

## Forage-feedstuff resources and economic constraints on crop/livestock smallholdings producing milk from cows and goats in three locations of Tanzania<sup>a</sup>

N F Massawe<sup>1</sup>, E Owen<sup>1</sup>, L A Mtenga<sup>2</sup>, S D Ashley<sup>3</sup>, S J Holden<sup>3</sup> and D L Romney<sup>4</sup>

<sup>1</sup>Department of Agriculture, The University of Reading, Earley Gate, PO Box 236, Reading, Berkshire RG6 6AT, UK

<sup>2</sup>Department of Animal Science and Production, Sokoine University of Agriculture, PO Box 3004, Morogoro, Tanzania

<sup>3</sup>Livestock in Development, PO Box 20, Crewkerne, Somerset TA18 7YW, UK

<sup>4</sup>NRI, Chatham Maritime, Chatham, Kent ME4 4TB, UK

### *Abstract*

*Studies conducted in three contrasting locations namely: Mwanza, Kilimanjaro and Morogoro (Mgeta) showed that the objectives of keeping livestock vary with location, and that there are similarities in the constraints and problems identified in forage utilization. In all locations, shortage of dry-season forage, low quality of forage and lack of improved forage feeding strategies were considered severe constraints. Land degradation associated with decline in soil fertility was reported in Kilimanjaro and Morogoro and it is assumed that this contributes to decreasing productivity of forage and food crops. In Kilimanjaro forage feed availability varies between farms depending on accessibility and use of land, labour and capital. Generally, insufficient forage is an obvious constraint, with a result that farmers rarely feel that they have an excess of forage and consequently do not consider that knowledge of forage conservation techniques is particularly important. High costs of transporting crop residues associated with shattering of leaves was found only in Kilimanjaro and were rated a severe constraint. Fluctuation in type of feed offered to dairy animals was also identified in Kilimanjaro and would be expected to have undesirable effects on milk production.*

*Other problems identified included high cost of concentrates which was reported a severe constraint in Kilimanjaro and a medium constraint in Morogoro, but was not obvious in Mwanza (Sukumaland) as concentrate feeding is not common there. Milk marketing was a problem in all locations, with Kilimanjaro being most affected.*

*The results of the present study support the hypothesis that poor forage utilization is a constraint to milk production in smallholder farms. Factors such as wealth, climate and local conditions, farming system, access to resources, location of land and current marketing infrastructure are important determinants in utilization of forage resources available on smallholdings. Depending on the constraint and the availability of resources, different farmers had different approaches to managing their animals and utilizing the available forage resources to suit their primary objective of keeping these animals. This implies that husbandry strategies for improving the utilization of the forage resources should vary, both across and within locations depending on wealth groups and individual farmers objectives.*

*The challenge to researchers, extensionists, NGOs and policy makers is how to help farmers manipulate factors under their control, using the resources available on farm to achieve profitable milk production. Further research is in progress to develop economically viable options for alleviating the constraints identified. The strategies developed will be evaluated by farmers using further PRAs.*

---

<sup>a</sup> Paper communicated to the 24<sup>th</sup> Annual Scientific Conference of Tanzania Society of Animal Production, held on 5<sup>th</sup> - 7<sup>th</sup> August 1997, Arusha, Tanzania

## Introduction

The high demand for liquid milk in Tanzania has been documented (Komba and Mjingo, 1992; Mdoe, 1993; Mdoe and Temu, 1994) and the recent rapid growth of dairy cattle keeping in urban and peri-urban areas suggests that the dairy business is flourishing and profitable. However, most milk producing animals are kept by rural smallholder farmers in the traditional sector where the main feed input is expected to be forage from natural grasslands, improved pastures and a variety of crop residues. It is hypothesised that one of the constraints to increased milk production is inadequate nutrition due to lack of farmer evaluated strategies for better use of forages available on farms.

Many studies on forage utilisation have been carried out in Tanzania (Kitalyi, 1982; Mbwire and Wiktorsson, 1982; Urio and Mlay, 1985; Mero and Uden, 1990; Kimambo *et al.* 1990; Kitalyi, 1993; Komwihangilo *et al.* 1993; Shem, 1993; Mlay, 1994; Urio *et al.* 1995). However, a review of forage utilization research (Kidunda, *et al.* 1990) revealed that few new technologies have been adopted by farmers.

