JOURNAL OF ANIMAL SCIENCE ADVANCES

Herd Characteristics on Smallholder Dairy Farms in Western Kenya

Wanjala S. P. O. and Njehia K. B.

J Anim Sci Adv 2014, 4(8): 996-1003

DOI: 10.5455/jasa.20140827111904

Online version is available on: www.grjournals.com

Original Article

Herd Characteristics on Smallholder Dairy Farms in Western Kenya

[*1,2]Wanjala S. P. O. and [1]Njehia K. B.

[1] Department of Agribusiness Management and Trade, Kenyatta University.
[2] Kenya Agricultural Research Institute.

Abstract

A cross-sectional proportional and stratified random sample survey of 400 smallholder dairy farms in Western Kenya was carried out to characterize the herd structure and determine its performance between July and October 2013. The results showed that the dominant improved breeds kept comprised exotic cattle-zebu crosses (41.7%), Friesians (34.3%), Aryshires (22.4%), Jerseys 1.6% with significant differences ($p<0.05$) in milk yields. The mean herd size was 2.46, while a proportion of 36.4% and 15% of the animals were lactating cows and heifers respectively. The mean milk yield /cow/day was 6.47 litres with 89.3% of the farms producing less than 10 litres of milk/cow/day. Average quantity of milk produced was 1168 litres/cow/year. Mean lactation length was 7.67 months (230 days) with majority of farms (77.8%) recording a lactation period of 5-7 months (150-210 days). The mean calving interval was 14.77 months (430 days) with a range of 12-36, while mean age at first calving was 28.16 months with a range of 24-38 months. 98% of the farms used Napier grass as the main fodder. The study concluded that the low performance of dairy herds in the region may be attributed to type of breeds kept, low numbers of lactating cows and replacement heifers, short lactation period and utilization of low quality feed resources. It is recommended that management skills, strong institutional linkages, support for commercial rearing of dairy breeding stock, and feeds diversification programme should be developed to improve performance of dairy herds in the region.

Keywords: Herd structure, dairy breeds, milk production, lactation period, calving interval, age at first calving.

[*] Corresponding author: Department of Agribusiness Management and Trade, Kenyatta University.
Received on: 15 Jun 2014
Revised on: 07 Jul 2014
Accepted on: 27 Aug 2014
Online Published on: 31 Aug 2014

Introduction

The dairy industry in Kenya accounts for about 4% Gross Domestic Product (GDP) and is a major source of livelihood for more than 1 million people in the sub sector (FAO, 2011). The country produces more than 4.5 billion litres annually mainly from cattle (3.5 million head of Friesian, Ayrshire, Jersey and Guernsey breeds and their crosses, and 9.3 million indigenous local cattle), camels (1 million) and goats (13.9 million) (FAO, 2011) . Dairy cattle alone produce about 70 percent of total national milk output (Karanja,2003).Out of the estimated national improved dairy herd of 3.5 million, smallholders own 3.3 million cattle and control over 80% production and over 80% of the marketed milk (GOK, 2010). These farmers own 1-3 cattle and market milk through a dualistic system either to processors or through the informal channel directly to consumers, traders or through cooperatives (Omore *et al.,* 2004). Smallholder dairy in Kenya has been described as one of the most successful in Africa (Staal *et al.,* 2008b). This success can be traced back to1954 when a colonial policy paper known as the "Swynnerton Plan" allowed Africans to engage in commercial agriculture using cross bred cattle (Conelly 1998). Soon after independence in 1963, government policy to support small scale farmers marked the beginning of smallholder domination of the dairy industry (Muriuki *et al.,* 2004). Despite the plausible performance, Kenya's dairy industry is still bedevilled by several challenges which include inadequate quantity and quality feed, prevalence of diseases, inadequate access to quality replacement stock, low adoption of technologies, high cost of farm inputs and low milk value addition among dairy producers (Omore *et al.,* 1999; GoK, 2010). Some of these challenges are being addressed through the Dairy Master Plan (GoK, 2010). However, studies of herd characteristics which could be useful in developing strategies for improving milk production across the country have mainly been carried out in the Central and Rift Valley regions where the national dairy herd and large scale farms are concentrated (Bebe *et al.,* 2003). Whereas these areas are largely self-sufficient in milk, the rest of Kenya, particularly the Western region, have low milk supply for most parts of the year (Wambugu 2011; Wanjala *et al.,* 2014). Low production of cows and low milk supply still persist in Western Kenya despite indications of great potential for dairy development in the region (Waithaka *et al.,* 2002; Mudavadi, 2000). Therefore, the objective of this study was to characterize the herd structure and performance on smallholder dairy farms in Butula and Butere districts of Western Kenya. Understanding the region's herd composition, performance and associated factors are essential in developing strategies for improvement.

