

Economic and nutritional contribution of camel milk in Northern Kenya

A field study in Isiolo County

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This report is one of a series of reports synthesising the findings of field research conducted by masters' and doctoral degree students at the University of Nairobi, who investigated the contribution of pastoral production to the local economy. The students developed the research to complement their degree studies, with support from the International Institute for Environment and Development.

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Executive summary

Many challenges threaten the existence of pastoralism as a land use system in Kenya. Most decision makers and policies view pastoralism as an outdated production system that must be replaced. A leading factor has been the lack of information on the sector's contribution to the national and local economies in terms of the marketed value of pastoral products and the cost of avoiding famine threats and improving pastoral household income and nutrition securities. This study aims to address this information gap by determining the contribution the camel milk subsector makes to household income and diets in Isiolo County and understanding the linkages between camel milk production clusters and the regional economy.

The study uses available secondary data and original data from key informant interviews, focus group discussions and a survey involving semi-structured interviews with a total of 100 milk producers and 60 herders from Central and Kulamawe, the two largest camel milk production clusters in Isiolo. The analysis focuses on assessing the value of marketed and consumed camel milk, and the number of people who benefit from this, directly or indirectly.

Our study estimates that:

- camel milk in both clusters has a total economic value of KSh222,667,200 (about US\$2.6 million) a year
- 10,532 people benefit directly and indirectly from camel milk production
- camel milk makes a significant contribution to pastoral household diets during both wet and dry seasons.

We also find strong interdependent relationships between the two clusters in terms of production and marketing, an important factor that enables production to play a role in supporting pastoralist households.

Based on these findings, we conclude that camel milk production contributes significantly to the economy of Isiolo county and supports a large proportion of the population. We believe that there is a need to invest in the sector, and camel milk production should be at top of the agenda for Isiolo County. We therefore recommend that policymakers:

- create an enabling policy environment to enhance milk production and marketing, which will encourage much-needed investment in the camel milk subsector
- take the important relationships between the two production clusters into account; harnessing the identified linkages will help improve milk production and marketing, and
- establish a framework that can be used to track the systematic improvement of camel milk production and marketing and generate more data on production, prices and contribution to households and the economy of Isiolo County.

Introduction

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Indicators such as gross domestic product, coupled with consideration of national food security and income, tend to guide national resource allocation. At the same time, mainstream economic statistics often fail to capture unseen indirect and intermediate goods and services. This results in the underestimation of contributions to the economy by sectors that produce hidden services, which in turn leads to lower levels of resource allocation and attention from policymakers. Such is the challenge faced in the pastoral production subsector in most African countries, and Kenya is no exception.

The 2013/14 budgetary allocation to the agriculture and livestock sector in Isiolo County, northeast Kenya, was estimated at KSh107,800,000 (around US\$1.26 million).¹ In comparison, tourism and county parks were allocated KSh224,800,000 (about US\$2.64 million) (Government of Kenya 2013). The greater investment in other sectors was probably a reflection of expected returns. Although pastoralism is the main source of livelihood for the population of Isiolo and other dryland parts of the country, it is widely considered not to have received attention commensurate with its economic contribution at both local and national levels (Davies and Hatfield 2007). A lack of available data on pastoral production and its contribution to the economy causes policymakers to underestimate its economic value (Krättli and Swift 2014, Hesse and MacGregor 2006, Hatfield and Davies 2006).

The camel production sector is particularly important in Isiolo and other drought-prone areas because camels can provide both food and non-food requirements throughout the year – even during drought periods (Yagil 1982, Noor *et al.* 2012 and 2013). Camel milk is a source of protein, vitamins and nutrients necessary for body growth and health (Njarui *et al.* 2009). During the wet seasons, milk provides an essential component of the pastoral household diet, but milk production falls drastically in the dry season (Ilatsia *et al.* 2007). When scarcity of water and pasture and weakened livestock reduce pastoralists' access to milk, acute

malnutrition rates tend to increase (Witsenburg and Adano 2009), but these decline rapidly once access to milk is increased again (Sadler *et al.* 2009). Camel milk is therefore important to reduce hunger in the arid and semi-arid lands.

Camel milk sales are a way to dispose of milk surpluses during the wet season and an integral part of the way households fund the purchase of other essential food items, especially during the dry seasons. Traditionally, camel milk production makes a significant contribution to the livelihoods of vulnerable groups of the population – particularly widows (Anderson *et al.* 2012). Recently, as a result of the rising demand for camel milk and its products both at local and national markets, more men and women investors have become engaged in camel milk production and marketing (Musinga *et al.* 2008). There is, however, no reliable estimate of the camel population and camel milk production volumes in Kenya, partly because camel-owning households often consume a significant proportion of the milk they produce.

This paper presents a synthesis of a field investigation in two camel milk production clusters, as a contribution towards enhancing the recognition of camel milk production within the local economy in Isiolo County. It presents and discusses key findings about the amount and value of camel milk produced, the number of people employed in the trade and the contribution of camel milk to pastoral households' diets. It also explores linkages between the production clusters and the neighbouring urban marketing, service and distribution centres in Isiolo County.

This research is a contribution to two projects: 'Mainstreaming climate change adaptation in drylands development planning (2011–12)' and 'Strengthening adaptation and resilience to climate change in Kenya (2013–16)'. The study complements a doctoral research project at the University of Nairobi (Elhadi 2014).

¹ Exchange rate US\$1 = KSh85 (April 2014). This rate can be applied to all costs mentioned in this report.

Valuing the uses of camel milk



This research is based on the idea that improved livelihoods in pastoralist households, more effective development planning and better county-level budgetary allocations to the pastoral subsector could increase understanding of, and accounting for, the benefits of pastoralism. A total economic value approach could capture the value of both marketed and non-marketed produce (Hatfield and Davies 2006, Hesse and MacGregor 2006, Davies and Hatfield 2007), but this would require data not previously available within Isiolo County. Analysing production and marketing linkages is equally important, as they play a critical role in determining the volume and value of milk that is produced and the distribution of inputs such as grazing and veterinary services (Staal *et al.* 2009).

