Breed preferences and breeding practices in smallholder dairy systems of the central highlands of Kenya

B. Omedo Bebe*[1,2,3], W. Thorpe[2], H.M.J. Udo[3] and W. Mulinge[4]

[1]Animal Science Department, Egerton University, Box 536 Njoro, Kenya
[2]International Livestock Research Institute, P.O. Box 30709, Nairobi, Kenya
[3]Animal Production Systems Group, Wageningen Agricultural University,
P.O. Box 338, 6700 AH Wageningen, The Netherlands
[4]Kenya Agricultural Research Institute, Box 57811 Nairobi, Kenya

Abstract

This paper describes, for smallholder dairying in the central highlands of Kenya, the sources of foundation stock, farmers' breed preferences and breeding practices for the major dairy breeds. Data were obtained from a cross-sectional characterization study of smallholder dairy systems in the central highlands of Kenya. The study began with a pilot survey in Kiambu district during June-July 1996 where a random sample of 365 households was interviewed. For this study, respondents were asked to state the sources of their dairy foundation stock and the reasons for selecting their current breeds. Subsequently the survey was extended during March-April 1998 to another eight districts in the central Kenya when 1390 households were randomly sampled. Complementary information on herd breeding history was collected through targeted surveys of 50 sample households representative of the major dairy systems in the region. Respondents were asked about the breed of sire mated to the first dairy cow owned and the sire breeds mated to the heifer progeny. The respondents were asked to rate their preference for a breed on a scale of 1 (1=least preferred) to 4 (4=most preferred) for each of ten characteristics: milk yield, fat yield, body weight, growth rate, fertility, disease resistance, feeding behaviour, market demand, slaughter/butcher value, and longevity.

Majority of the farmers (68%) indicated specifically selecting the breed of sire for mating but only 37% used AI service and 63% used bull service. High milk yield was the most important criteria for selecting a dairy breed. As result, Friesian and Ayrshire were the most preferred breeds. Ayrshire was favoured over Friesian for disease resistance and feeding behaviour but not for market value and body weight. Common breeding practice was pure breeding for Friesian, and upgrading of Guernsey to Friesian and to a lesser extent Ayrshire. Breeding practises reflected producers' efforts to maximise the proportion of Friesian genes in their herds.

---

* *Corresponding author*

International Livestock Research Institute, P.O. Box 30709, Nairobi, Kenya
Email:B.Bebe@cgiar.org

Introduction

Dairy production in Kenya began in 1901 with the establishment of large-scale commercial dairy farms in the central highlands. The foundation stocks were founded by grading-up of indigenous zebu cattle with European dairy breeds imported from South Africa (Mosi *et al*., 2000). By 1912, cattle population in the central highlands was estimated at 77050, comprising 43.4% local zebus, 55.7% dairy crossbreds and 0.9% dairy high-grade (Mosi *et al*., 2000). After Kenya's independence in 1963, the predominant dairy production system rapidly shifted from large-scale to small-scale (Stotz, 1979; MoALDM, 1998). The shift to small-scale dairying came also with an increase in the population of dairy high-grade cattle and Friesian dairy breed. In recent characterisation study of smallholder dairy systems in the central highlands, cattle population comprised 3.8% zebus, 53.6% dairy crosses and 42.6% dairy high-grade (Staal *et al*., 1998). The predominant dairy breeds on the sample farms were Friesian (51%), Ayrshire (23%) and Guernsey (13%) and the rest being Jersey and local zebus.

