



sheep-dairy, tea-dairy, coffee-dairy, food crop-dairy and wheat-dairy. The selected Districts and their classification were:

- High dairy production potential
  - medium market access ( Kirinyaga, Murang'a, Maragua)
  - low market access (Nyandarua)
- Medium dairy production potential
  - high market access (Nairobi and Machakos)
  - medium market access (Nakuru)
  - low market access (North Narok)

Maps of the randomly selected sub-locations within the chosen Divisions were drawn from ILRI's GIS databases. On these maps, enumerators marked major landmarks like schools, hospitals, churches, rivers, etc. Transect lines were then drawn between random pairs of landmarks, along which every 5<sup>th</sup> farm/household was sampled alternately on the left and right. The sample size was calculated per stratification group to estimate the difference between two means, with a confidence level of 95%, based on a coefficient of variation in number cows of 68% and to observe a level of difference of 20% for important farm/household variables (Staal *et al*, 1998). Preliminary results are presented here.

### 3. RESULTS AND DISCUSSION

Of the 1390 households interviewed, 1015 (79%) had agricultural activities, and 741 (74%) of these had cattle. The vast majority of the rural households were smallholder farms, confirming the importance of smallholders and of dairy to Kenya's rural economy. Table 1 shows for five districts that reflect the important variation observed in the whole sample, the proportion of agricultural households and those with cattle, the majority of which were dairy types (Table 3).

**Table 1: Number of households surveyed and the proportions with agricultural activities, and the proportion of the agricultural households that had cattle.**

District	Total HH	Agricultural		With cattle	
		N	%	N	%
Kirinyaga	100	96	96	76	79
Nairobi	293	25	8	14	56
Nyandarua	113	110	97	98	89
Nakuru	393	351	89	230	66
Narok	79	42	53	36	86

Within the central highlands, the increase in human population and subsequent sub-division of land holdings has stimulated more intensive land use, including the adoption of high-grade dairy cattle and a shift from grazing-based to stall-feeding systems. As Tables 2 and 3 show for representative Districts, feeding practises have intensified significantly during the last 10 years in areas with high production potential and good market access (represented here by Kirinyaga, where now 95% of cattle are kept in semi-zero or stall feeding systems). By contrast, areas with medium to low market access (represented by Nyandarua and Narok) have shown less intensification of feeding practises. In the same way, the adoption of dairy cattle has been slowest in Narok, an area of relatively poor market access and medium production potential.

**Table 2: Main feeding systems practised (%) 10 years ago and now.**

District	Grazing		Semi-zero		Stall feeding	
	Ago	Now	Ago	Now	Ago	Now
Kirinyaga	31	5	27	30	42	65
Nairobi	80	0	0	27	20	73
Nyandarua	26	23	70	71	4	6
Nakuru	53	32	30	49	17	19
Narok	100	97	0	3	0	0

**Table 3: Predominant dairy breeds in the herd (%).**

District	Friesian	Ayrshire	Jersey	Guernsey	Zebu
Kirinyaga	23	18	7	49	3
Nairobi	77	8	0	15	0
Nyandarua	68	27	2	1	2
Nakuru	47	24	4	10	15

Narok	0	0	0	0	100
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While the shift from indigenous zebu cattle to those with exotic dairy genes has resulted in marked increases in daily milk yields (Table 4: Narok with zebu yielding less than 1 litre; Nairobi dominated by Friesian yielding over 6 litres), absolute yields are still much below the genetic potential for these dairy grades. The low milk yields and the poor reproductive performance, characterised by long calving intervals, can be attributed to under-nutrition compounded by inadequate AI services.

**Table 4: Dairy production performance.**

District	Calving Interval, days		Daily Milk Prod., Litres	
	Mean	SD	Mean	SD
	Kirinyaga	607	209	4.6
Nairobi	548	258	6.4	7.1
Nyandarua	519	123	5.1	2.9
Nakuru	522	216	4.8	2.7
Narok	519	128	0.9	0.6