Study context

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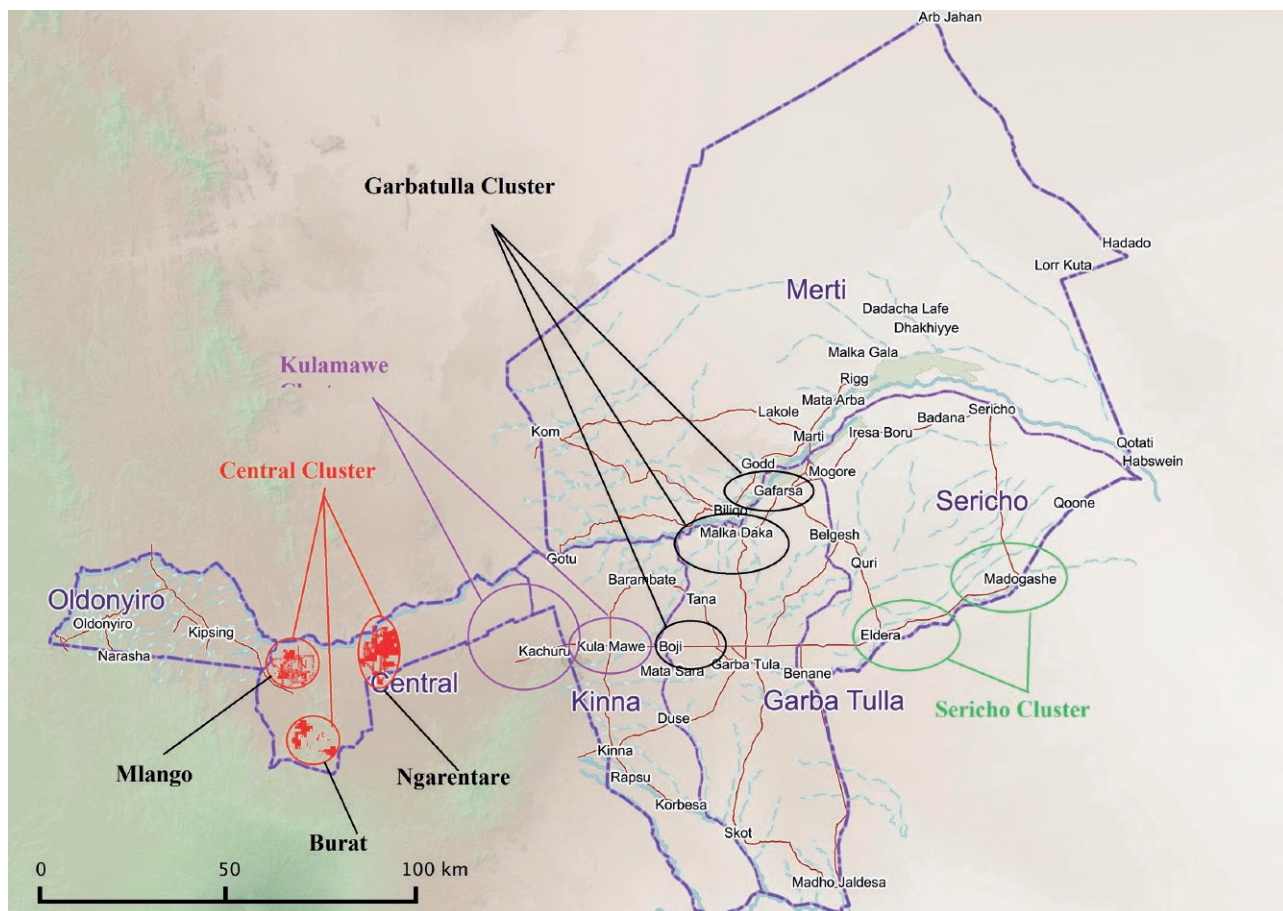
Isiolo County is predominantly flat, with low-lying plains and an altitude range of 200–300 metres above sea level. The county is classified as arid and semi-arid. Rainfall is low, bimodal and erratic; annual rainfall is 350–600mm (Herlocker *et al.* 1993, Sombroek *et al.* 1982, Isiolo County Government 2013). Annual rainfall variation in Isiolo County follows the passage of the inter-tropical convergence zone and the changes in wind directions, accompanied by dramatic shifts in precipitation regimes from very dry and very rainy. The rainfall regime is dominated by two dry and two rainy seasons a year. The rainy season known as the long rains lasts for three months from around mid-March and contributes about 40 per cent of total precipitation. The short rains usually start in October and last for two to three months, contributing 60 per cent of total precipitation (Francine and Hughes 1984, Isiolo County Government 2013). Local precipitation patterns in Isiolo County are further complicated by the influence of Mount Kenya and the Rift Valley, and droughts that lead to devastating loss of livestock and human lives are common (Government of Kenya 1997). The county is hot throughout the year, with mean annual temperatures between 24–30°C (Jaetzold and Schmidt 1983).

The population is 143,294; its estimated poverty level of 71 per cent is high compared with other counties in the arid and semi-arid lands (Isiolo County Government 2013). More than 70 per cent of the county population is estimated to be involved in livestock production, either directly or indirectly (Government of Kenya 2010). The main livestock production system comprises cattle, goats, sheep and camels.

A pastoralist is defined as any livestock keeper whose livestock or livestock-related activities generate 50 per cent or more of household gross revenue (Odhiambo 2013). In previous studies, camel milk production in Isiolo County has been grouped in four clusters, based on the size of camel population, level of milk production and level of commercialisation among producers (after Musinga *et al.* 2008): Mlango-Ngarentare-Burat clusters in Central division; Kulamawe cluster in Kinna division; and two minor clusters – Modogashe-Eldera in Sericho and Boji-Galfarsa-Malkadaka in Garbatulla.

This study focuses on the Central and Kulamawe clusters (Figure 1) because they have larger camel populations, accounting for more than 40 per cent of Isiolo County's total camel population. This translates

Figure 1. Camel milk production clusters, Isiolo County



to high milk production compared to other clusters. The clusters include both traditional camel milk producers (Somali community) and non-traditional producers (Borana community).

Pastoral households are usually distributed between mobile herders' camps and settled households within or near towns. In most cases, household members spend some time in trading centres and the rest of their time in herders' camps. They may consume more livestock products while in the camps and more grain when they return to the settlements (Sato 1997). Most pastoralists in Isiolo and elsewhere sell or exchange livestock and livestock products to meet their needs for essential non-livestock food items. The extent to which pastoralist households consume cereals, sugar, oil and rice depends on many factors such as culture, cash, availability of alternative sources of energy and protein and distance to nearest trading centre.

The two selected clusters are more commercially oriented than the county's minor clusters. In Garbatulla cluster, milk is mostly consumed by producers and their families and marketed locally within the subcounty trading centres; the milk produced in Sericho is consumed within the subcounty, with an insignificant portion supplied to Maua town nearby in Meru County.

The main production areas in Central cluster include Mlango, Burat 1 and Burat 2, Kiwanjani, Biliqo, Maili Saba, Ngare Ntare, Lagilaba and Lombolio villages. In Kulamawe cluster, the main production areas include Yaqbarsadhi, Kulamawe, Kachuru and Barambate areas (Musinga *et al.* 2008). Milk production in the two major clusters is mostly peri-urban, particularly in Central. Lactating females are mostly kept on the outskirts of Isiolo Town (20–25km from town), with the rest of the herd grazed freely. Movement is mostly determined by the availability and sometimes quality of forage, as well as other factors such as the security situation. Milk from the peri-urban herd is mostly brought into Isiolo Town by motorbike, donkey and lorry.

