CONSUMER ACCEPTANCE OF GOAT MILK PRODUCTS IN WESTERN KENYA

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SUMMARY

The Small Ruminants Collaborative Research Support Program is evaluating the potential role for goats producing milk and meat for family use on small farms in western Kenya. The potential for milk as a protein supplement to the daily diet of these families is of particular interest. A relevant question in this evaluation is if people will readily accept goat milk products. Answering this question was the primary objective of the research described in this report.

Current milk production, processing, and consumption practices were monitored on 80 smallholder farms in two districts in western Kenya. Thirty-six of the eighty farms had cows at the end of 1982. Average lactation yields were 295 kg over 216 days in Siaya District and 430 kg over 197 days in Kakamega District.

The most commonly consumed dairy products were milk used in tea preparation in both districts and milk as a liquid stock for cooking vegetables in Siaya District. Other common products were spontaneously fermented milk, butter prepared from soured milk and fresh milk.

Average daily milk consumption was .82 liters per family in Kakamega and .42 liters per family in Siaya. In both districts, daily milk consumption was higher on farms with cows than on farms without cows ($p<.01$). Eighty-six percent of all the farmers interviewed indicated that current milk supplies were inadequate for their family needs.

Goat milk product acceptability was evaluated in taste tests in schools and other sites in rural western Kenya. The comparisons were against identically prepared cow milk samples as references. Results from taste tests involving a total of 367 people indicated no difference in acceptability of goat and cow milk products. Levels of acceptability, especially for fresh and soured milk, were high.

The conclusion drawn from this study is that acceptability of goat milk products is not a constraint to establishment of dual-purpose goat production systems on small farms in rural western Kenya.

INTRODUCTION

The Small Ruminant Collaborative Research Support Program (SR-CRSP) is investigating the potential for dual-purpose (milk and meat) goat systems on small farms in western Kenya. The objectives of the SR-CRSP are to investigate current small farm production constraints and identify and test potential interventions that might improve conditions on small farms.

SR-CRSP research in Kenya is done in collaboration with the Ministry of Agriculture and Livestock Development (MALD). Field enumerators were seconded from the Central Bureau of Statistics in the Ministry of Finance and Economic Planning.

RESEARCH GOALS

DAIRY PRODUCTION AND CONSUMPTION ON SMALL FARMS IN WESTERN KENYA

According to the Ministry of Livestock Development (1980) and Mbugua (1976), there is a demand for more milk in Kenya's rural areas. Lack of production and consumption figures on smallholder farms (MLD--Kakamega, 1982; MLD--Nyanza, 1982) frustrate attempts to quantify that demand.

One goal of this research was to quantify milk production and product consumption on eighty small farms in western Kenya and to collect on-farm milk processing information.

RELATIVE ACCEPTABILITY OF GOAT AND COW MILK

Although cow milk is a popular product in farming regions of western Kenya, goat milk products are not widely consumed (Nolan, 1982). Therefore, determination of the relative acceptabilities of goat and cow milk products are an important aspect of testing dual-purpose milk and meat goat production systems.

Attitudes toward and anecdotes about goat milk were collected, goat milk products were developed and experiments were designed to test the hypothesis that goat and cow milk products are equally acceptable to western Kenya consumers.

PROJECT LOCATION

The SR-CRSP is based at the Maseno Veterinary Farm in western Kenya. The field research sites are in Kakamega and Siaya Districts (figure 1). Agriculture in both Kakamega and Siaya consists primarily of small, family-run operations. Farm activities, particularly cropping, are determined by rainfall patterns. Both areas generally have an annual bimodal rainfall pattern. The "long rains" may fall from March through