A recent review of locally available literature (Massawe *et al.* 1997) indicated that research on forage production and utilization was based mainly on-station (SUA and Mpwapwa) and had given little or no consideration to socio-economic issues, farmer local knowledge, available resources and other constraints of the farmer. Therefore the objective of the present study was to identify, together with farmers, the constraints to, and opportunities for, improved forage utilisation for profitable milk production on smallholder farms in Tanzania. It is intended that by involving farmers in the identification of researchable issues, appropriate technologies can be developed which will be more likely adopted.

## Materials and methods

The field studies were conducted in three contrasting locations namely: Mwanza, Kilimanjaro and Morogoro (Mgeta) between January and April 1997. Mwanza is a fairly dry area receiving about 900 mm annual rainfall and dominated by cotton/sorghum/millet/rice farming system. The system is associated with extensive keeping of local cattle and goats grazed on communal land. This location is also a priority area in Tanzania for the acknowledged sponsor. Kilimanjaro receives about 1600 mm annual rainfall and is a high potential area for dairying in coffee/banana based farming system. Livestock kept are improved cattle and goats under intensive stall-feeding. Morogoro, i.e. Mgeta area, has an annual rainfall of 1200 mm. It is an area where milk production is entirely from dairy goats integrated in a maize/vegetable farming system. The goats are either tethered to graze or herded with some stall feeding based on cut and carry.

The Participatory Rural Appraisal (PRA) approach was used in gathering information in order to allow scientists, extensionists, NGOs and farmers to interact in sharing knowledge, identifying problems and constraints, and suggesting avenues for research interventions. Group meetings were organised in which techniques used included component scoring and ranking, participatory mapping of resources and semi-structured interviews using a check-list. Meetings and interviews with key informants were used for wealth ranking and confirmation of information obtained in the other group meetings. In Mwanza, where milk production was not a primary objective for the majority of farmers, additional group meetings were held with farmers who sell and or process milk.

Except for Morogoro (where wealth ranking was not done), wealth ranking in Mwanza and Kilimanjaro involved use of key informants acquainted with the majority of village members (e.g. leaders of sub-villages, retired village leaders, leaders of prominent groups such as farmer research groups, women groups and a school teacher), were asked to rank according to wealth a systematically selected but unbiased list of about 20% of the village households (including the informants). The wealth ranking exercise gave an opportunity to select farmers for individual interviews to ensure that views of those in different wealth categories were represented. Target wealth categories, where farmers agreed that research efforts should be focused, were identified. In Morogoro, the farmers used were under a dairy goat project (supervised by SUA) located in three different villages. The distribution of these farmers made it difficult to wealth rank them and it was therefore decided to conduct individual farmer home visit PRA using the same checklist and assessing wealth based on the existing structures such as houses, goat shed and the surrounding environment of the homestead.

## Results and discussion

### *Feeding systems and wealth ranking*

Feeding systems, feed resources and population density varied in the three locations (Table 1). This reflects the differences in climate and farming systems (as described in materials and methods) and perhaps differences in soil fertility. In Mwanza and Kilimanjaro key informants were able to place village members into between 6 and 10 wealth categories. Groups suggested targeting farmers in the medium categories, excluding the poorest farmers as not having the resources to allow adoption of improved technologies. The wealthiest categories were also excluded as not being in need of assistance. The main feed resources in all three locations were natural and improved pastures and crop residues, the latter used in both extensive grazing or stall-feeding systems (Table 1).

### *Objectives of livestock keeping*

As might be expected given the different farming systems, the major animal outputs i.e. milk, meat, draught power, manure and cash income were ranked differently in the three locations (Table 2). In Kilimanjaro, milk was mentioned as a reliable source of household income and this was justified by the presence of more improved dairy animals. Draught power was more important in Mwanza where there is more land and cotton cultivation allows use of oxen. Draught power was not used in Kilimanjaro and Morogoro due to limitations of land size, crops grown and physical features (mountainous areas not suitable for use of animals for cultivation). The ranking of animal outputs also differed between households practising similar systems, depending on the strategies followed, e.g. in Morogoro farmers more interested in cash income practised early breeding with short lactation length and had cash income as their first rank. The ranks shown in Table 2 are therefore oversimplification for location as individual farmers within a location may have different rankings.