The estimated camel population in our study area is 15,400 – 9,400 in Central cluster and 6,000 in Kulamawe cluster (MoLD 2012). According to our key informants, there are many more *bomas*² in Central cluster (325) than in Kulamawe cluster (150). Both clusters follow similar husbandry practices, with opportunistic movement in search of appropriate grazing areas. There are watering points in various production areas – including Mlango, Burat and Bikigo in Central cluster and Yaqbarsadhi, Kulamawe, Kachuru and Barambate in Kulamawe cluster.

² Traditional homesteads for people and livestock comprising an enclosed compound.

Methodology



Building on a literature review and available secondary data, the study collected primary data through:

- **Key informant interviews** with representatives from government and non-governmental institutions such as the Kenya Camel Association and Kenya Livestock Marketing Council, relevant key players in local administration and the camel milk subsector in Isiolo County. This included key informants from all the camel keepers' clans in the study area, to identify the number of producers and herders, in their respective clans within the two production clusters.
- **Focus group discussions and semi-structured survey interviews** (see Appendix 3 for questionnaire) with camel milk producers and herders. Camel milk producers own camels and may also herd them, while camel milk herders do not own the camels they herd and mostly stay at the camel *boma*.

The study purposefully selected Central and Kulamawe clusters based on their greater levels of camel production and market orientation of producers, compared to other clusters. Within these clusters, we randomly sampled three sublocations and then randomly selected and interviewed a total of 100 milk producers and 60 herders. We used the proportional probability-to-size formula suggested by Yates and Grundy (1953) to determine sample size.

We used the questionnaire data to calculate the volumes of milk that households consumed and sold. We could not determine the volume of milk

consumed by calves, spoiled or not extracted from females. To determine the contribution of camel milk to the household food basket, the study focused on basic food-stuffs consumed by pastoral households. We multiplied the various food proportions identified through the survey by their current market prices to derive their shares in household food expenditure, converting these shares to percentages in relation to the total cost of the reported food basket.

To derive the contribution of camel milk to household income, we used two sets of prices: farm gate prices (Ksh30 per litre) to determine the value of camel milk produced in the two clusters and current market prices to value the milk consumed by producers, herders and their families. We based our estimation of the total value of camel milk by combining the value of milk consumed with milk sales at markets in the two clusters and beyond. We used the prices paid by middlewomen in Isiolo Town to value milk from Kulamawe cluster and the prices paid to middlewomen in Nairobi market to value the milk transferred to Nairobi.

We used information from key informants in the two clusters to estimate the number of people benefiting directly and indirectly from camel milk at production level, cross-checking it with information from the questionnaire.

Study findings

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5.1 Interlinked production and marketing

The study identified a mutual relationship in production linkages between Central and Kulamawe clusters, which can be categorised in terms of production and marketing linkages (see Figure 2).

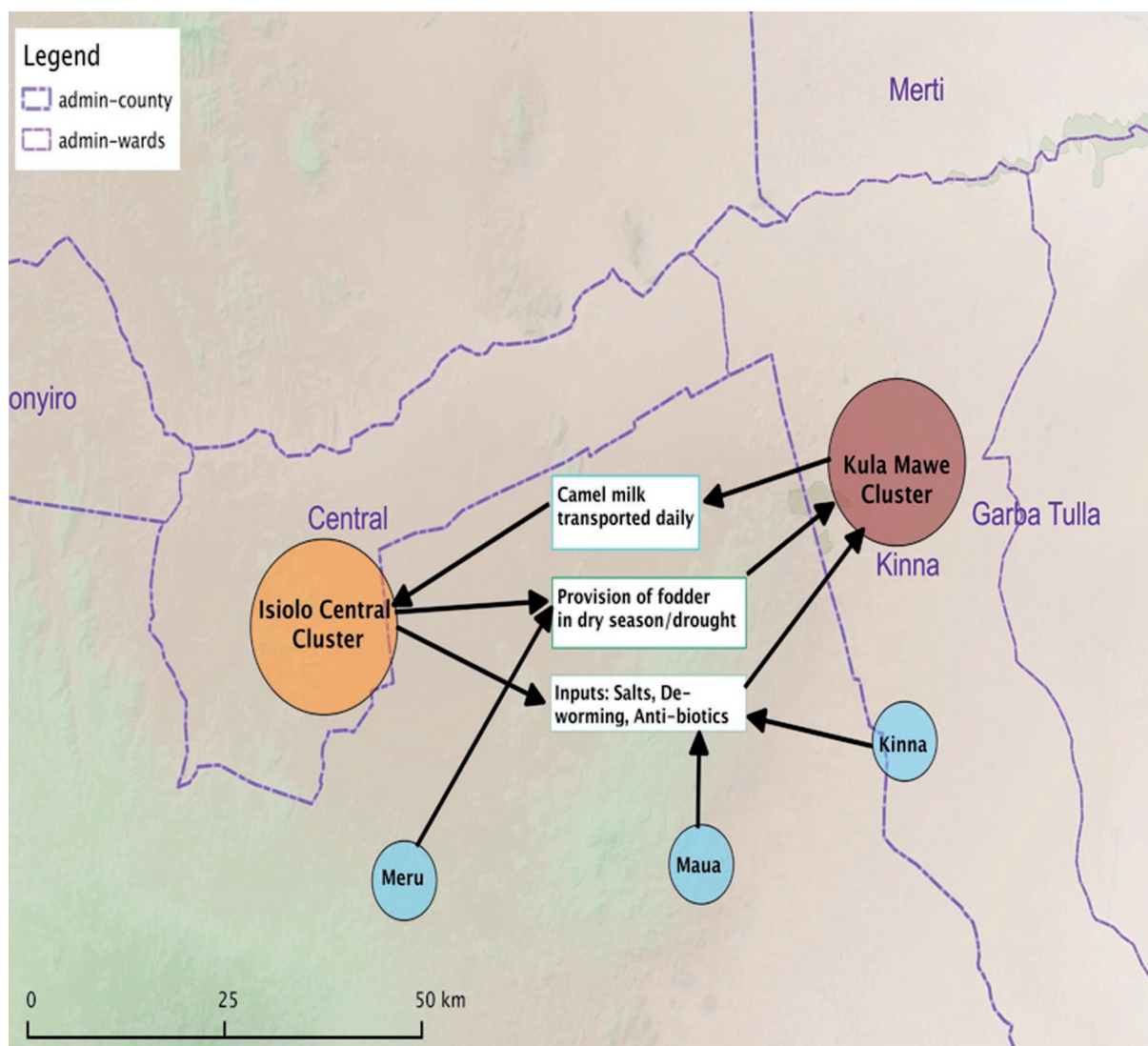
Kulamwe cluster provides the base for grazing during the drought and prolonged dry spells. It is traditionally a dry season grazing area with strong customary pasture management committees that ensure enough forage resources throughout the year. Most producers in Central cluster take their camels to Kulamawe cluster for grazing during such periods. This movement is mostly based on prior agreement between the producers in the two clusters and involves no payment. Producers

from Central only take their dry herds to Kulamawe for feeding; they keep their lactating herds in Central cluster, where there are opportunities around Isiolo Town for the commoditisation of camel milk due to demand and a ready market.