Materials and Methods

Study Area

The study was carried out in Butula and Butere districts in Busia and Kakamega counties of Western Kenya. The region has an estimated 99000 smallholder dairy farmers keeping about 192300 improved dairy cattle (FAO 2011). Both Butula and Butere lie at an altitude of 1200-1500 Meters above sea level and experience a bimodal rainfall pattern of 1500-2000 mm (Jaetzold *et al.,* 2006). Farmers practice mixed livestock-crop farming, in which sugarcane is the main cash crop while maize, beans, sweet potatoes and cassava are the main staples. Dairy farming is a prominent activity in Butula and Butere districts and is mainly organized around groups formed by NGOs such as Heifer Project International who are involved in dairy development.

Study Variables

Four categories of variables were investigated in this study. These included: Herd structure (size, composition); herd performance (Milk production, lactation length, calving interval and age at first calving); Breeds kept (sources, their performance and associated problems); and grazing systems, sources and types of fodder on farms.

Statistical Analysis

A cross sectional survey using semi structured questionnaire was carried out from a stratified proportional random sample of 400 farmers keeping improved dairy cattle in Butula and Butere districts

of Western Kenya. The questionnaire was administered by trained enumerators selected with the assistance of the livestock office. Within each district, all divisions were stratified, while the number of farmers from each division was proportionally selected from groups and subjects for the study chosen at random from lists provided by the livestock office. Thus 227 farmers were chosen from Butula district while 173 were selected from Butere district. Dairy groups were preferred since they have been in existence for seven years and had undergone training in various modules including record keeping.

Additional data was collected from district livestock offices through interviews and farm observations. Data obtained was coded and uploaded in Microsoft excel 2007 spread sheet computer program and analyzed using SPSS version 19. Analysis of herd characteristics entailed use of frequency counts, percentages and means to produce tables and pie charts, while Univariate Analysis of Variance (ANOVA) was used to test differences in milk yield between breeds.

Results and Discussion

The results presented and discussed are for the regional pooled data since preliminary analysis showed that there were no significant differences between Butula and Butere in all the four categories of variables investigated.

Herd Composition

The findings obtained showed that the herd size ranged from 1-8 animals with a mean of 2.46, while a proportion of 36.4% and 15% of the animals were lactating cows and heifers kept by 72.6% and 37% of the total number of farms respectively (Table 1). These results suggest that there is a major shortage of replacement heifers on about 63% of smallholder farms in Western Kenya. This, together with the low numbers of lactating cows may be an indication as to why the region is perpetually milk deficient (Wanjala *et al.,* 2014; Waithaka 2002). Inadequate and un availability of replacement stock on smallholder farms has been a key concern for the dairy industry in Kenya since these farms own about 80% of total dairy herd population and produce more than 70% of marketed milk (Bebe *et al.,* 2003a; Muruiki 2004). In the past, state farms and large scale private farms produced replacement stock for smallholders often at subsidised price, but these have since collapsed or sub divided for human settlement (Connely 1998). For smallholders in the region to easily access breeding stock to maintain the population of their herds and be able to produce milk for food and incomes, new strategies such as encouraging the rearing of improved dairy heifers as a business by farmers, Agricultural Training Centres and individual entrepreneurs should be considered.

Table 1: Herd structure on smallholder farms in Western Kenya.

