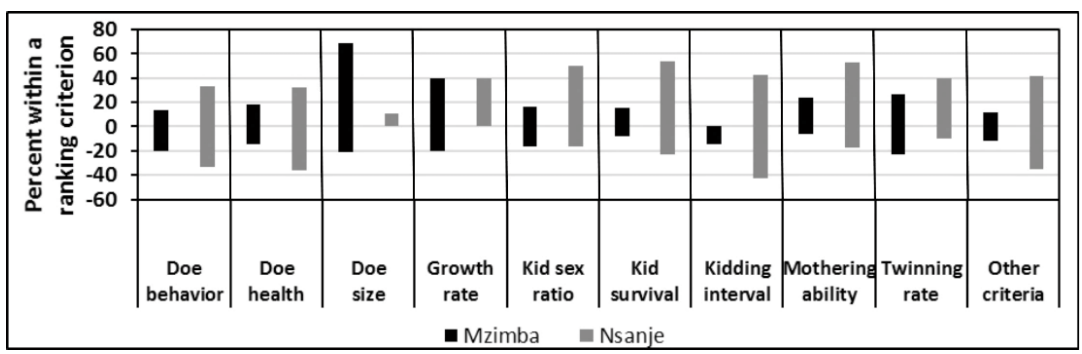

Figure 2: *Percentages of positive and negative rankings within ranking criteria by site*

Table 1: *The distribution of weight, height at withers, body length, heart girth, height at rump, twinning rate and kid survivability*

Measurement	P	Rank			Overall
		Best	Average	Worst	
Body weight	0.149	35.41 ± 1.28	32.21 ± 1.47	32.60 ± 1.54	33.41 ± 0.98
Boy length	0.272	63.80 ± 1.10	62.00 ± 1.23	61.46 ± 1.14	62.43 ± 0.79
Heart girth	0.014*	78.36 ± 1.02	75.20 ± 1.14	74.40 ± 1.06	75.99 ± 0.72
Height at withers	0.159	61.94 ± 0.74	61.44 ± 0.83	60.05 ± 0.77	61.14 ± 0.52
Height at rump	0.132	63.82 ± 0.70	63.23 ± 0.79	61.91 ± 0.73	62.98 ± 0.50
Litter size	0.354	1.640 ± 0.082	1.55 ± 0.09	1.48 ± 0.08	1.56 ± 0.06
Twinning rate	0.098	68.67 ± 7.26	47.92 ± 8.13	53.5 ± 7.5	56.71 ± 5.13
Survivability	0.016*	89.92 ± 5.60	95.99 ± 5.98	75.27 ± 5.5	86.95 ± 3.74

* = significant at P = 0.05

3.3 RELATIONSHIP BETWEEN DOE RANKS AND MORPHOMETRIC AND OTHER TRAIT MEASUREMENTS

Most of the quantitative measurements (weight, body length, heart girth, height at withers, height at rump, litter size and kid survivability) were nearly normally distributed within the sites, with coefficients of variation of 21 %, 10 %, 7 %, 6 %, 5 %, 30 % and 31 %. Twinning rate was highly variable, with a coefficient of variation of about 76 %. The body condition scores of the does were different between the ranks (3.1, 3.5 and 2.6 for best, average and worst does, respectively). None of the farmers who ranked their does reported milking the goats, and there was no clear relationship between incidence of diseases and rank of the doe. Similarly, there was no relationship between doe rank and doe coat colours. The mean amounts of money for which the farmers said they would be willing buy the does in each rank for breeding were MWK19,527, MWK17,157 and MWK16,463 for best, average and worst animals, respectively (€1 ~ MWK480), but there were no significant differences between these values.

Least squares means of doe body weight, body length, heart girth, height at withers, height at rump, litter size, twinning rate and survivability were, 33.41 kg, 62.43 cm, 75.99 cm, 61.14 cm, 62.98 cm, 1.56, 56.71 % and 86.95 %, respectively (Table 1). Banda *et al.* (1993) reported 32.4 kg, 68.9 cm, 74.9 cm and 60.5 cm for weight, body length, heart girth and height at withers, respectively for adult female East African goats on some government farms. This represents an increase of about 1 kg in body weight over 23 years. This breeding program intends to achieve 0.2 to 0.4 kg in 3 years. In comparison, female Iramba goats in Tanzania (also East African) have been reported to have 24.2 kg, 57.7 cm, 53.3 cm, 68.1 cm and 55.1 cm for body weight, height at withers, height at rump, heart girth and body length, respectively (Chenyambuga *et al.*, 2012). The litter sizes seemed to have improved from 1.35 reported by Karua and Banda (1993) and Wilson (1988) on government and research institutional farms in Malawi. Heart girth (a measure of body size and weight) decreased down the ranks from best to worst, implying that farmers could indeed be interested in bigger animals. Does ranked average had the highest kid survival rates followed by those ranked best.