### *Constraints to improved production*

Table 3 shows constraints and problems identified in all locations. Shortage of dry-season forage, low quality of forage and lack of improved forage feeding strategies were considered severe constraints in all locations. However, farmers in Kilimanjaro cited a number of additional constraints not mentioned in the other locations. These differences in constraint identification were found to be as a result of existing farming systems. Location of land was important in Kilimanjaro, where animals are kept at the highland site, while the bulk of the feed comes from the low land site, so necessitating transportation leading to cost input and loss of leaves. Land scarcity, caused by high population density as shown in Table 1 was most serious in Kilimanjaro and Morogoro and land degradation was considered to be a significant constraint to improved production. Bhatia and Ringia (1996) concluded that the issue of land degradation is the result of low-input farming carried out in smallholder sector and needs to be addressed for sustainable agricultural production and environment conservation. Jähnig (1996) recommended contour planting coupled with the use of a mixture of grasses and legumes to boost forage production and soil fertility in Morogoro. Per Assmo and Erikson (1994) documented achievements made by the Soil Conservation and Agroforestry Project Arusha (SCAPA) in increased forage production and environment conservation. It is suggested that the recommendations given under the SCAPA Project be extended to other locations of Tanzania.

High cost of concentrates was reported to be a severe constraint in Kilimanjaro and a medium constraint in Morogoro. This problem was not obvious in Mwanza as concentrate feeding is not common there. Milk marketing was found to be a problem in all locations, with Kilimanjaro being most affected. A case study in one of the selected villages (Samaki Maini) showed that farmers were reluctant to invest more on feeding for more milk production following closure of the nearby milk collecting centre (Sanya Juu collecting centre which was under the defunct Tanzania Dairies Limited). Other problems such as availability of credit, low prices of agricultural products not matching with high prices of inputs, poor feeding troughs and poor roads also had implications for the utilization of forage. This implies that efforts to increase milk production through better utilization of forage should go hand in hand with improvement of other infrastructures to facilitate marketing. Linkages with policy makers and NGOs working for the development of rural people is therefore likely to be important.

The constraints identified also differed for farmers in different wealth categories. In Kilimanjaro it was noted that the bulk of forage was obtained from crop residues located at 15 - 30 km from where the animals are kept. Therefore, wealthier farmers, with more access to resources and able to employ casual labourers, had

more forage than the rest in the community. The implication of this is that husbandry strategies for better utilization of forages should take into consideration wealth differences among the target community. Generally, insufficient forage is an obvious constraint, with the result that farmers rarely felt they had an excess of forage and consequently did not consider knowledge of forage conservation techniques as being particularly important. High costs for transporting crop residues and the associated shattering of leaves were found only in Kilimanjaro and were rated severe constraints.

#### ***Implementation of a research programme***

Research addressing some of the constraints identified has been carried out but many of the findings have not reached the farmers (Kidunda et al. 1990). Farmers are the clients of agricultural research, however, they are not always consulted when research projects are identified, or when deciding which technologies merit on-farm testing. In Kilimanjaro, farmers reported attempts to introduce urea treatment of maize stover using pit and basket methods. Although 2 farmers were observed to have modified this technique and were sprinkling urea on the straw before feeding (practising supplementation rather than treatment), the original treatment recommended was found not to be sustainable since it relied on use of expensive equipment and materials (e.g. tractor driven chopper, chicken wire and polythene bags), required bulk transportation of stover and demanded high inputs of labour. The suitability of the technology was therefore limited to a few wealthier farmers. Mlay (1994) cited another technology on the use of urea-molasses liquid mixture which failed on similar grounds. Urea feeding strategies and its importance in improving poor quality roughages has been widely used and proved useful (Schiere and Ibrahim, 1989). The need of the technology for smallholder farmers in Tanzania feeding bulk of crop residues is therefore important. The cases observed in Kilimanjaro demonstrated the importance of careful consideration of the system and existing constraints before introducing new technologies for testing or adoption. A solution may be to involve farmers in screening potential technologies and selecting issues from researchable constraints identified by the scientist before initiating a research programme.