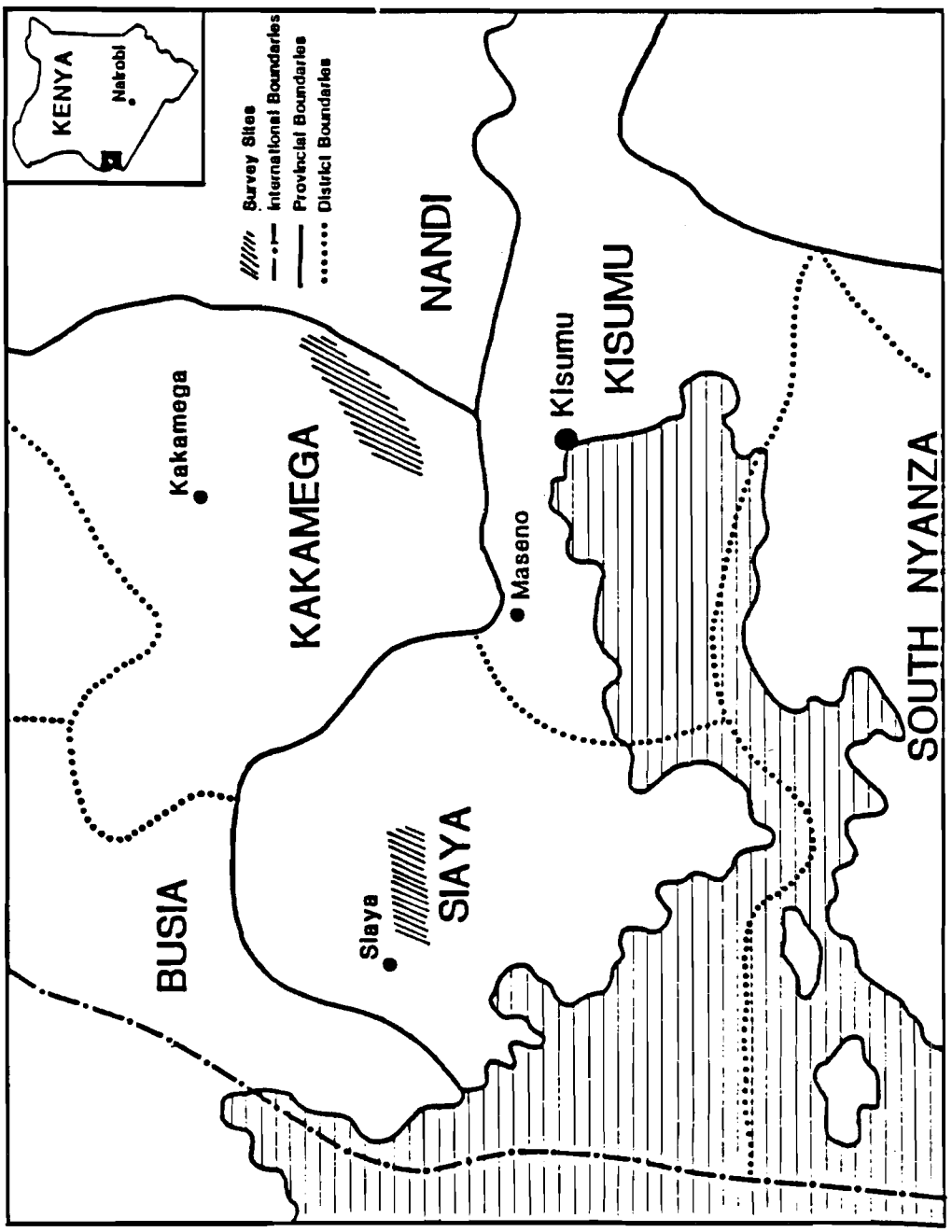

Figure 1. Map of western Kenya

May or June and the "short rains" in October and November. Kakamega receives, on the average, between 1834 and 2015 mm of rain per year; Siaya averages 1139 mm (Sands, 1983).

In 1978, Kakamega district was reported as having 294 people/km^2 in most areas and up to 880 people/km^2 in others (Lihanda, 1978; cited by Sands, 1983). Land pressure in Siaya was estimated at 186 people/km^2 (Sands, 1983).

The predominant tribe in Kakamega district is the Abaluhya. Siaya District is primarily inhabited by the Luo tribe.