Producers from Kulamawe usually stay within the borders of Kulamawe cluster, although key informants indicated that herders from Kulamawe moved to Central cluster for grazing during the drought of 2007/08. However, producers in Kulamawe cluster rely primarily on Central cluster (and, to a lesser extent, on Kinna and Maua towns in Meru county) for the supply of inputs such as salts (minerals), de-wormers and antibiotics.

Camel milk from the two clusters is mainly sold in Nairobi market (Eastleigh) and locally at open air markets in Isiolo and Kulamawe Towns and at household level to neighbours. Milk from all production areas in the

Figure 2. Production and marketing linkages between clusters



county is initially transported to Isiolo Town, where the majority is cooled overnight and transferred to Nairobi market in the morning.

In Kulamawe cluster, producers normally collect milk in small containers (3–5 litre plastic jerry cans) and deliver it to designated collection points such as Kulamawe, Kashuru and Yaqbarsadhi, for collection by members of the Kulamawe women’s group. These middlewomen give the milk to lorry drivers for delivery in Isiolo Town. The lorries passing by Kulamawe are mostly from Wajir Town and Garbatulla. There is usually only one lorry every other day, which will transport 300 litres of milk in one trip during the dry season and 800 litres in the wet season. The milk transported to Isiolo Town constitutes the amount that Kulamawe cluster contributes to the county’s marketed milk. Rough terrain, high temperatures and frequent mechanical problems mean that the milk sometimes gets spoiled on route to Isiolo Town.

Producers from Central cluster sell their milk directly to bulking and cooling hubs or take it to collection points along the routes in Isiolo Town using various means of transportation including vehicles, motorbikes, donkeys and/or carrying it on foot.

5.2 Camel milk consumption

On average, producer households in Central cluster consume three litres of milk a day. This amounts to a total of 1,614 litres a day in a general calculation without considering seasonal fluctuations in camel milk production (see Table 1). Herders in the same cluster

each consume about two litres – a total of 570 litres – a day. Producers in Kulamawe cluster consume less per household than their counterparts in Central, and herders consume more. However, there are less people in Kulamawe, so total milk consumption is significantly lower – 560 for producers and 525 for herders litres a day. Total average consumption of camel milk in both Isiolo and Kulamawe clusters is about 3,269 litres a day or 1,176,840 litres a year.

Herders in Kulamawe cluster consume more milk each than those in Central cluster. Herders’ camps in Central cluster are around Isiolo Town and other trading centres, giving them easier access to other food stuffs to supplement livestock products. Producers in Central cluster consume more milk each than herders in the same cluster and producers in Kulamawe. This is likely because of larger household sizes. Producers in Kulamawe are also relatively new to camel milk production, and have yet to adopt camel milk as their main source of nutrition.

5.2.1 Contribution of camel milk to household diet

Respondents reported that basic household food baskets for both producers and herders consist of livestock products, grain and associated products, vegetables and sugar (Tables 2 and 3).

Table 1. Estimated milk consumption, by cluster

Clusters	Camel milk producers			Camel herders			
	Number of producers	Average milk consumed/ household (litres)	Total consumption (litres)	Number of herders	Average milk consumed/ household (litres)	Total consumption (litres)	Total amount (litres)
Central	538	3	1,614	285	2	570	2,184
Kulamawe	280	2	560	150	3.5	525	1,085
Total	818		2,174	435		1,095	3,269

Source: First authors’ calculation and key informant interviews (2014)

Table 2. Camel milk producer households' daily food basket

FOODSTUFF	WET SEASON				
	N%	Daily consumption (kg/litre)	Price (Ksh/kg/litre)	Expenditure (KSh/kg/litre)	Proportion of total expenditure (%)
Cow milk	23.1	2.1	40.00	83.60	9.4
Camel milk	88.0	2.0	70.70	140.50	15.9
Cow meat	9.9	0.4	271.70	120.70	13.6
Goat meat	14.3	0.3	290.50	88.20	10.0
Camel meat	34.1	0.4	259.20	110.80	12.5
Maizemeal	42.9	1.1	61.90	65.90	7.4
Vegetables	46.2	0.5	24.40	12.70	1.4
Oil	56.0	0.5	120.70	55.30	6.2
Rice	49.5	1.0	76.30	74.60	8.4
Spaghetti	41.8	0.8	78.30	65.90	7.4
Sugar	100	0.6	115.00	67.10	7.6
Total				885.30	100.0

FOODSTUFF	DRY SEASON				
	N%	Daily consumption (kg/litres)	Price in (Ksh/kg/litre)	Expenditure (KSh/kg/litre)	Proportion of total expenditure (%)
Cow milk	20.9	0.5	40.90	20.50	2.9
Camel milk	97.8	3.5	81.50	285.30	40.1
Cow meat	8.8	0.2	300.80	60.20	8.4
Goat meat	9.9	0.3	310.30	93.10	13.1
Camel meat	23.1	0.5	315.40	157.70	22.1
Maizemeal	33.0	0.4	65.80	26.30	3.7
Vegetables	25.3	0.3	25	7.50	1.1
Oil	37.4	0.1	120.90	12.10	1.7
Rice	33.0	0.1	76.70	7.70	1.1
Spaghetti	33.0	0.1	75.80	7.60	1.1
Sugar	100	0.3	114.40	34.30	4.8
Total				712.10	

Source: First authors' calculation (2014)

Table 3. Camel herder households' daily food basket

FOODSTUFF	WET SEASON				
	N%	Daily consumption (kg/litre)	Price in (Ksh/kg/litres)	Expenditure (KSh/kg/litre)	Proportion of total expenditure (%)
Cow milk	1.6	0.3	40.00	12.00	1.9
Camel milk	83.6	5.0	48.90	244.60	38.8
Camel meat	9.8	0.3	350.00	116.70	18.5
Maizemeal	73.8	1.1	63.10	66.60	10.6
Vegetables	11.5	0.1	30.80	2.20	0.3
Oil	50.8	0.1	115.30	6.70	1.1
Rice	44.3	0.6	73.50	43.60	6.9
Spaghetti	5.0	1.0	60.00	60.00	9.5
Sugar	91.8	0.7	119.10	77.60	12.3
Total				630.00	100.0

FOODSTUFF	DRY SEASON				
	N%	Daily consumption (kg/litres)	Price in (Ksh/kg/litre)	Expenditure (KSh/kg/litre)	Proportion of total expenditure (%)
Cow milk	0	0	0	0	0
Camel milk	98.4	4.0	81.50	326.00	62.7
Camel meat	8.2	0.1	315.40	35.00	6.7
Maizemeal	82.0	0.6	65.80	36.60	7.0
Vegetables	59.0	0.1	25.00	1.80	0.3
Oil	39.3	0.1	120.90	7.00	1.4
Rice	40.9	0.3	76.70	26.30	5.1
Spaghetti	3.3	0.4	75.80	29.60	5.7
Sugar	90.4	0.5	114.40	57.40	11.0
Total				519.60	100.0

Source: First authors' calculation (2014)

The average cost of the food basket in producer households is Ksh885.30 (US\$10.4) in wet season and Ksh721.10 (US\$8.50) in dry season. Although consumption varies between households, we found that:

- almost all households consume sugar and camel milk
- 61.4 per cent of expenditure is on livestock products during the wet season and 86.6 per cent in the dry season
- camel milk contributes the most, followed by cow meat, camel meat, goat meat and cow milk, and
- other foodstuffs such as spaghetti and maize meal contribute only 7.4 per cent each during the wet season; sugar contributes 7.6 per cent.