Herd composition	No of farms	% of total farms	Mean	StdDev	Min	Max	Total no of animals	Proportion (%) of animals
Herd size	400	100	2.46	1.33	1	8	995	100
Male calves	107	26.8	1.12	0.36	1	3	120	12.1
Female calves	132	33	1.14	0.37	1	3	150	15
Immature bulls	40	10	1.23	0.57	1	3	49	4.9
Heifers 1-2 yrs	148	37	1.15	0.46	1	4	169	17
Steers	6	1.5	1.13	0.52	1	2	8	0.8
Bulls	18	4.5	1.17	0.71	1	1	18	1.8
Lactating cows	291	72.6	1.24	0.50	1	3	362	36.4
Dry cows	106	26.7	1.12	0.33	1	2	119	12.0

Source: cross sectional survey data.

Performance Indicators

Milk Production

The findings of this study revealed there mean milk yield /cow/day was 6.47 litres with 53.6% of the farms producing less than 5 litres of milk/cow/day, while 35.7% and 6.7% produced 6-10 and 11-15 litres respectively. Only 3.8% of the farms produced more than 15 litres / cow/day (Table 2). The low average milk yields could be attributed to poor or underfeeding of lactating cows, and poor feed quality since 98% of the farms relied on Napier grass as the main roughage (Table 6). Studies have generally shown that milk yields are affected by genetic, management and environmental factors (Msanga *et al.,* 2000). Staal *et al.,* (1998a) reported that dairy animals on smallholder farms in Kenya are underfed, resulting in low milk yields. To improve the quantity of milk produced on smallholder farms particularly in Western Kenya, diversification of feed resources especially the utilization of crop residues (maize stovers, sugarcane tops), legumes (sweet potato vines, bean stalks/ husks, desmodium) and industrial by-products (molasses) should be emphasised. Of particular importance would be a shift from the common practice of wet feeding observed on most farms to best practice of dry matter feeding. There is also urgent need for capacity building of dairy groups on making of homemade dairy cattle feed rations, utilization of pulveriser technology for feed processing, and cultivation of feeds with high energy and protein value such as Rhodes grass, forage maize, and Lucerne.

Lactation Period

The mean lactation period on smallholder farms in the region was very low at 7.67 months (230 days) with majority of farms (77.8%) recording a lactation period of 5-7 months (150-210 days). This finding means that the cows are drying up too early before the desired normal lactation period of 305 days (Chamberlain and Wilkinson, 2002). The results further indicate that average milk yield/cow/year in Western Kenya was 1168 litres. The average annual milk production in the country is estimated to be 1600 kg per lactating cow. The officially recorded average for the Friesian breed is about 4200 kg over 305 days of lactation (FAO, 2011). Varying lactation periods and yields of 2407.47 litres in 239 days and 200-250 days have been reported in different parts of the country (Ongadi *et al.,* 2007, Muhuyi *et al.,* 2001). The low yields and short lactation length observed in this study could be attributed to inadequate nutrition characterised by low quantity and quality of feeds. The association between feeds, yield, and lactation length has been reported in various studies (Staal *et al.,* 1998; Msanga *et al.,* 2000; Chamberlain and Wilkinson, 2002).

Calving Interval and Age at First Calving

The mean calving interval was 14.77 months (430 days) with a range of 12-36, while mean age at first calving was 28.16 months with a range of 24-38 months. The prolonged calving intervals and age at first calving resulted in reproductive wastage on the smallholder farms. Reproductive wastage on smallholder dairy farms in Kenya has been reported by Lanyasunya *et al.,* (1999), Bebe *et al.,* (2003b) and Katiku *et al.,* (2007). In the case of Western Kenya this could be mitigated through efficient feeding regimes, timely delivery of artificial insemination, access to veterinary services and proper estrus detection.

Table 2: Performance of dairy cows on smallholder farms in the study area.