KENYAN AGRICULTURE

Kenya has a total land area of 56,925,000 ha (FAO, 1982). Of that land, only about 7% is classified as "suitable for agriculture" (Hopcraft, 1976). Another 13% to 18% may be considered marginal to medium potential land, in terms of adequate rainfall and suitable soil (Ministry of Livestock Development, 1980). The remaining 75% to 80% of the total land area receives less than 600 mm of annual rainfall and is considered to be of low agricultural potential (Ministry of Livestock Development, 1980). According to Hopcraft, only .04% of total land area was under irrigation in 1976. FAO Production Yearbook estimates that in 1980, 10.6% of total land area was in use for crops or as pasture.

In 1981, Kenya's population topped 17 million and was increasing at an annual growth rate of over 4% (FAO, 1982). Approximately 80% of the population live on the 20% to 25% of the land that has marginal to high agricultural potential (Ministry of Livestock Development, 1980). Nearly 80% of total employment in Kenya is derived from the agricultural sector (table 1).

TABLE 1. KENYAN POPULATION AND EMPLOYMENT TRENDS: 1970-1981

Year	Total population	Agricultural population	Economically active population[a]		
			Total	Agricultural	% Agricultural
1970	11,253[b]	9,242	4,572	3,755	82.1
1975	13,514	10,504	5,299	4,236	79.9
1979	15,815	12,346	6,011	4,692	78.1
1980	16,466	12,773	6,226	4,829	77.6
1981	17,148	13,213	6,442	4,964	77.1

Source: FAO (1982).

[a] Includes employers, salaried and unsalaried workers, and employees on family farms.

[b] All figures are in thousands.

There are various types of land holdings in Kenya. The large plantations and ranches settled by European colonists were reported in 1976 to have been little changed since Independence in 1963 (Hopcraft, 1976). These ranches produce almost exclusively for export. At the same time, there were 1540 large-scale mixed farms, averaging 600 ha to 700 ha each (Hopcraft, 1976). Europeans retained ownership of a few of these, but most are now owned by individual Africans, agricultural societies or cooperatives. Nearly half of Kenya's marketed agriculture output is produced on these large ranches and farms (Hopcraft, 1976).

The majority of rural Kenyans live and work on individual small holdings, most of which are less than 2 ha in size. Very few are larger than 5 ha (Hopcraft, 1976). Personal observation suggests that since 1976, some of the large-scale farms and ranches mentioned above have been partitioned into small-scale, individual family holdings.

MLD (1980) describes a typical smallholder farm in the medium- to high-potential areas as including cash and subsistence crops, as well as some livestock. Common cash crops are coffee, tea, pyrethrum, and sisal. Subsistence crops vary from area to area, but generally include maize, beans, bananas, cassava, several Brassica species, and assorted vegetables. "Unimproved" zebu cattle, fat-tailed sheep, and native goats are, by far, the most common livestock. Numbers of "improved" livestock are slowly increasing, but have not yet become well established in the very rural areas.

The rapid population growth is creating a dilemma at the small-farm level. As children mature and inherit part of the family holding, farms are subdivided into fractions too small to produce enough food to support each resulting family (table 2). In Kakamega District, a high-potential, agricultural area in western Kenya, average farm size has decreased to .4 ha per holding (MLD-Kakamega, 1982). As a result:

1. Men are frequently forced to leave the homestead and seek remunerative employment (Sands, 1983).

2. A farm's croplands are reduced to little more than "kitchen gardens" and the resulting food produced is often inadequate for the family's needs.

3. Families are increasingly forced to choose between raising family food crops or livestock (MLD--Kakamega, 1982).

4. Families must buy food to supplement what little they can produce, eventually requiring importation from more productive districts or countries.

5. Social and economic structures must change rapidly as society depends less on subsistence farming and more on cash markets.

Improved agricultural practices, aimed at maximizing small farm productivity, are needed to counterbalance these alarming trends.