On smallholder dairy farms, the process to the present predominance of dairy high-grade and Friesian breed is said to have been through upgrading of indigenous breeds in unplanned indiscriminate breeding practice (Bondoc *et al*., 1989; Mohammad *et al*., 1999; Kahi *et al*., 2000a). There are arguments against upgrading to higher exotic grades and/or use of Friesian breed in low-external input systems of smallholder dairying on the basis of their low adaptability to tropical stresses of poor nutrition, disease challenges and heat tolerance (Cunningham and Syrstad, 1987). The arguments are based on the results of reproduction and production evaluations but the knowledge and preferences of the people who own and use these genotypes is ignored. A review of published results for various dairy genotypes in the tropics (Rege, 1998) showed that at the same level of indigenous genes, crosses of different exotic breeds differed in their performance indicating that no one breed, crossbreed or crossbreeding strategy will have superior aggregate performance in all production environments. Farmer's knowledge and preferences about the genotypes should therefore be an integral part of breeding improvement efforts because farmers adopt and adapt genotypes to their needs and circumstances. For example, farmers might tend to upgrade to higher exotic grades and/or Friesian based on higher milk yields even though the overall productivity, on the account of reproduction and production, may be low. In addition, large dairy breeds are associated with high milk yields and are likely to be more popular than smaller breeds in production systems such as found in Kenya where milk is sold on volume basis. The importance of farmers' choice, preferences for different breeds, criteria used for selection of breed and knowledge about specific attributes of different breeds under low-input systems have not been documented for smallholder dairying in the central highlands of Kenya.

This paper describes, for smallholder dairying in the central highlands of Kenya, the sources of dairy foundation stock, breeding practices for the common dairy breeds, and farmers' breed preferences. The primary objective of the study was to improve understanding of smallholders' breeding practices and breed preferences in order to explore the possibilities for improving the breeding practices and developing policies in support of smallholder dairy producers in the central highlands of Kenya.

Materials and methods

A cross-sectional characterization study of smallholder dairy systems was conducted in the central highlands of Kenya. The study began with a pilot survey in Kiambu district during June-July 1996 (Staal *et al*., 1998). A random sample of 365 households was interviewed using a pre-tested structured questionnaire with emphasis on dairy production. Data collection was based on recall of events during the past 12 months. These included herd inventories, cattle management practices, milk marketing, and income sources. Respondents were also asked to state the sources of their dairy foundation stock and the reasons for selecting the breeds they were keeping now. Subsequently the survey was extended to another eight districts during March-April 1998 when 1390 households were randomly sampled. Random sample was obtained as follows. Two pairs of landmarks (permanent features like Trading Centre, School, Church, Factory, Rivers) were selected at random for each sub-location from the GIS database. Two transect lines were then drawn joining each pair of landmarks. Thereafter sampling was done following the marked transects as closely as possible. Each fifth household on the right and on the left was interviewed alternately, regardless of whether they were in farming or non-farming activities. The data from the nine districts was pooled and comprised 987 dairy households. Dairy genotypes were classed as: crossbreds (50% or less *Bos taurus*), or high-grade dairy (more than 50% *Bos taurus*). The *Bos taurus* breeds were: Friesian, Ayrshire, Guernsey and Jersey.

Complementary information on herd breeding history was collected through targeted surveys of 50 sample households representative of the major dairy systems in the central highlands of Kenya. Respondents were asked about the breed of sire mated to the first owned dairy cow and the subsequent sire breeds mated to heifer progenies related to the first owned dairy cow. Respondents were also asked open-ended questions about the main advantages and disadvantages they associate with the major dairy breeds based on their dairying experience. To quantify breed preferences, respondents were asked to rate a breed on a scale of 1 (1=least preferred) to 4 (4=most preferred) for each of ten characteristics: milk yield, fat yield, body weight, growth rate, fertility, disease resistance, feeding behaviour, market value, slaughter/butcher value, and longevity.

In this paper, descriptive statistics using cross tabulation are presented to describe smallholders' breeding practices and breed preferences.

Results and discussion

The head of the sample households had an average age of 50.5 y (SD=14.2) with farming experience of 20.1 y (SD=11.2) and dairying experience of 16.3 y (SD=9.9), indicating that dairying was generally in the hands of the old age with long dairying experience. Over 80% of the smallholders purchased their first dairy cow, less than 10% actually upgraded their stock and none indicated obtaining direct project support (Table 1). This shows that smallholder dairying developed independently of direct project donations and without the long process of upgrading indigenous zebus to exotic dairy breeds. The availability of dairy stock for purchase can be attributed to the once predominant large-scale dairy farms in the central highlands (Conelly, 1998), which demonstrate their important role in the foundation of smallholder dairying in Kenya.