#### **Conclusion**

The current study has shown that factors such as wealth, climate and local conditions, farming system, access to resources, location of land (distant fields in Kilimanjaro) and current marketing infrastructure are important determinants in utilization of forage resources available on smallholdings. Some of these factors (such as climate) are beyond the control of the farmer. The challenge to researchers, extensionists, NGOs and policy makers is how to help farmers manipulate factors under their control, using the resources available on farm to achieve profitable milk production. Further research is in progress to develop economically viable options for alleviating the constraints identified. The strategies developed will be evaluated by farmers using further PRAs.

#### **Acknowledgements**

This publication is an output from a research project funded by the Department for International Development (DfID) of the United Kingdom. However, DfID can accept no responsibility for any information provided or views expressed.

## References

- Bhatia, Z. and Ringia, O. 1996. *Socio-economic Survey of Selected Villages in the Uluguru Mountains, Tanzania. Uluguru Slopes Planning Project. Report No 3.* A joint project between: The Government of the United Republic of Tanzania, The European Community and The Royal Society for the Protection of the Birds (RSPB), RSPB International Department, Bedfordshire UK. 78 pp.
- Jähnig, G.F. 1996. Production of Small East African Goats and Norwegian Crosses in the Uluguru mountains in Tanzania: Farmers perspectives on feed resources and feeding systems. *MSc. Thesis*, The University of Reading. 121 pp.
- Kidunda, R.S., Lwoga, A.B. and Mtengeti, E.J. 1990. Utilization of pasture research results in Tanzania. *In: PANESA/ARNAB (Pasture Network for Eastern and Southern Africa/African Research Network for Agricultural By-products). 1990. Utilization of research results on forage and agricultural by-product materials as animal feed resources in Africa.* Proceedings of the first joint workshop held in Lilongwe, Malawi, 5 - 9 December 1988. PANESA/ARNAB, Addis Ababa, Ethiopia. 833 pp.
- Kimambo, A.E., Shem, M.N., Lyimo, S.B. and Royer, V. 1990. Nutritive value of different feeds used by smallholder dairy farmers in Kilimanjaro and Arusha Regions. *In: Proceedings of the 18<sup>th</sup> Scientific Conference of the Tanzania Society of Animal Production.* Volume 17:36 - 47. TSAP, SUA, Morogoro, Tanzania.
- Kitalyi, A.J. 1982. Effect of supplementing low quality hay with different protein levels on growth and performance of goats. *MSc. Thesis*, Sokoine University of Agriculture, Morogoro, Tanzania. 157 pp.
- Kitalyi, A.J. 1993. Sorghum stover and lablab bean haulm for dry-season feeding of lactating cattle in the semi arid Central Tanzania. *PhD Thesis*, The University of Reading, Reading, U.K. 303 pp.
- Komba, G.L. and Mjingo, M. 1992. Small scale dairy development in Tanzania. *Livestock Production in Rural Development. Proceedings of the International Workshop on Development of Livestock Policies.* 20-31 January 1992. International Agricultural Centre, Wageningen, The Netherlands.
- Komwihangilo, D.M., Mwilawa, A.J. and Goromela, E.H. (1993) Performance and nutritive value of local trees and shrubs for livestock feeding in semi arid Central Tanzania. *In: Sustainable Livestock Based Smallholder Systems in the Semi Arid Areas of Central Tanzania.* Proceedings of a Seminar held at Arusha International Conference Centre, Tanzania, 27 - 28 September 1993. p 39-55.
- Massawe, N F., Owen, E., Mtenga, L.A., Romney, D.L., Holden, S.J. and Ashley, S. 1997. Review of literature on forage production and utilization in Tanzania. Output 1 from a research project (R6619) funded by Department for International Development (DfID) of the United Kingdom (Unpublished).
- Mbwile, R.P. and Wiktorsson, H. 1982. Fodder supply to dairy cows during the dry season in Tanzania: Comparative evaluation of three silage and lupin green forage. *Journal of Agricultural Science Cambridge* 99:651-658.
- Mdoe, N.S.Y. 1993. Smallholder dairy production and marketing of milk in Hai District. *Ph D Thesis*, The University of Reading, UK. 310 pp.
- Mdoe, N.S.Y. and Temu, A.E. 1994. Dairy production and food security in Tanzania: policies and future prospects. *In: Proceedings of the 21<sup>st</sup> Scientific Conference of Tanzania Society of Animal Production.* Volume 21:80-95. TSAP, Sokoine University of Agriculture, Morogoro, Tanzania.