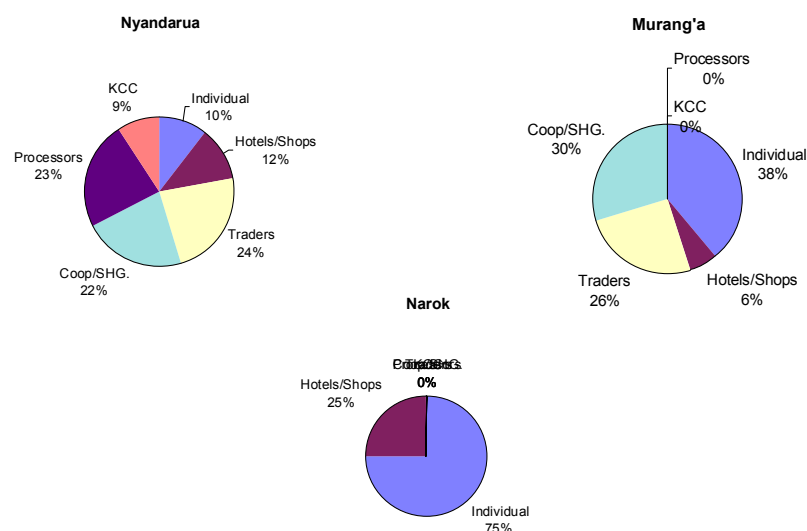
The survey results confirmed the expected variation in market access (as assessed by availability of milk sales outlets) and producer prices, which were higher nearer Nairobi, reflecting the concentration of consumers, the competition amongst milk purchases and the relative absence of milk surpluses (Table 5: representative Districts).

**Table 5: Mean quantities of milk consumed and sold by producer households and the sale price**

District	Consumed, litres		Sold, Litres		Price per litre Ksh.	
	Mean	SD	Mean	SD	Mean	SD
	Kirinyaga	2.2	1.0	3.5	3.0	15.6
Nairobi	-	-	13.8	22.2	27.8	4.5
Nyandarua	2.7	1.6	7.9	6.3	14.4	1.6
Nakuru	2.2	1.0	5.8	7.5	14.6	2.5
Narok	2.4	1.0	3.2	1.8	18.2	2.5

Sales outlets were mainly individual consumers, traders (hawkers), hotels/shops, dairy cooperatives, KCC and private processors (Fig. 2), with greatest dependence on individual consumers in areas of poor market access (Narok). The results indicate that the role of traders is most important in areas either very close to major markets (parts of Kiambu, where they can offer higher prices to farmers than dairy co-operatives) or where market access is poor and formal collection has not been established.

**Fig. 2: Primary milk sales outlets (%)**



As a result of the variation in costs of production, Districts with less intensive production systems had higher net cash flow per metric ton of milk produced relative to those with more intensive ones (Table 6). Although cash flows per farm are lower in those areas, labour costs per farm are likely to be much higher due to higher opportunity costs.

**Table 6: Net cash flow per farm and per tonne of milk produced by level of intensification (at the household level)**

Intensification	N	Cash Flow Per Farm (Ksh)	Cash Flow Per MT of Milk
Low	114	37,337	20,562 <sup>a</sup>
Intermediate low	141	36,239	14,259 <sup>ab</sup>
Intermediate high	170	41,445	15,519 <sup>a</sup>
High	183	48,808	9,679 <sup>ab</sup>

<sup>a b</sup> Results with the same superscripts are not significantly different ( $P > 0.01$ )

#### 4. CONCLUSION

The results confirmed the importance of dairy production as a source of income for the majority of smallholder households and showed that milk marketing provides employment for many other low income earners. The results also showed that intensification, through changes in cattle type and management, feeding strategies, and land allocation, have occurred at a rapid rate over the last ten years in areas where access to dairy markets is good, but more slowly, if at all, where market infrastructure is poor. On the other hand, net cash flow per unit of milk was higher for the less intensive production systems, suggesting long-term ability to withstand potential declines in real milk prices. Dairy production systems in central Kenya therefore display a wide variability of strategies, each responding to the particular marketing and production environments in an area. The longer term competitiveness of these systems, therefore, depends not only on how labour and land values change over time, but also on changes in market and institutional infrastructure. If road and market infrastructure improves, organised marketing is likely to better reach distant areas, bringing higher milk prices to those producers. Under those circumstances, the competitiveness of production is likely to shift significantly. Therefore, Government and private sector support to smallholder dairying, whether through improved policies, institutions or technologies, has to simultaneously, not separately, consider marketing and production aspects.

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