Table 1. Frequency (%) distribution for the sources of dairy foundation stock, the current mating method and genotypes on smallholder farms in the central highlands of Kenya

	Frequency (%)
Source of dairy foundation stock (% farms, n=987)	
Purchased	82.7
Gift	9.4
Upgrading from zebus	7.9
Project support	0.0
Current mating method (% farms, n=987)	
Bull	62.2
Artificial Insemination	37.3
Genotypes (% cattle, n=3966)	
Zebus	24.0
Dairy crosses	35.7
Dairy high-grade	40.3

Slightly more than a third (37%) of the respondents indicated using artificial insemination (AI) service (Table 1), which is an indication of low accessibility to AI services. Individual interviews with farmers during targeted surveys revealed that majority (68%) of the farmers specified to AI service the breed of sire they wanted for mating. Low accessibility to AI services for smallholders should be of great concern viewed on the reports that during 1992 in the central Kenya highlands, only 40% of the eligible cows had access to AI service (Okeyo *et al*., 2000). Evidence indicates a worsening situation as the AI serviced cows in the national herd fell from 8.1 to 6.4% during 1998-1999 period and in 1999, only 10% of the available semen at the Central Artificial Insemination Station (CAIS) was actually delivered to farmers (Oluoch-Kosura *et al*., 2000; Okeyo *et al*., 2000).

Though majority of the smallholders are using bull service (62%), only 20% keep bulls on the farm (Gitau *et al*., 1994), suggesting that bulls are shared. Accessibility to bull service will possibly restrict the farmer to the breed available within the locality. Sharing of bulls requires stringent health preventive measures to control possible incidences of breeding diseases. Given that few farmers keep their own bulls and breeding stocks are recycled within the community (Bebe et al., 2000) with small population (small herd size), there are possibilities of increasing inbreeding rates in the population. Exploring cheaper AI delivery services on small-scale can improve accessibility to AI service for smallholders.

A major shift in the genotypes (Tables 2 and 3) can be observed from zebus to dairy high-grade cattle and to predominance of Friesian (55%) followed by Ayrshire (25%). This has occurred with the decline in average herd size as land holdings decreases and with this, preference is high for genotypes with high milk production potential (Ibrahim and Jayatileka, 2000). It is clear that high milk yield is the most important criteria for

selecting a specific dairy breed as was expected under Kenyan production systems where milk is sold on volume basis. Friesian and Ayrshire were the most preferred breeds for high milk yield, which explains their predominance in the smallholder systems. However, Ayrshire was more favoured over Friesian (Table 3) for disease resistance and feeding behaviour but not for market value and body weight.

Table 2. Frequency (%) distribution of reasons for selecting a certain breed according to smallholders in the cross-sectional survey sample in the central highlands of Kenya

Breeds	n	Reasons for selecting breeds kept				
		High milk yields	Lack of choice of semen	Better looking animals	Extension advice	Others
Most dominant breed						
Friesian	374	77.5	3.2	3.7	2.9	12.7
Ayrshire	166	59.0	6.6	6.0	2.4	26.0
Guernsey	109	46.8	3.7	9.2	7.3	33.0
Jersey	27	44.4	3.7	7.4	0.0	44.5
Second dominant breed						
Friesian	49	65.3	2.0	12.2	4.1	16.4
Ayrshire	120	76.7	5.0	3.3	5.8	9.2
Guernsey	35	54.3	0.0	11.4	2.9	31.4
Jersey	10	70.0	0.0	10.0	10.0	10.0

Table 3. Rating (4=most preferred, 1=least preferred) of dairy genotypes by sample dairy households (n=50) during targeted survey in the central Kenya highlands