Milk Production/cow/day (litres)	No of farms	Percentage
1-5	156	53.6
6-10	104	35.7
11-15	20	6.9
> 15	11	3.8
Total	291	100
Mean milk production/cow/day = 6.47 $\pm$ 3.88		
Lactation period (months)		

5-7	238	77.8
8-10	39	11.7
11-12	29	10.5
Total	306	100
Mean lactation period = 7.67± 1.6 months (230 days)		
Calving interval (months)		
12-18	290	90.9
19-24	32	6.9
25-30	3	0.9
31-36	4	1.3
Total	329	100
Mean calving interval =14.77 ± 2.61 months		
Age at first calving (months)		
24-28	139	65
29-33	49	22.9
34-38	23	12.1
Total	214	100
Mean age at first calving = 28.15± 3.9 months		

Source: cross sectional survey data.

Cattle Breeds

The study found the common breeds kept for milk production were exotic cattle-zebu crosses (41.7%) and Friesians (34.3%), followed by Aryshires (22.4%), while Jerseys were kept on 1.6% of the farms (Table 3). Farmers interviewed reported that Crosses were obtained through upgrading of local cows while improved breeds were mainly donations by development NGOs, particularly Heifer International through send-a-cow-scheme (62%). Other sources of dairy cattle included purchases from the Rift Valley (22%), neighbours (11%) and miscellaneous sources such as markets and dowry (Fig 1). Problems associated with breeds as perceived by farmers were: low milk production (46%), cow not easily coming on heat (20.5%), reproductive disorders (16.5%), and frequent treatment (16%) (Table 5). In terms of breed performance, Friesians produced a higher mean yield of 7.6 litres/day compared to Aryshires at 7.0 kg, while Jerseys produced 6.1 litres per day. Low mean yields of 3.9 litres were reported in Crosses. There mean yields between exotic breeds (Friesians and Aryshires) and crosses were significantly different ($p<0.05$) (Table 4). These results suggest that besides poor feed quality, the low performance of dairy herds on smallholder dairy farms in the region may also be associated with the type of breeds kept (Table 6).

Table 3: Dominant improved cattle breeds kept in the study area.

Cattle breed	No. of farms	Total no of animals	Proportion (%) of animals
Crosses	222	415	41.7
Friesian	148	341	34.3
Aryshire	127	223	22.4
Jersey	15	16	1.6

Source: cross sectional survey data.

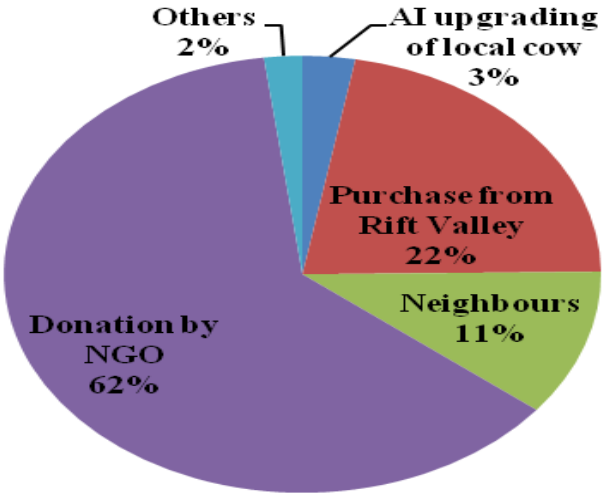

Fig. 1: Sources of dairy cattle breeding stock.

Table 4: Mean milk yields of different cattle breeds in the study area.

Cattle breed	No of farms	Milk yield /cow/day (litres)		
		Mean	Min	Max
Friesian	76	7.6	4.0	20.0
Aryshire	68	7.0	3.5	20.0
Jersey	15	6.1	3.0	15.0
Crosses	111	3.9	1.0	6.0
Pair wise comparisons*				
Breed[b] (I)	Breed (J)	Mean difference (I-J)	Std error	P value
Friesian	Aryshire	0.6	1.087	0.997
	Crosses	3.7[a]	0.0878	0.001
Aryshire	Friesian	- 0.6	1.087	0.997
	Crosses	3.1[a]	1.153	0.008
Crosses	Friesian	-3.7[a]	0.878	0.001
	Aryshire	-3.1[a]	1.153	0.008

* The farm sizes were unequal. Jersey was dropped due to sample size less than 30.
[a] The mean difference in milk yields was significant at 0.05 level.
[b] F statistic for effect of breed was significant (F_2, 270 = 6.905, $p<0.001$).
*Only farms with one type of breed producing milk were selected.
Source: cross sectional survey data.