TABLE 2. TRENDS IN KENYAN FOOD SUPPLY (PER CAPUT PER DAY)[a,b]

	66-68	69-71	75-77	78-80	WHO intake recommendations[c]
Kcalories grand total	2252	2269	2157	2055	Male (3000)
Vegetable	2017	2030	1923	1830	Female (2200)
Animal	235	239	234	225	
Protein (g) grand total	66.3	66.3	61.5	56.8	Male (37)
Vegetable	51.7	51.5	47.6	42.5	Female (29)
Animal	14.6	14.8	14.0	14.3	
Calcium (mg) grand total	453	452	417	376	Male (400-500)[d]
Vegetable	219	216	200	183	Female (400-500)
Animal	233	236	218	193	

Sources: FAO (1982).

[a] These declining trends may be due to population increases and(or) production or import decreases. The 1980 figures may be low due to prolonged drought in late 1979 and early 1980.

[b] Data are based on total production and importation figures; that is, total food theoretically available. No losses, including processing, storage, etc., are taken into account.

[c] These figures are based on WHO recommended intakes of nutrients for moderately active adults (male--65 kg; female--55 kg). In this table, these data are intended only for use as reference points.

[d] Recent evidence indicates that humans can probably adapt to lower intakes of calcium than "recommendations" suggest. Therefore, low intake values do not necessarily indicate calcium deficiencies (Kon, 1972).

DAIRY INDUSTRY IN KENYA

The Ministry of Livestock Development estimates that total milk produced in Kenya during 1979 was 1,149 x 10^6 l. This figure includes cattle, camel, and goat production.

Of this total figure, approximately 60% or more is estimated to be consumed by the farmer or sold at informal markets. Less than 40% of the total is handled through formal market channels (i.e., through the Kenya Cooperative Creameries) (MLD, 1980).

Grade or "improved" cattle are unevenly distributed throughout the country. The Central and Rift Valley Provinces, which include the highland areas, had 82% (398,000) of the grade herd in 1976. The densely populated, smallholder farming areas of Western and Nyanza Provinces had only 8.7% (42,000) of the total (485,000) grade herd. The large farm sector, which has the highest concentration of grade cattle, produced an estimated 70% of the formally marketed milk in 1976 (Hopcraft, 1976).

Zebu cattle make up nearly 90% of the total mature cow population (4,253,000), but produce less than 50% of the total milk supply. Zebu cows are the principal source of milk in the smallholder and pastoral areas; only about 2% of the milk produced by Zebus leaves the community and passes through formal marketing channels (Hopcraft, 1976).

Individual animal production figures are difficult to verify, since few producers keep accurate records, but estimates of annual production have been made. For 1973, grade cow production averaged 1491 liters. For Zebu cattle, the average amount beyond that taken by the calf was 120 liters (Hopcraft, 1976).

MILK MARKETING

The Kenya Cooperative Creameries (KCC) essentially have a monopoly on processing and marketing Kenyan dairy products. Approximately 96% of all commercially handled milk passes through the KCC (Hopcraft, 1976). The only other recognized processors are various small producers who, under laws supported by the KCC, must be licensed to sell milk. Virtually all of these producers are located in isolated rural areas.

The Kenya Dairy Board was set up at the urging of the KCC, primarily to act as an instrument to control and license non-KCC distributors of dairy products. Licensing is very difficult to enforce in rural areas. Individual farmers frequently ignore the regulations. Periodically, however, the authorities do crack down. In early March, 1983, the English language national newspaper, "The Nation," reported that three women had been fined the equivalent of about US$140 for carrying approximately 8 liters of milk for sale without a permit.

KCC PROCESSING AND SALES

The KCC produces an array of products (table 3). Institution of the School Milk Program* by President Daniel Arap Moi in 1979 has greatly increased demand for fluid milk products. This program has also caused a dramatic shift in product manufacture (table 3). Milk powders, cheese, butter, and ghee were available, however, in 1983 (personal observation).

Sales figures for 1978 to 1980 reflect these trends (tables 4 and 5). A prolonged drought during late 1979 and early 1980 greatly decreased milk production during that period. Milk products became both scarce and expensive (Sands, personal communication). Conditions had improved by late 1981, but active production figures have not been published.

For many years before 1980, Kenya had significant milk and dairy product exports (table 6).