Characteristic	Friesian		Ayrshire	
	Mean	SD	Mean	SD
Milk yield	3.85	0.45	3.63	0.89
Fat yield	1.07	0.38	1.16	0.50
Body weight	1.64	0.91	1.21	0.63
Growth rate	1.04	0.19	1.05	0.23
Fertility	1.25	0.65	1.09	0.19
Disease resistance	1.25	0.75	2.16	1.01
Feeding behaviour	1.68	0.82	2.05	0.91
Market value	2.18	0.94	1.79	0.92
Slaughter value	1.07	0.26	1.09	0.37
Longevity	1.04	0.19	1.05	0.29

Smallholders stated during targeted surveys that feed requirement of a breed was an important criterion in breed selection. Friesian was preferred in zero-grazing systems because of her unselective feeding behaviour, making her suitable where a wide variety of feeds are fed. On the other hand, Ayrshire was preferred under semi-zero and free grazing systems because of her ability to graze well in open pastures. High rating given to Friesian for body weight and market demand demonstrates that popularity of Friesian is also for economic reasons attached to salvage value, which is paid on a body weight basis. High rating given to Ayrshire for disease resistance was explained during targeted surveys as ‘‘less frequent disease incidences’’ than Friesian.

The illustrated breeding history for each breed (Figures 1, 2 and 3) over the generations indicates pure-breeding (for Friesian) and crossbreeding practice directed towards large dairy breeds (Frisian and Ayrshire). Large breeds have been crossbred between themselves whereas small breed (Guernsey) has been upgraded using large breeds (Figure 3). It is noticeable that lack of choice of semen had little contribution to smallholders' breeding practice. The observed breeding practice can partly be explained by farmers' perception of associating large breeds with high milk yield. Another possible explanation is that choice for bull or AI semen is limited to the available genotypes, in which case the most available genotype will be favoured in breeding. In Kenyan dairy systems, the most available dairy genotypes are Friesian and Ayrshire (Stotz, 1979; Gitau *et al*., 1994; Mosi *et al*., 2000), which is in agreement with the present study.

Kahi *et al.* (2000b) presented evidence in crossbreeding studies from large-scale farms, which showed that introducing Friesian breed improves milk yields in the herd. In their study, crosses with 50% Friesian genes out-performed other crosses from Ayrshire, Brown Swiss, or Sahiwal in lactation milk yield, annual milk yield and lactation length. However, studies on smallholder systems (Wakhungu et al., 2000) showed that Friesian was out-performed by small breeds (Guernsey and Jersey) in milk yield per lactation, fitness traits and production efficiency. On large-scale farms, management was superior in terms of feeding and health, implying that Friesian will maintain her superiority with improved management. The present study shows that breeding practises reflect smallholders' efforts to maximise the proportion of Friesian genes in their herds to increase milk yield potential. Maximisation of the proportion of Friesian genes in the herd will require increased use of inputs, especially feed resources, to realise the desired high milk. The unselective feeding behaviour of Friesian may not be advantageous for the desired high milk production if the variety of feeds offered is of poor quality. Milk production can only be increased when farmers make less use of poor quality feeds and increase the supply of higher quality feeds such as concentrates and leguminous tree leaves (Zemmelink, 1996; Kaitho, 1997). In the absence of such improvements, small dairy breeds (Jersey or Guernsey) should be favoured and breeding policy options for Friesian re-evaluated under smallholder dairy systems.