Although expenditure for non-livestock products remains almost identical in the wet and dry seasons, high prices mean that households buy less food for the same amount of money. Access to livestock products produced at homesteads compensate for the higher price of food in the dry season. So, instead of falling by about 70 per cent, overall food consumption only drops by about 35 per cent. Camel milk provides about 40 per cent of the food consumed during the dry season – without it, overall food consumption would drop by some 42 per cent, leaving households hungry.

During the dry season, the contribution of different foodstuffs to producer households' food basket changes dramatically, as they eat more livestock products and less non-livestock products. This is attributable to price change for various commodities, particularly meat and milk. Camel milk makes the highest contribution to the food basket in the dry season, followed by camel and goat meat. Cow meat and milk

contribute least among livestock products. Maize meal contributes only 3.7 per cent, and sugar 4.8 per cent. Rice, spaghetti, oil and vegetables each account for 1.1 per cent of the household food basket.

The daily average cost of the herders' food basket is Ksh630 (US\$7.4) in the wet season and Ksh519.60 (US\$6.1) in the dry. During the wet season, households consume a daily average of 0.3 litres of cow milk and 5 litres of camel milk, accounting for 1.9 and 38.8 per cent of the household food basket respectively. During the dry season, herders reported a drop in camel milk consumption from 5 to 4 litres, an absence of cow milk and a drop in camel meat consumption from 300 to 100g per household. Camel milk is the highest contributor to herders' food basket in the dry season, accounting for 62.7 per cent of total household expenditure, followed by sugar, maize meal, camel meat, spaghetti and rice.

5.3 Camel milk sales

The study found that the quantity of milk sold in both clusters varies between wet and dry seasons (see Table 4). In Central cluster, producers sell around 7,800 litres a day in the wet season and around 4,200 litres a day in the dry. Local sales represent about 100 litres in both seasons. This absence of variation in the local market could be due to the small number of clients, as most camel milk consumers in Isiolo and Kulamawe Town have access to milk from their own herds. In Kulamawe cluster, producers only sell 15 litres locally in the wet season, and 20 litres in the dry. They sell about 850 litres to Isiolo middlewomen in the wet season, falling to 350 litres in the dry.

Table 4. Milk sales in litres, by cluster

CLUSTERS	WET SEASON			DRY SEASON		
	Milk sold/day to Nairobi/ Isiolo	Milk sold/day in local market	Total milk sold	Sold/day to Nairobi/Isiolo	Sold/day in local market	Total milk sold
Central	7,800	100	7,900	4,200	100	4,300
Kulamawe	850	15	865	350	20	370
Total			8,765	4,550	120	4,670

Source: First authors' calculation and key informant interviews (2014)

5.3.1 Contribution of camel milk to household income

Livestock-related activities contribute most to milk producers' household income during the wet season (see Table 5), with camel milk sales accounting for 30.5 per cent of total income, followed by livestock (20.7 per cent) and cow milk (14.1 per cent). Salaries from formal employment (government jobs) and casual labour contribute 23.5 per cent and 11.2 per cent respectively.

Although livestock contribute less during the dry season, it remains the major source of income, accounting for 63.6 per cent. Camel milk remains producers' main source of income in the dry season, providing 31 per cent of total income, followed by livestock sales and formal employment.

Camel herders in Central cluster derived most of their income from camel milk sales during both seasons, providing almost 70 per cent of their total monthly income in the wet season and almost 60 per cent in the dry. In the wet season, this is followed by herding salary and sales of livestock and in the dry season, sales of livestock outstrip herding salaries (see Table 5 for detailed figures).

In Kulamawe cluster, producer livelihood activities rely heavily on livestock and camel milk sales (Table 6). Camel milk is the highest contributor to producers' total monthly income in the wet season, providing 35.2 per cent of income. This is closely followed by sales of livestock (32 per cent) and cow milk (27 per cent). Producers' income from most livelihood sources is higher in the dry season, but the contribution of camel milk falls slightly to 34 per cent and the contribution of cow milk is slightly higher (28.7 per cent).

Herders in Kulamawe cluster mostly rely on livestock sales, which contributes 64.1 per cent of household income during the wet season and 75.1 per cent in the dry season. Camel milk sales contribute 27.4 per cent in wet season and 14.8 per cent in the dry. Herding salaries contribute the least during both wet and dry seasons, generating only 8.4 and 10.1 per cent.

Table 5. Camel milk producers' and herders' livelihood activities in Central cluster, 2013

Livelihood activity	CAMEL MILK PRODUCERS				HERDERS			
	Wet season (September-December)		Dry season (July-August)		Wet season (September-December)		Dry season (July-August)	
	Income (Ksh)	% of total income	Income (Ksh)	% of total income	Income (Ksh)	% of total income	Income (Ksh)	% of total income
Camel milk sales	35,675.40	30.5	34,817.39	31	31,476.90	69.4	25,834.60	58.0
Livestock sales	24,230.80	20.7	29,178.57	26	5,928.60	13.1	12,000.00	26.9
Cow milk sales	16,550.00	14.1	7,400.00	6.6	–	–	–	–
Casual labour	13,123.30	11.2	13,333.33	11.9	–	–	–	–
Formal employment	27,500.00	23.5	27,500.00	24.5	–	–	–	–
Herding salary	–	–	–	–	7,919.20	17.5	6,738.10	15.1

Source: First authors' calculation (2014)

Table 6. Camel milk producers' and herders' livelihood activities in Kulamawe cluster, 2013

Livelihood activity	CAMEL MILK PRODUCERS				HERDERS			
	Wet season (September–December)		Dry season (July–August)		Wet season (September–December)		Dry season (July–August)	
	Income (Ksh)	% of total income	Income (Ksh)	% of total income	Income (Ksh)	% of total income	Income (Ksh)	% of total income
Camel milk sales	21,252.20	35.2	22,838.90	34	14,910.50	27.4	6,807.90	14.8
Livestock sales	19,310.00	32	21,505.00	32	34,842.10	64.1	34,470.60	75.1
Cow milk sales	16,300.00	27	19,300.00	28.7	–	–	–	–
Petty trade	3,500.00	5.8	3,500.00	5.2	–	–	–	–
Herding salary	–	–	–	–	4,585.70	8.4	4,630.80	10.1

Source: First authors' calculation (2014)

5.4 Total value of camel milk

We estimate the annual value of milk consumed at Ksh23,587,200 in Central cluster and Ksh11,718,000 in Kulamawe cluster (see Table 7). The value of marketed milk is Ksh174,240,000 (Central) and Ksh13,122,000 (Kulamawe), bringing the total value of camel milk in both clusters to about Ksh222,667,200 a year.