Does in Nsanje had higher body weights, body lengths and twinning rates (Fig. 3). Although the differences in body lengths and body weights between the two sites do not shed light on the trends of body sizes of

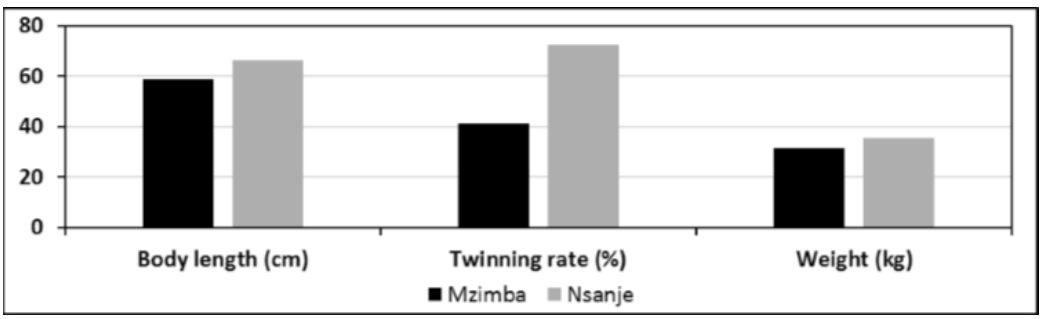

Figure 3: *Least squares means of body length (cm), twinning rate (%) and body weight (kg) by site*

the goats in Mzimba, they do confirm the concern of the farmers in Mzimba about the small sizes of their goats.

Information on growth rates, which was not captured in this study, for the Malawian Small East African goats is scanty and old. Banda *et al.* (1993) reported pre-weaning growth rates of up to 45 grams/day on government farms. Growth rates reported for the Small Eat African goats in the region are below 50 grams/day, such as 28 grams/day reported by Safari *et al.* (2005). Pre-weaning growth rates of up to 50 grams/ day can therefore be expected.

3.4 BREEDING OBJECTIVES FROM A NARROWER PERSPECTIVE

The expressed interest in bigger goats was only partly reflected by the association between the morphometric measurements, with reported worst does not being substantially smaller than reported best goats. However, it is apparent from the association between doe rank and the farmers' reasons for ranking animals that the farmers' goal in both sites was to get more money from sale of meat or live goats. This implies that the farmers' breeding objective was to produce more meat since nearly all the goats that are sold are ultimately destined for slaughter for meat (Maganga *et al.*, 2015).

More money from sale of live goats can be achieved through faster growth rates, higher twinning rates and higher survivability. However, a balance needs to be stricken between these traits, since kids born in multiples tend to have lower birth weights and lower growth rates in the pre-weaning period. In some cases, kids born in multiples may even have lower survivability, which might explain why kid mortality is higher in Nsanje (Fig. 3). Assuming that such kids born in multiples survive, they may fetch lower prices than singletons of the same age if sales are based on live weight, which is usually the case in Mzimba, so having heavier animals is important. On the other hand, sales of kids in Nsanje are generally not based on live weight, so that weight differences between individuals of the same age may not influence the prices much. Subsequently having more animals to sell is more important than having bigger animals, although in the long run, bigger and heavier animals may fetch better prices. The breeding program implemented intends to improve the goat marketing functions towards differential product pricing. This points to the need to have different selection strategies for each of the sites in order to realise genetic gain that meets the needs of the farmers. The data from the routine recording that is going to be effected for the breeding programs will establish appropriate balances between the traits of importance in the two sites.

3.5 BREEDING GOAL AND EXPECTED SELECTION INTENSITIES

The breeding goal of the goat farmers may be summarised as:

Profit = Behaviour traits + Fitness traits + Productive traits + Reproductive traits

The behaviour traits include the ease of management and mothering ability, both of which are not easy to measure objectively, although mothering ability can be indirectly related to kid survival. Fitness traits include health and kid survival. Productive traits include weight and growth rate. Reproductive traits include kid sex ratio, kidding interval and twinning rate. It is expected that the weights on the traits are going to be different between the sites to reflect the differences in the farmers' breeding objectives. Selection intensity in does is expected to be very low, since farmers normally keep all females for breeding. The breeding program is expected to achieve male selection intensity (i) corresponding to selection of less than a quarter of the candidates ($i > 1.27$).

4 CONCLUSION

The results suggest that there was some agreement between the farmers' ranking and the measurements taken on the goats that were ranked, especially for heart girth and survivability. It is expected that with appropriate recording this agreement will become clearer. The main goat breeding objective was to increase meat production. Farmers in Mzimba were more interested in higher growth rates and higher mature weights, while farmers in Nsanje were more interested in improving traits aimed at increasing off-take rates. It may be necessary to have different selection strategies for each of the sites in order to realise genetic gain that meets the specific needs of the farmers.

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