Table 5: Problems associated with breeds as perceived by farmers.

Problem	Frequency	Proportion of farms (%)
Low milk production	92	46
Cow does not easily come on heat	41	20.5
Reproductive disorders	33	16.5
Cow needs frequent treatment	32	16
Cow has bad temper	2	1
	n = 200	100

Source: cross sectional survey data.

Results displayed in table 6 indicate farmers' over reliance on Napier grass (98%) as the main

source of roughage, mainly grown on own farm (90.1%). The main feeding systems used were zero grazing (stall-feeding 67.1%), semi grazing (23.9%), tethering (5.3%) and open grazing (3.8%). Several studies in Kenya have reported that feeding Napier grass alone without supplementation yielded about 5 litres of milk/day (Waithaka *et al.,* 2002, Muraguri *et al.,* 2004). This is in agreement with the low yields of 6.47 litres found in this study. With increasing intensification of farms through zero grazing occasioned by dwindling land sizes, we argue as before, that a strategy to diversify feed resources on farms has potential to enhance quantity of milk produced.

Table 6: Grazing systems, sources and type of fodder on smallholder dairy farms.

Parameter	Description	No of farms	Percentage
Grazing system (N=398)	Zero grazing	267	67
	Semi grazing	95	23.9
	Open grazing	15	3.8
	Tethering	21	5.3
Source of fodder (N=394)	Own farm	355	90.1
	Roadside grass	1	0.3
	Purchase from outside	30	7.6
	Rented land	8	2.0
Main fodder fed (N=400)	Napier grass	392	98.0
	Natural pasture	8	2.0

Source: cross sectional survey data.

Conclusion and Recommendations

This study sought to investigate the type of breeds, herd composition, performance and feeding systems which characterize the dairy herds in Western Kenya. The study found the mean herd size was 2.46, while a proportion of 36.4% and 15% of the animals were lactating cows and heifers respectively. The mean milk yield /cow/day was 6.47 litres with 89.3% of the farms producing less than 10 litres of milk/cow/day. The mean differences in milk yields between exotic breeds and crosses was significant ($P<0.05$). The study found that the mean lactation period was very low at 7.67 months, while mean calving interval was 14.77 months. 98% of the farms used Napier as the main fodder. The study concluded that the low performance of dairy herds experienced in the region may be attributed to low numbers of lactating cows and replacement heifers, type of breeds kept, short lactation period and low quality feed resources. It is suggested that management skills, institutional linkages, support for commercial rearing of dairy breeding stock, and feeds diversification programme should be developed to improve performance of dairy herds in the region.

Acknowledgement

The authors are grateful for the support given by enumerators, dairy farmers, the county directors and livestock production officers in Butula and Butere districts. The study was facilitated by Kenya Agricultural Research Institute and funded by East African Agricultural Productivity Project. This paper is submitted for publication with permission from Kenyatta University.

References

Bebe BO, Udo HMJ, Rowlands GJ, Thorpe W (2003a). Smallholder dairy systems in the Kenya highlands: Cattle population dynamics under increasing intensification. Liv. Prod. Sc., 82: 11-221.

Bebe BO (2003b). Herd dynamics of smallholder dairy farms in the Kenya Highlands. PhD Thesis, Wageningen University, the Netherlands. ISBN., 90-5808-788-3.

Chamberlain AT, Wilkinson JM (2002). Feeding the dairy cow. Lincoln, UK: Chalcombe Publications.

Conelly WT (1998). Colonial Era livestock Development Policy: Introduction of improved dairy cattle in Central highlands of Kenya. World Dev., 26: 1733-1748.

FAO (2011). Dairy development in Kenya, by HG Muriuki. Rome: Food and Agriculture Organization of the United Nations.

Government of Kenya (2010). Kenya National Dairy MasterPlan. Nairobi: Ministry of Livestock Development, Nairobi.

Jaetzold R, Schmidt H, Hornet ZB, Shisanya CA (2006). Farm management handbook of Kenya. Natural conditions and farm information, vol 11/C, 2nd edn. Nairobi: Ministry of Agriculture/GTZ.