5.4.1 Camel milk beneficiaries

Our study found that camel milk production supports 3,766 people in Central cluster and camel herding supports a further 1,140 people (see Table 8). This brings the total estimated number of direct beneficiaries to 4,906 people.

In Kulamawe cluster, we estimate that camel milk production supports 1,680 people, and herding another 900, bringing the total number of people supported by camel milk at the production level to 2,580.

If we add the numbers together, we find that 7,486 people in both clusters rely on camel milk at the production level for their living.

People who are supported indirectly by revenue from camel milk include relatives, family friends and other people who we do not consider to be part of producers' and herders' immediate households. Most of this support is transferred through payment of school fees, medical help and other forms of social aid. We estimate that revenue from camel milk at the production level indirectly supports some 2,184 people in Central cluster and 860 people in Kulamawe cluster.

If we separate these figures by activity, camel milk production supports 5,446 people directly and 2,174 people indirectly; camel herding directly supports 2,040 people and indirectly supports 870. This brings the total number of beneficiaries at production level to 10,530 people.

Table 7. Value of camel milk, by cluster

CLUSTERS	MILK CONSUMED			MILK SOLD			TOTAL VALUE (KSH)
	Litres per year	Price (Ksh)	Value (Ksh)	Litres per year	Price	Value (Ksh)	
Central	786,240	30	23,587,200	2,178,000	80	174,240,000	197,827,200
Kulamawe	390,600	30	11,718,000	218,700	60	13,122,000	24,840,000
Total			35,305,200			187,362,000	222,667,200

Source: First authors' calculation and key informant interviews (2014)

Table 8. Direct camel milk beneficiaries, by cluster

CLUSTERS	PRODUCERS			HERDERS		
	Number of producers	Average household size	Total beneficiaries	Number of herders	Average household size	Total beneficiaries
Central	538	7	3,766	285	4	1,140
Kulamawe	280	6	1,680	150	6	900
Total	818		5,446	435		2,040

Source: First authors' calculation and key informant interviews (2014)

Table 9. Indirect camel milk beneficiaries, by cluster

CLUSTERS	CAMEL MILK PRODUCERS			CAMEL HERDERS		
	Producers	People supported	Total beneficiaries	Producers	People supported	Total beneficiaries
Central	538	4	1,614	285	2	570
Kulamawe	280	2	560	150	2	300
Total			2,174	435		870

Source: First authors' calculation and key informant interviews (2014)

Discussion

6

This study estimates the annual value of marketed camel milk at Ksh187,362,000 – a figure well in excess of the public funds spent on Isiolo County's entire agriculture and livestock sector in 2013/2014 (Government of Kenya 2013). Taking into account the milk that is consumed by producer and herder households, the total value of milk production is double current public expenditure for the sector. If we were to add the benefits to non-pastoralists along the value chain, the contribution of camel milk to the local economy could be further amplified across the country.

Our findings show the extent to which pastoralist households in Isiolo rely on livestock products such as milk and meat for both income and subsistence. In addition to the essential cash that camel milk generates during dry seasons, it also provides seven per cent of pastoralists' diet over these periods. This makes the critical difference between a manageable 35 per cent seasonal reduction in food intake and an unacceptable 42 per cent reduction, which would result in hunger. Camel milk production offers an opportunity to address food and income insecurity in the county, reducing or avoiding the costs of famine and drought relief.

To exploit the full potential of the camel milk production subsector, there is a need for supportive policies and regulation at national and county levels. This should build pastoralist market participation and lead to accelerated growth for food security and social development. Our study identifies enabling complementarities between the two camel milk production clusters in input provision, output marketing and wider options for grazing during drought. These linkages can provide entry points for interventions to enhance camel milk production and marketing.

Further studies are needed on the role of political and economic institutions in the camel milk value chain, to provide in-depth understanding of the system and inform development interventions.

Conclusion



Camel milk production supports a significant proportion of the population in Isiolo County – both urban and rural – and should be at the top of the county's agenda. In the context of recurrent drought and diminishing grazing and water resources, rearing camels as an alternative to other livestock or crops can provide a pathway to more resilient livelihoods. This makes a strong case for the county to consider allocating more resources to the camel milk subsector.

This study has made a much-needed contribution towards filling the gaps in available data and understanding the contribution of camel milk to pastoral households' income and diet in the selected clusters – and more broadly. Our findings highlight an opportunity to enhance milk production and marketing. To create an enabling environment, policymakers should ensure that:

- policies promote camel milk as a suitable strategy to build pastoral household resilience
- investments strengthen existing linkages between the clusters – particularly in terms of the interdependent relationship in production, marketing and drought resilience, and
- they continue collecting data on production, prices and contribution to households and the wider county economy so they can track the systematic improvement of camel milk production and markets.

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Appendices

Appendix 1: Camel milk producer questionnaire

1. General information

- 1.1 Date of interview: _____ / _____ / _____
- 1.2 Name of enumerator: _____
- 1.3 Name of respondent: _____
Sex: (1) Male (0) Female
- 1.4 Location _____ Sublocation _____ Village _____
- 1.5 Age: (1) Under 30 (2) 30–60 (3) Over 60
- 1.6 Relationship of respondent to the household head?
(1) Self (2) Spouse (3) Son (4) Daughter (5) Relative

2. Household head's information

- 2.1 Sex: 1) Male _____ 2) Female _____
- 2.2 Age _____
- 2.3 Education: (1) None (2) Primary (3) Secondary (4) Post-secondary
- 2.4 Household size/composition _____
No. of males _____ No. of females _____
- 2.5 General information on household members

Member (husband, wife/s child)	Sex (F/M)	Age	Education level

Codes for education: (1) None (2) Primary (3) Secondary (4) Post-secondary

- 2.6 What is your main occupation? _____
- 2.7 Is any member of your family employed elsewhere?
1) Yes _____ 2) No _____
- 2.8 If **yes**, how many are employed? _____
- 2.9 Do you receive any remittance from them?
1) Yes _____ 2) No _____
- 2.10 If **yes**, how much did you receive from them last month? _____

2.11 How many times do you receive the normal remittances in a year? _____

2.12 Did you receive any food aid/ relief food last year?

1) Yes _____ 2) No _____

2.13 Please list all your household's income-generating activities and how much you get from each per month

Source of income	Wet season (KSh per month)	Is that the normal? Yes/no. If no, what is normal?	Dry season (KSh per month)	Is that the normal? Yes/no. If no, what is normal?