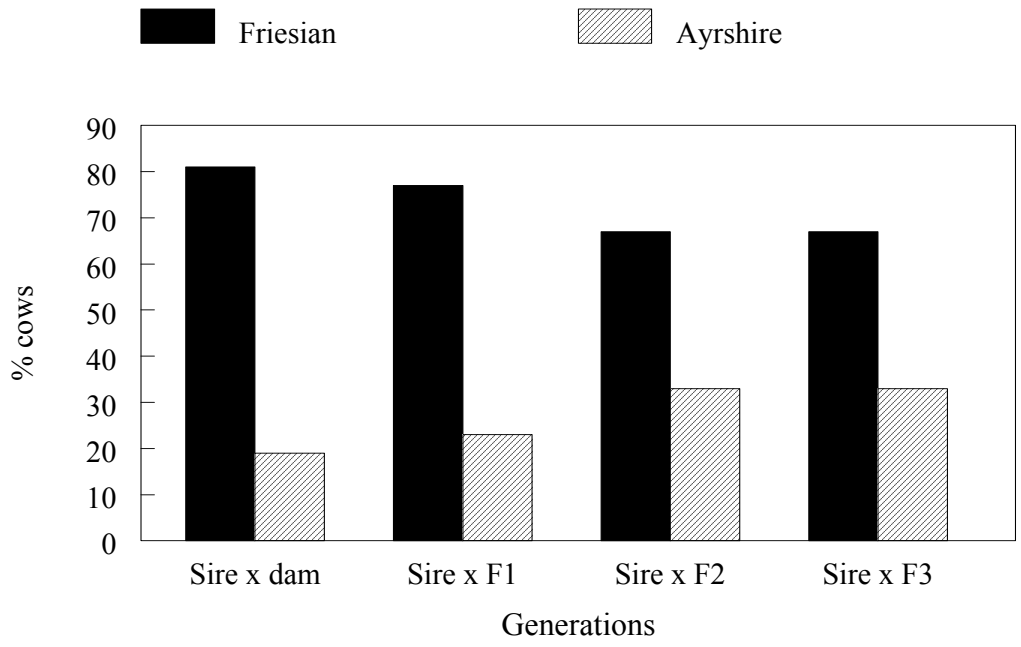

Figure 1. Breeding history for Friesian cow foundation stock and her following heifer relatives

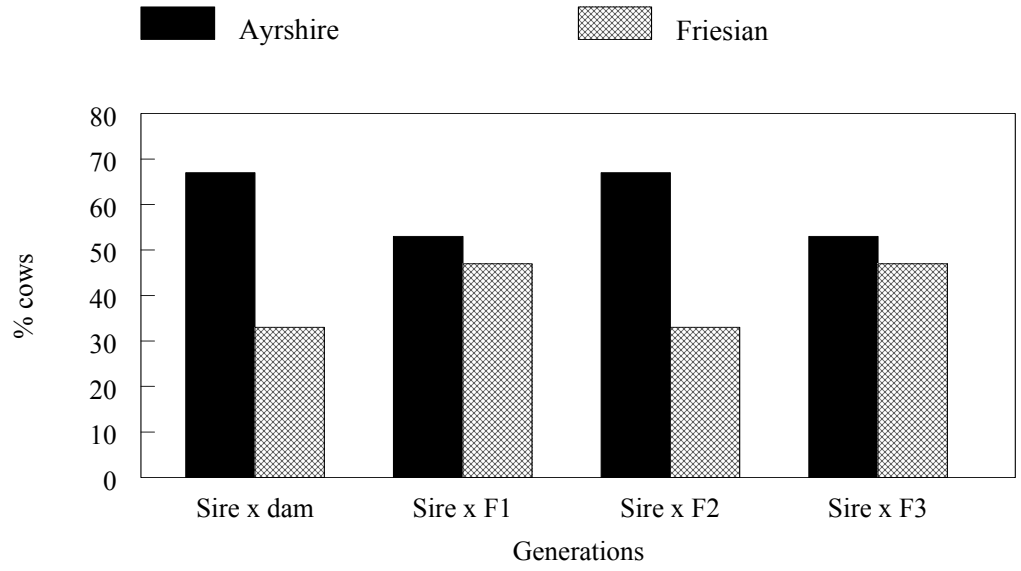

Figure 2. Breeding history for Ayrshire cow foundation stock and her related heifer relatives