Karanja AM (2003). The Dairy Industry in Kenya: The Post-Liberalization Agenda. Tegemeo Institute/Egerton University Research Paper. Nairobi, Kenya. 51 pp.

Katiku PN, Gachuiri CK, Mbugua PN (2011). Characterization of dairy cattle farming in Mbeere District of Eastern Kenya. Livest. Res. Rural. Dev., Vol. 23: 11.

Lanyasunya TP, Wekesa FW, de Jong R, Udo H, Mukisira EA, Ole Sinkeet NS (1999). Effects of a calf rearing package introduced to smallholder dairy farms in Bahati division, Nakuru district, Kenya. In: Proceedings of 6th Biennial KARI Scient. Conf., held on 9-13 November, (1998), Nairobi, Kenya. pp. 450-457.

Mudavadi PO, Otieno K, Wanambacha JW, Odenya JO, Odendo M, Njaro OK (2001). Smallholder dairyproduction and marketing in western Kenya: A Review of Literature. The Smallholder Dairy (R&D).

Msanga YN, Bryant MJ, Rutam IB, Minja FN, Zylstra L (2000). Effect of environmental factors and of the proportion of Holstein blood on the milk yield and lactation length of crossbred dairy cattle on smallholder farms in north-east Tanzania. Trop. Anim. Health Prod., Vol. 32(1): 23-31.

Muhuyi WB, Wekesa FW, Mukisira EA, Mosi RO, Isika M, Okore C, Kirui J, Makori J, Lukibisi FB (2001). Sustainability of smallholder dairy production systems in the semi-arid Rongai Division of Nakuru. In: The challenges of drought to livestock production in Kenya. Proceedings of APSK Annual Symposium held on 7-March at Egerton University, Njoro, Kenya.

Muraguri GR, Mcleod A, Taylor N (2004). Estimation of milk production from smallholder dairy cattle in the Coastal lowlands of Kenya. Trop. Anim. Health Pro., Vol. 36(7): 673-684.

Muriuki H, Omore AO, Hooton N, Waithaka M, Staal SJ, Odhiambo P (2004). The policy environment in the Kenya dairy sub-sector: a review (Research Report). MoA/KARI/ ILRI Smallholder Dairy Project, International Livestock Research Institute: Nairobi, Kenya.

Omore A, Muriuki H, Kenyanjui M, Owango M, Staal S (1999). The Kenya Dairy sub sector: A rapid appraisal (Research & Development) Project Report. Ministry of Agriculture / Kenya Agr. Res. Inst.

Ongadi PM, Wakhungu JW, Wahome RG, Okitoi LO (2007). Characterization of grade dairy cattle owning households in mixed small scale farming systems of Vihiga, Kenya. Livest. Res. Rural Dev., Vol. 19: 3.

Staal S, Chege L, Kenyanjui M, Kimari A, Lukuyu B, Njubi N, Owango M, Tanner J, Thorpe W, Wambugu M (1998a). Characterization of Dairy Systems Supplying the Nairobi Milk Market. KARI/ILRI/MALDM Collaborative Dairy Research Program. International Livestock Research Institute, Nairobi, Kenya.

Staal SJ, Pratt AN, Jabbar M (2008b). Dairy Development for the Resource Poor Part 1: A Comparison of Dairy Policies and Development in South Asia and East Africa. PPLPI. Working Paper No. 44-1 Int. Livestock Res. Inst.

Waithaka MM, Nyangaga JN, Staal, SJ, Wokabi AW, Njubi D, Muriuki KG, Njoroge LN, Wanjohi PN (2002). Characterization of dairy systems in the Western Kenya region. Nairobi: The Smallholder Dairy (R and D) Project Report, 73, pp.

Wambugu S, Karimi L, Opiyo J (2011). Productivitytrends and performance of dairy farming in Kenya. Tegemeo Inst. Agr. Pol. Dev., Egerton University.

Wanjala SPO, Njehia B, Ngichabe C (2014). Assessment of the Structure and Performance of the Milk market in Western Kenya. IJCR., Vol. 6(3): 5652-5656.