2.14 What was your household's main food during the last ...

wet season _____ dry season _____

drought _____

2.15 How much ... did your household consume yesterday? Please fill the table below with normal consumption.

Food item	Quantity (kg/litre/ KSh, etc)	Is that the normal? If no, what is normal?	Price (KSh/ kg/ litre)	Food item	Quantity (Kg/litre/ KSh, etc.)	Is that the normal? If no, what is normal?	Price (KSh/ kg/ litre)
Cow milk				Oil			
Goat milk				Rice			
Camel milk				Bananas			
Cow meat				Potatoes			
Goat meat				Eggs			
Camel meat				Watermelon			
Maize and beans				Fruit			
Ugali				Honey			
Vegetables				Spaghetti			
Tomatoes				Sugar			
Onions				Other (specify)			

2.16 How much did you spend on the following items?

Items	Cost (KSh)	Items	Cost (KSh)
Food per day		Electricity per month	
Clothing per year		Water per month	
Healthcare per year		Security per month	
School fees per year		Other cost	

3. Camel milk production and consumption

3.1 Did you inherit the camel rearing business or start it yourself? 1) Inherited 2) Started.....

3.2 Why did you start keeping camels? _____

3.3 How many years have you been keeping camels? _____ years

3.4 How many lactating animals did you have during the following seasons last year?

3.5 Dry season (January–March): _____

3.6 Wet season (April–June): _____

3.7 Dry season (July–August): _____

3.8 Wet season (September–December): _____

3.9 What size is your camel herd? ... Please fill the table below?

	Total number	Mortality last year	Amount of salt supplied per day	Cost per day KSh/kg	Cost of watering
Male					
Female					
Calf					

3.10 How many members of your family are involved in camel milk production? _____

3.11 Is that the normal?

1) Yes _____ 2) No _____

If **no**, what is the normal? _____

3.12 How do you pay them? In cash? How much (KSh)? _____ In kind? _____

3.13 How many permanent labourers (herders) did you have last year? _____

3.14 Is that the normal?

1) Yes _____ 2) No _____

If **no**, what is the normal? _____

3.15 How much did you pay them per month? Cash/kind _____

3.16 How many casual labourers did you have last dry season? _____

3.17 How many casual labourers did you have last wet season? _____

3.18 What do you use for milking your camels? _____

3.19 Where did you go yesterday in search of feed? _____

3.20 How far did you go yesterday in search of feed? _____ km

3.21 Is that the normal?

1) Yes _____ 2) No _____ If no, what is the normal? _____ km

3.22 If **no**, why not? _____

3.23 Where did you go yesterday in search of water? _____

3.24 How far did you go yesterday in search of water? _____ km

3.25 Is that the normal?

1) Yes _____ 2) No _____

If **no**, what is the normal? _____ km

3.26 If **no**, why not? _____

3.27 What livestock do you keep?

Animal type	Number	Breed	The purpose of keeping	Value per head (KSh)
Camel				
Cattle				
Goats/sheep				
Donkey				

Code of purpose of keeping: 1) Milk 2) Meat 3) Cultural 4) Other (specify)

Value of animal per head at 2013 market price

3.28 What is the main purpose of camel keeping?

- 1) Milk _____ 2) Meat _____
 3) Cultural _____ 4) Others _____

3.29 If the purpose is milk, how many litres of milk did you get yesterday? _____

3.30 Is this the normal amount?

- 1) Yes _____ 2) No _____

If **no**, what is the normal amount? _____

3.31 If **no**, why not? _____

3.32 How much of what you produce did you use at home? _____

3.33 How much of what you produce did you sell? _____

3.34 Is this amount the normal?

- 1) Yes _____ 2) No _____

If **no**, what is the normal amount? _____

3.35 If **no**, why not? _____

3.36 Has your household milk consumption increased in last five years?

- 1) Yes _____ 2) No _____

3.37 If yes, why? _____

3.38 How many times do you use camel milk per day? _____

3.39 How do you use camel milk at home?

- 1) Fresh _____ 2) Soured _____ 3) Mixed with other milk _____
 4) Other (specify) _____

3.40 Who consumes camel milk in your household?

- 1) Male children _____ 2) Female children _____ 3) Adult males _____
 4) Adult females _____ 5) Other (specify) _____

3.41 How much do you spend on the following per month in camel milk production?

Item	Herding salary	Miraa* for herders	Food for herder	Watering	Supplementary feeds	Salts	De-wormers and veterinary drugs	Acari-cides	Secu-rity	Others
Cost per month (KSh)										

* herbal product, also known as *khat*

3.42 What was the major problem you faced in camel milk production last year? _____

4. Camel milk marketing

4.1 Do you sell your camel milk?

1) Yes _____ 2) No _____

4.2 If **yes**, how many litres did you sell yesterday? _____ litres

4.3 Is this the normal amount of milk you sell?

1) Yes _____ 2) No _____

4.4 If **no**, what is the normal amount you sell daily? _____ litres

4.5 If **no**, why not? _____

4.6 What was the price per litre yesterday? _____ KSh

4.7 What determines the amount of milk you sell? _____

4.8 Where do you sell your milk? Please fill the table below

Market name	Market type	Distance (km)	Mode of transport	Hours spent (hrs)	Why? Give reason for your choice

4.9 How much do you spend (KSh) on the following per day dealing with camel milk?

Container	Packaging price	Transport/loading	Off-loading	Communication	Others
20 litres					
10 litres					
5 litres					
3 litres					
Other (specify)					

4.10 Do you get any support to improve your camel milk business?

1) Yes _____ 2) No _____

4.11 What is the major problem you faced in camel milk marketing last year? _____

Appendix 2: Camel herder questionnaire

Hello. My name is Yazan Ahmed Mohamed Elhadi. I am a PhD fellow at the Department of Land Resource Management and Agricultural Technology, University of Nairobi. I am conducting a household survey to gather information on camel milk production and marketing. The survey is intended to identify an information gap, to help the government formulate better interventions and policies that will improve pastoral production system reliance.

Your participation is voluntary and the information provided will be confidential. I am asking your permission to ask you some questions for the study.