FAO (1972) reported that KCC exports peaked in 1968 to 1969, with 21% of the total dairy produce sold outside Kenya. By 1969 to 1970, exports had dropped to just over 15% of total production. In 1968 to 1969 and 1969 to 1970, 95.5% and 98.8% of the exported goods went to Uganda and Tanzania. The remainder went to other African countries, except small amounts of ghee, butter, and skimmed milk powder sold to Britain and Germany.

By 1980, the combination of increased demand for dairy products in Kenya and the drought-induced decrease in milk production caused a tremendous decrease in export capabilities (Republic of Kenya, 1980). By 1983, the dairy industry had not regained its pre-1980 export production levels.

DAIRY INDUSTRY CONSTRAINTS

The current commercial dairy industry in Kenya faces many serious obstacles (Hopcraft, 1976; Mbugua, 1976; Ministry of Livestock Development, 1980).

1. During the wet seasons, forage and cattle feed are relatively plentiful and milk production increases sharply. During flush seasons, lack of adequate processing capabilities is a major limiting factor. Large quantities of raw milk may actually spoil while waiting in collection cans, even when processing plants are working to capacity (Mbugua, 1976).

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* The goal of the School Milk Program is to provide every school child with one cup of milk every day. The goal has not yet been achieved, but progress is continuing.

TABLE 3. KCC PRODUCTS PROCESSED: 1978-1980

Product	Unit	1978		1979		1980	
		1st half	2nd half	1st half	2nd half	1st half	2nd half
Whole milk powder	MT	3,302	934	1,158	260	11	N.A.
Cheese	MT	99	154	165	99	83	N.A.
Evaporated milk	MT	573	112	40	--	43	N.A.
Skim milk powder	MT	1,582	1,374	1,203	26	76	N.A.
Butter	MT	1,464	1,348	936	1,070	702	N.A.
Ghee	MT	611	451	332	195	131	N.A.
Cream	1000 liters	30	30	32	10	11	N.A.
UHT milk	1000 liters	18,898	23,867	20,088	16,458	13,237	N.A.
Mala (yogurt)	1000 liters	39	16	9	9	1	N.A.
Bulk milk	1000 liters	4,331	4,294	4,522	2,278	655	N.A.
Tetrapak	1000 liters	60,691	66,617	N.A.	86,264	62,035	N.A.

Source: Republic of Kenya (1978-1980).

TABLE 4. KCC AVERAGE DAILY SALES OF FLUID MILK PRODUCTS

Product	Unit	1978		1979		1980	
		1st half	2nd half	1st half[a]	2nd half	1st half	2nd half
Bulk milk	1000 liters	18	17	18	23	8	13
Tetrapak	1000 liters	325	351	400	1,383	1,035	1,424
UHT and Mala[b]	1000 liters	104	121	109	257	203	233
Total	1000 liters	447	489	527	1,663	1,246	1,670

Source: Republic of Kenya (1978-1980).
[a] Kenya School Milk Program begins.
[b] Mala = yogurt

TABLE 5. SALE OF MANUFACTURED KCC PRODUCTS IN KENYA

Product	Unit	1978		1979		1980	
		1st half	2nd half	1st half	2nd half	1st half	2nd half
Whole milk powder	MT	1,275	929	1,309	1,433	342	306
Cheese	MT	136	135	130	143	78	88
Evaporated milk	MT	502	173	33	17	--	--
Skim milk powder	MT	861	662	1,342	671	408	320
Butter	MT	947	878	950	922	667	770
Ghee	MT	345	350	386	408	147	201
Cream	1000 liters	36	36	51	11	11	7

Source: Republic of Kenya (1978-1980).

TABLE 6. KCC EXPORTS: 1978-1980

Product	Unit	1978		1979		1980	
		1st half	2nd half	1st half	2nd half	1st half	2nd half
Whole milk powder	MT	491	935	637	544	933	.02
Cheese	MT	10	10	8	11	9	--
Skim milk powder	MT	4	55	264	508	--	--
Butter	MT	391	655	506	310	1	.03
Ghee	MT	2	14	3	12	--	.04

Source: Republic of Kenya (1978-1980).