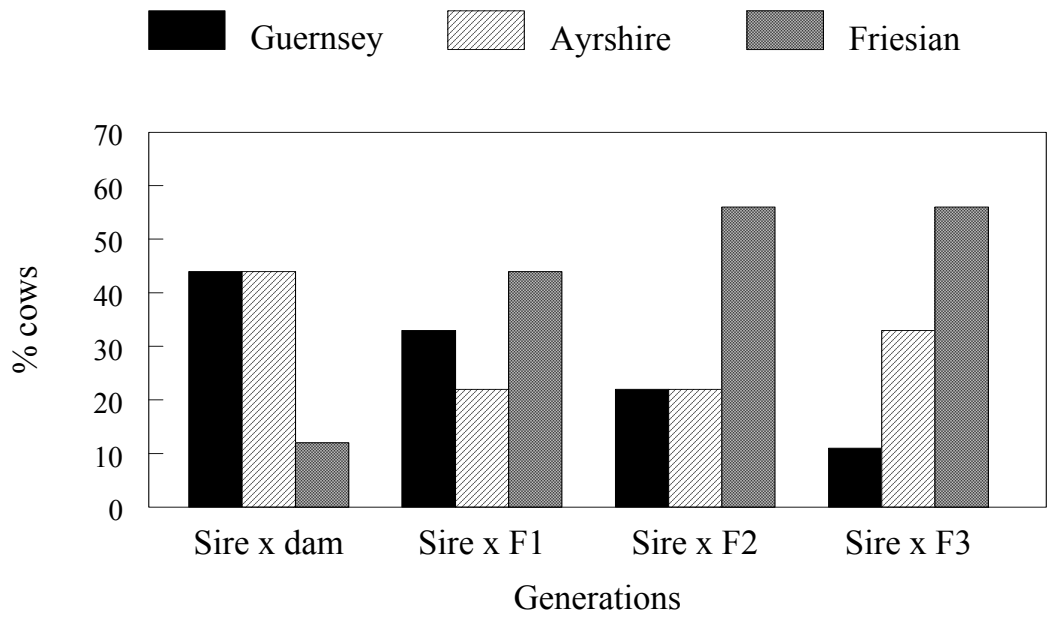

Figure 3. Breeding history for Ayrshire cow foundation stock and her following heifer relatives

Acknowledgements

We gratefully acknowledge the support of the Smallholder dairy (R&D) Project (SDP) of the Kenya Ministry of Agriculture and Rural Development, the Kenya Agricultural Research Institute (KARI) and the International Livestock Research Institute (ILRI). SDP is funded by the UK Department for International Development (DFID). The first author was supported by a research grant from The Netherlands Foundation for the Advancement of Tropical Research-WOTRO. The views expressed are those of the authors and not necessarily those of DFID, SDP or WOTRO.

References

Bebe, B.O., Udo, H.M.J and Thorpe, W., 2000. Disposal and replacement practices in Kenya's smallholder dairy herds. Proc 3rd All Africa Conference on Animal Agriculture and 11th Conference of the Egyptian Society of Animal Production, Alexandria, Egypt from 6th –9th November 2000.

Bondoc, O.L., Smith, C and Gibson, J.P., 1989. A review of breeding strategies for genetic improvement of dairy cattle in developing countries. Anim. Breed Abstracts. 57: 819-829.

Conelly, W.T., 1998. Colonial Era Livestock Development Policy: Introduction of improved dairy cattle in high potential farming areas of Kenya. World Development, 26:1733-1748.

Cunningham, E.P and Syrstad, O., 1987. Crossbreeding *Bos indicus* and *Bos taurus* for milk production in the tropics. FAO Anim. Prod. and Health Paper No. 68.

Gitau, J.K.; O'Callaghan, C.J, McDermott, J.J, Omore, A.O., Odima, P.A., Mulei, C.M and Kilungo, J.K., 1994. Description of smallholder farms in Kiambu District, Kenya. Prev. Vet. Med. 21-2: 153-166.