- Mero, R.N. and Uden, P. 1990. Effect of supplementing mature grass hay with dried leucaena leaves on organic matter digestibility and voluntary intake by sheep. *Animal Feed Science and Technology*, **31**:1-8.
- Mlay, D.G. 1994. Cereal crop residues for livestock feeding based on urea-molasses blocks and high offer levels in Central Tanzania. *MSc. Thesis*, Swedish University of Agricultural Sciences, Uppsala. p 1-15.
- Per Assmo and Arne Erikson. 1994. *Soil Conservation in Arusha Region Tanzania*. Manual for Extension Workers with Emphasis on Small Scale Farmers. RSCU/SIDA, Technical Handbook No 7. SIDA, Nairobi, Kenya. 99 pp.
- Schiere, J.B. and Ibrahim, M.N.M. (1989). *Feeding of urea-ammonia Rice Straw*. Compilation of miscellaneous reports produced by the straw utilization project (Sri Lanka). Pudoc Wageningen, The Netherlands. 125 pp.
- Shem, M.N.N. 1993. Evaluation of the locally available feed resources on smallholder farms on the slopes of Mount Kilimanjaro. *PhD Thesis*, Aberdeen University, U.K. 189 pp.
- Urio, N.A. and Mlay, G.I. 1985. *Dairy Feeding Systems: Second Progress Report*. SUA/IDRC Project 3-P-82-0085, Sokoine University of Agriculture, Morogoro, Tanzania.
- Urio, N.A.; Mtengeti, E.J. and Mlay, G.I. 1995. Intensive fodder gardens for improving forage availability for smallholder dairy production in Hai District. In: *Meeting Farmers' Needs Through Agricultural Research* A.Z.Matee, K.P.Sibuga, J.M.R.Semoka and M.Tsunoda (Editors) Proceedings of the First Faculty of Agriculture Annual Research Conference held at the Institute of Continuing Education, Sokoine University of Agriculture 28<sup>th</sup> to 30<sup>th</sup> August 1995, Morogoro, Tanzania. 373 - 386 pp.

**Table** *Major feeding systems, feed resources and human population density*

	<b>Mwanza</b>	<b>Kilimanjaro</b>	<b>Morogoro</b>
Feeding system	Extensive grazing	Stall-feeding	Tether grazing
Pasture based feeds	Natural pastures	Improved pastures	Natural and improved pastures
Crop residues used	Maize, beans, sorghum and chick pea residues	Maize, beans, sunflower and banana based residues	Maize, beans and vegetable based residues
Use of concentrates	Tried with work oxen		✓
Human population density (person/km <sup>2</sup> )	50	650	225

**Table 2** *Objective of keeping livestock as ranked in the three locations*

<b>Objective</b>	<b>Mwanza</b>	<b>Kilimanjaro</b>	<b>Morogoro</b>
		3	4
	2	2	3
	4	4	2

4 = low

**Table 3** *Summary of constraints and problems identified in all locations*

<b>Constraint/problem</b>	<b>Mwanza</b>	<b>Kilimanjaro</b>	<b>Morogoro</b>
Shortage of dry-season forage	✓✓✓	✓✓✓	✓✓✓
Low quality forage	✓✓✓	✓✓✓	✓✓✓
Lack of improved forage feeding strategies	✓✓	✓✓✓	✓✓✓
Lack of knowledge on forage conservation		✓✓	✓
High transport costs of crop residues and loss of leaves		✓✓✓	
Land degradation and decline in soil fertility		✓✓✓	✓✓
Fluctuations in type of feed offered		✓✓	
High cost of concentrates		✓✓✓	✓✓
Problems of milk marketing	✓	✓✓	✓
Poor feeding troughs leading to feed loss		✓✓	✓

✓ low severity    ✓✓ medium severity    ✓✓✓ high severity