During dry seasons, milk production drops off. There are two major reasons for this (Hopcraft, 1976; MLD, 1980):

(a) Most farmers lack the capital and the expertise to successfully preserve adequate amounts of feed necessary to maintain lactation during the dry season.

(b) The current government-controlled pricing system does not provide incentives for farmers to invest in technology needed to increase milk production during the dry season. The same price is paid for milk throughout the year. Therefore, it is in the farmers' interest to produce as much milk as he or she can while feed costs are low.

Milk shortages are, however, often handled creatively. In response to Nairobi consumer complaints about "an odd flavor in the milk," an article appeared in the April 9, 1982, Kenyan newsmagazine "The Weekly Review." The KCC managing director attributed the odd flavor to product formulation. Skimmed milk powder had been mixed with butter oil to create a product that had been marketed as fluid milk. Fresh milk alone could not meet national demand between January and March 1982.

2. KCC is essentially only a surplus buyer in the small holder farming areas (Hopcraft, 1976; Mbugua, 1976). The rural areas' demand for milk has not yet been met. Substantial increases in milk production would be absorbed before any impact could be made on the commercial market.

3. Evening milk is very rarely collected. One reason may be the substantially increased difficulty of driving after dark on poor roads. By morning, the quality of raw evening milk has often deteriorated beyond acceptable limits (Mbugua, 1976).

4. Payments to farmers are often delayed.

5. Producers' prices are quite low.

6. Relatively high consumer prices of both commercial and non-commercial milk are prohibitive for very poor families.

MILK IN THE KENYAN DIET

Along with a chronic need for calories, undernourished people require high quality protein, calcium, and both fat and water soluble vitamins. As a single food, milk comes closest to meeting these needs, as well as providing a source of fat and minerals. Milk is, however, an incomplete source of iron, copper, and vitamins C and D.

Kenya has a long dairying history that extends, perhaps, as far back as 4000 to 3000 B.C. (Johnson et al., 1974). Milk and dairy products have

remained popular through the years (Kurwijila, 1980; MLD, 1980) and demand, particularly in densely populated areas, exceeds currently available supplies.

Despite the nutritional benefits of consuming milk, policies designed to encourage increased milk consumption in developing countries are controversial. The major concern involves malabsorption of lactose and subsequent detrimental effects on health.

Common clinical symptoms of lactose malabsorption include development of abdominal distension, cramps, and watery diarrhea within an hour or two after drinking milk (American Academy of Pediatrics, 1974). Usually, but not always, these disturbances are the result of lactase deficiency (Kretchmer, 1972; Johnson et al., 1974; Pieters and Van Rens, 1973).

Lactase (beta-D-galactosidase) hydrolyzes lactose into glucose and galactose. This enzyme is normally located in the brush border of the epithelial cells of the small intestine. Insufficient quantity and(or) activity of this enzyme allows lactose to pass unaltered to the colon, where its osmotic effect causes fluid to be drawn into the gut (American Academy of Pediatrics, 1974). In addition, bacterial fermentation of the lactose produces lactic acid and other organic acids, which lower stool pH below 6.0 (Kretchmer, 1972). Discomfort and explosive diarrhea result.

There are many possible causes for lactase deficiency, but most fall into three broad categories: congenital, secondary, and primary (Pieters and Van Rens, 1973). Congenital lactase deficiency is an extremely rare condition which is present at birth. Continued ingestion of lactose by the infant results in malnutrition and failure to thrive. The continually rapid passage rate prevents the infant from absorbing adequate nutrients (Johnson et al., 1974).

Secondary lactase deficiency is a reduction in enzyme activity resulting from physical damage to the G.I. tract. Damage could be caused by gastroenteritis, infections, hepatitis, protein-calorie malnutrition or other assorted maladies. Lactase can regain full activity if scarring of the gut wall is not too severe (Johnson et al., 1974).

Primary "adult" lactase deficiency is most prevalent. There is general agreement that this type develops as progressive diminution in the ability to hydrolyze lactose after the age of three years (American Academy of Pediatrics, 1974).