1. General information

- 1.1 Date of interview: _____ / _____ / _____
- 1.2 Name of enumerator: _____
- 1.3 Name of respondent: _____
Sex: (1) Male (0) Female
- 1.4 Location _____ Sublocation _____
Village _____

2. Herder information

- 2.1 Sex:
1) Male _____ 2) Female _____
- 2.2 Age _____
- 2.3 Education:
(1) None (2) Primary (3) Secondary (4) Post-secondary
- 2.4 Household size/composition _____
No. of males _____ No. of females _____
- 2.5 How long have you been working as camel herder? _____ years
- 2.6 Is any member of your family employed elsewhere?
1) Yes _____ 2) No _____
- 2.7 If **yes**, how many are employed? _____
- 2.8 Do you receive any remittance from them?
1) Yes _____ 2) No _____
- 2.9 If yes: how much did you receive from them last month? _____
- 2.10 How many times do you receive the normal remittances in a year? _____
- 2.11 Did you receive any food aid/ relief food last year?
1) Yes _____ 2) No _____
- 2.12 What is our household's main source of income? _____

2.13 Please list all your household's income-generating activities and how much you get from each per month.

Source of income	Wet season (KSh per month)	Is that the normal? Yes/no. If no what is normal?	Dry season (KSh per month)	Is that the normal? Yes/no. If no, what is normal?
Herding salary				
Selling milk (own)				
Selling live animals (own)				
Other (specify)				

2.14 Are there any other people you support directly, apart from your family?

1) Yes _____ 2) No _____

2.15 If **yes**, how many? _____ No. of males _____ No. of females _____

2.16 What was your household's main food during the last ...

wet season _____ dry season _____

drought _____

2.17 How much ... did your household consume yesterday? Please fill the table below with normal consumption.

Food item	Quantity (kg/litre/ KSh, etc.)	Is that the normal? If no, what is normal?	Price (KSh/ kg/ litre)	Food item	Quantity (Kg/litre/ KSh, etc.)	Is that the normal? If no, what is normal?	Price (KSh/ kg/ litre)
Cow milk				Oil			
Goat milk				Rice			
Camel milk				Bananas			
Cow meat				Potatoes			
Goat meat				Eggs			
Camel meat				Watermelon			
Maize and beans				Fruit			
Ugali				Honey			
Vegetables				Spaghetti			
Tomatoes				Sugar			
Onions				Other (specify)			

2.18 How much did you spend on the following items?

Items	Cost (KSh)	Items	Cost (KSh)
Food per day		Electricity per month	
Clothing per year		Water per month	
Healthcare per year		Security per month	
School fees per year		Other cost	

3. Camel herding

3.1 Do you have animals?

1) Yes _____ 2) No _____

3.2 If **yes**, what livestock do you keep?

Animal type	Number	Breed	The purpose of keeping	Value per head (KSh)
Camel				
Cattle				
Goats/sheep				
Donkey				

Code for purpose of keeping: 1) Milk 2) Meat 3) Cultural 4) Other (specify)

Value of animal per head at 2013 market price

3.3 Do you own the camels you are herding?

1) Yes _____ 2) No _____

3.4 If **yes**, do you own all of them?

1) Yes _____ 2) No _____

3.5 If **no**, how many are yours? _____

3.6 Who owns the rest of the herd? _____

3.7 How many years have you been herding camels? years

3.8 How many lactating animals did you have during the following seasons last year?

3.9 Dry season (January–March): _____

3.10 Wet season (April–June): _____

3.11 Dry season (July–August): _____

3.12 Wet season (September–December): _____

3.13 What is the size of your camel herd? ... Please fill the table below.

	Total number	Mortality last year	Amount of salt supplied per day	Cost per day KSh/kg	Cost of watering
Male					
Female					
Calf					

3.14 How many members of your family are involved in camel milk production? _____

3.15 Is that the normal?

1) Yes _____ 2) No _____

If **no**, what is the normal? _____

3.16 How do they get paid? In cash? How much (KSh)? _____ In kind? _____

3.17 How many permanent labourers (herders) did you have last year? _____

3.18 Is that the normal?

1) Yes _____ 2) No _____

If **no**, what is the normal? _____

3.19 How much do you get per month? Cash/kind _____

3.20 How many casual labourers did you have last dry season? _____

3.21 How much were they paid? _____

3.22 How many casual labourers did you have last wet season? _____

3.23 How much milk did you get yesterday? _____

3.24 Is this the normal amount?

1) Yes _____ 2) No _____

If **no**, what is the normal amount? _____

3.25 If **no**, why not? _____

3.26 How much did the herders consume? _____ litres

3.27 How much was sold? _____

3.28 What do you use for milking your camels? _____

3.29 How many times do you milk the camels? _____

3.30 When do you milk the camels? _____

3.31 What determines the amount of milk you get? _____

1.32 Do you extract all milk for the lactating camel?

1) Yes _____ 2) No _____

3.33 If **no**, why not? _____

3.34 Where did you go yesterday in search of feed? _____

3.35 How far did you go yesterday in search of feed? _____ km

3.36 Is that the normal?

1) Yes _____ 2) No _____

If **no**, what is the normal? _____ km

3.37 If **no**, why not? _____

3.38 How do you transport milk to the market? _____

3.39 How far do you travel daily to the market? _____

3.40 Where did you go yesterday in search of water? _____

3.41 How far did you go yesterday in search of water? _____ km

3.42 Is that the normal?

1) Yes _____ 2) No _____

If **no**, what is the normal? _____ km

3.43 If **no**, why not? _____

3.44 Do often experience milk spoilage?

1) Yes _____ 2) No _____

3.45 If **yes**, how many times a week? _____

3.46 What are the reasons for this spoilage? _____

3.47 What was the major problem you faced in camel milk production last year?

3.48 What are the solutions for the above problems? _____

Appendix 3: Key informant interview guide

Date: _____ Checklist no: _____

Section A. Background

1. Name of respondent _____
2. Sex: _____ M/F
3. Rank/title of respondent _____
4. Current occupation _____

Section B: Milk Production and Marketing

1. What is the extent of camel milk production in this county? _____

2. How do different milk clusters interact in this county? _____

3. What is the extent of camel milk consumption in this county? _____

4. Who benefits from camel milk production in this area, apart from the milk producers? _____

5. How do they benefit? _____
6. What is the total amount of milk produced in the county? _____
7. Where are the major areas of milk production? _____

8. What strategies does your organisation have in place to improve camel milk production, consumption and marketing? _____

9. Approximately how many people (and their roles) are involved in camel milk production? _____

10. Please explain your answer above _____

11. What do you think is the level of hygiene of milk along the value chain? _____

12. What can be done to improve the level of milk hygiene along the value chain? _____

13. Are any households entirely dependent on camel milk as their main diet and main livelihood activities?
If **yes**, please explain _____

14. How can milk production be strengthened and formalised with retailers and service providers?

15. What constraints/challenges are there in camel milk production? _____

16. What constraints/challenges are there in camel milk marketing? _____

Thank you for your time

This report is one of a series of reports synthesising the findings of field research conducted by masters' and doctoral degree students at the University of Nairobi, who investigated the contribution of pastoral production to the local economy. The students developed the research to complement their degree studies, with support from the International Institute for Environment and Development.

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