Ibrahim, M.N.M and Jayatileka, T.N., 2000. Livestock production under coconut plantations in Sri Lanka: Cattle and Buffalo production systems. Asian-Aus. J. Anim. Sci. 13-1:60-67.

Kaitho, R.J., 1997. Nutritive value of browses as protein supplement(s) to poor quality roughages. PhD Thesis, Wageningen Agricultural University, Wageningen.

Kahi, A.K., Nitter, G., Thorpe, W and Gall, C.F., 2000a. Crossbreeding for dairy production in the lowland tropics of Kenya. II. Prediction of performance of alternative crossbreeding strategies. Liv. Prod. Sci. 63:53-63.

Kahi, A.K., Thorpe, W, Nitter, G., and Baker, R.L., 2000b. Crossbreeding for dairy production in the lowland tropics of Kenya. I. Estimation of individual crossbreeding effects on milk production traits and cow live weight. Liv. Prod. Sci. 63:53-63.

MoALDM, 1998. Kenya's Dairy Development Policy: Towards the development of a Sustainable dairy industry, Hill Plaza, Nairobi, Kenya. 53pp.

Mohammad, A. J., Swallow, B.M and Rege, J.E.O., 1999. Incorporation of farmer knowledge and preferences in designing breeding and conservation strategy for domestic animals. Outlook on Agriculture. 28:239-243.

Mosi, R.O., Wakhungu, J.W., Okeyo, A.M and Okore, C., 2000. A review of dairy cattle improvement in Kenya. Proc. Dairy Cattle Breeding in East Africa and Sustainable Artificial Insemination Service, KARI HQs, Nairobi, Kenya. p13-14.

Okeyo, A.M., Kajume, J.K, Mosi, R.O., Okila, E.V.A., Gathuma, J.M., Kiere, S.M.N, Agumba, G., Kuria, J.N and Chema, S., 2000. Artificial insemination as a bio -technological tool for genetic improvement of the Kenyan dairy cattle herds: Historical perspective, current status, challenges and the way forward. Proc. Dairy Cattle Breeding in East Africa Sustainable Artificial Insemination Service, KARI HQs, Nairobi, Kenya. p10-11.

Oluoch-Kosura, W., Okeyo, A.M., Waithaka, M.M and Okilla, E.A., 2000. The economic implications of declining artificial insemination service provision in Kenya. Proc. Dairy Cattle Breeding in East Africa Sustainable Artificial Insemination Service, KARI HQs, Nairobi, Kenya. p12-13.

Rege, J.E.O., 1998. Utilization of exotic germplasm for milk production in the tropics Proc. 6th World Cong. On Genetics Applied to Livest. Prod. 25:193-200.

Staal, S.B.; Chege, L.; Kenyanjui, M.; Kimari, A.; Lukuyu, B.; Njubi, D.; Owango, M.; Tanner, J.; Thorpe,W. and Wambugu, M., 1998. Characterisation of dairy systems supplying the Nairobi milk market: A pilot survey in Kiambu district for the identification of target groups of producers. Project report of the MoA/KARI/ILRI Smallholder Dairy (R&D) Project. Nairobi, Kenya, 85p.

Stotz, D., 1979. smallholder dairy development in past, present and future in Kenya. PhD Thesis, Hohenheim University, Germany.

Wakhungu, J.W., Mosi, R.O. and Carles, A.B., 2000. Dairy cattle breeding policy for Kenyan smallholders: An evaluation based on demographic stationary state

productivity model. Proc. Dairy Cattle Breeding in East Africa Sustainable Artificial Insemination Service, KARI HQs, Nairobi, Kenya. p17-18.

Zemmelink, G., 1996. Increasing productivity of tropical crop-livestock systems by optimal utilisation of crop residues and supplementary feeds. Final Scientific Report. Program for development DG12-TS3-CT92-0120. Commission of the European Community, Brussels.