In 1965, the results from a Johns Hopkins School of Medicine study showed malabsorption problems among 6% to 15% of the white subjects, but a startling 70% among black subjects (Kretchmer, 1972). These findings launched many investigations into possible ethnic origins of lactose malabsorption.

By 1970, research began to indicate that lactose tolerance might be the more unusual condition among the world's population. The major ethnic groups who retain the ability to hydrolyze lactose through adulthood are

northern Europeans and their descendents and members of three African pastoral tribes. Many other generally tolerant groups also exist, but most of the peoples of the world seem to retain only a limited ability to hydrolyze lactose (Kretchmer, 1972). Theories pertaining to the retention of continued high levels of lactase activity throughout life among certain ethnic populations are still open for speculation (Kretchmer, 1972; Johnson et al., 1974).

Lactose malabsorption is diagnosed by one or more of the following methods (Kretchmer, 1972):

1. Observation of clinical symptoms (flatulence, diarrhea) 30 min to 60 min after ingestion of a lactose dose of 2 g/kg body weight, up to a maximum of 50 g or 100 g

2. Low lactase activity (less than 2 enzyme units per gram of wet tissue weight) as determined by biopsy of the small intestine following lactose ingestion

3. Blood glucose elevation of less than 20 mg/100ml of blood following ingestion of measured lactose doses

Inability to completely hydrolyze lactose, as indicated by low blood glucose elevation, does not necessarily mean that clinical symptoms will develop when milk is ingested. Adverse symptoms seem to be a function of quality of milk consumed, intervals between consumption and other foods consumed along with milk (Simoons et al., 1977).

The results from a study in Lagos, Nigeria, suggest that lactose tolerance levels can be increased by regular intake of lactose over a long period of time (Kretchmer, 1972). The mechanism for this apparent phenomenon is unclear. Blood glucose levels remained depressed, indicating no real increase in enzymatic activity. Researchers hypothesized that the diet effected a change in the gut microflora and that the new bacteria was able to metabolize the lactose (Kretchmer, 1972).

Lactose malabsorption symptoms do not usually occur after ingestion of fermented milk products such as yogurt and cheese. One possible explanation for this is the overall reduced lactose content in fermented dairy foods (Johnson et al., 1974). A recent study in Nairobi showed high consumer acceptability of fermented milk products. No undesirable effects were caused by tasting the various yogurts (Kurwijila, 1980). The Department of Food Science and Technology at the University of Nairobi is currently studying the potential for development of safe and acceptable fermented milk products (Schulthess and Kurwijila, personal communication).

Lactose malabsorption has been documented among a group of Kenyan school children (Pieters and Van Rens, 1973). Seventy-three percent of the 72 children in the study were found to have low blood glucose elevation levels following lactose ingestion. Despite this evidence of lactose malabsorption, no clinical symptoms developed within this group, even after test doses of milk were doubled and quadrupled.

The conclusions from this study were very similar to those of the American Academy of Pediatrics (1974). Both state that evidence is insufficient to discourage consumption of milk in areas where childhood malnutrition are common. The nutritional effects of moderate, informed use of milk outweigh the potential risks.

ROLE OF LIVESTOCK IN KENYAN SMALLHOLDER FARM SYSTEMS

Livestock play a very important role on small farms in rural Kenya. Livestock ownership is an integral part of the Kenyan social fabric and must be examined as part of a complex system rather than as an independent phenomenon (Sands, 1983).

Traditionally, animals may have been valued more for quantity than quality, so a farmer's objective may be to maximize his herd numbers rather than any particular aspect of production. Livestock may be units of exchange, "savings account" equivalents, or yardsticks of social achievement.

In addition, livestock are expected to provide traction, meat, milk, hides, and an assortment of other by-products (Hopcraft, 1976; Sands, 1983).

The question of resource allocation between livestock production and(or) production of strictly human food is a serious concern in the densely populated smallholder farming areas (MLD--Kakamega District, 1982). The Council of Agricultural Science and Technology (CAST, 1975) warns that livestock might disappear from small farm systems in areas or periods of critical food shortages. Indeed, according to Ministry of Livestock Development reports, a trend toward smaller numbers of animals may be developing (MLD-Kakamega District, 1982).

Animal products are, however, a very important source of high quality protein in the human diet. In regions where food is scarce, efforts must be made to place emphasis on animal protein production through conversion of feeds that are noncompetitive with human food resources (Devendra, 1980).

DUAL-PURPOSE GOATS

One SR-CRSP goal in Kenya is to determine the viability of goat management systems producing milk for human consumption. A desirable system is one in which the farmer provides goats with fodder, crop by-products, reasonable health care, and protection from predators. In turn, the goat system would provide the farmer with milk, manure for fertilizer, meat, and kids.

The rationale behind selecting goats as test animals includes the following:

1. Goats are less costly than cattle, requiring smaller initial investment and therefore less financial risk by the farmer.

2. A goat may kid between 1 yr and 2 yr of age after only a 5-mo gestation period, whereas a cow in the tropics may take 3 yr to 5 yr to reach the necessary weight and maturity for her first breeding.

3. A goat requires less feed than a cow.

4. Goats can produce milk and meat proteins from crop by-products that otherwise might not be utilized.

Kenya's goat herd was estimated at 4,580,000 in 1981 (FAO, 1982). Most of these goats were not bred for milk production. FAO (1982) estimates that total goat milk yield in 1981 was 44,000 MT. There is no commercial goat milk industry in Kenya; most of the milk produced was consumed by Kenya's pastoral tribes living in arid low agricultural potential areas.

Goat milk is not commonly consumed among smallholders in western Kenya (Nolan, 1982). There are religious sects (e.g., the Legion Maria) which do not utilize goat products. However, a principal factor is that the small East African goats which predominate in this region generally do not produce more milk than is needed to raise their offspring.

CHARACTERISTICS OF GOAT MILK

The representative values for major constituents of goat milk are quite similar to those for cow milk (table 7), but there are a few observed differences that are worth mentioning.

Proteins. The major proteins in goat milk are beta-lactoglobulin, alpha-lactalbumin, kappa-casein, beta-casein and alpha$_{S2}$-casein. These proteins are homologous to the corresponding proteins in cow milk (Jenness, 1980).

TABLE 7. REPRESENTATIVE VALUES FOR SOME MAJOR CONSTITUENTS OF GOOD QUALITY MILK (g/100 g)

	Fat	Solids not fat	Protein NX6.38	Lactose (anhyd)	Calcium	Energy kcal/100g
Human	4.62	8.97	1.23	6.94	.03	73
Cow (Friesian)	3.50	8.65	3.25	4.60	.115	62
Goat	4.50	8.70	3.30	4.40	.13	71

Source: S. K. Kon (1972).

Goat milk has little or no alpha$_{S1}$-casein, a protein present in cow milk (Jenness, 1980). The lack of this protein seems to cause acidified goat milk to have softer, smaller curds than acidified cow milk. These softer curds have given rise to speculation that goat milk proteins may be more readily digested than cow milk proteins, but this has not been experimentally proven (Jenness, 1980).

Nonprotein nitrogen (NPN) is higher in goat milk than in cow milk (Jenness, 1980; Devendra, 1980).

Vitamins. When data on vitamin content of goat milk are calculated in relation to calorie requirements of infants (i.e., goat milk as the sole food source), vitamin A, niacin, thiamin, riboflavin, and pantothenate are found to be adequate. Goat milk is deficient in vitamins C, D, B_{12}, pyroxidine, and folate (Jenness, 1980). By the same measure, cow milk is deficient in vitamins C and D, but is considered adequate in B vitamins.

Agglutinin. Goat milk lacks "agglutinin," the factor present in cow milk which causes fat globules to cluster when cooled (Jenness, 1980). As a result, cream rises very slowly in goat milk.

MILK PRODUCTION, PURCHASE, PROCESSING, AND DAIRY PRODUCT CONSUMPTION IN EIGHTY HOMESTEADS IN WESTERN KENYA

INTRODUCTION

An estimated 60% of Kenya's total milk production is consumed on the producer's farm or sold through informal markets (MLD, 1980). Despite the impact smallscale, rural dairy industries have on regional economies and nutritional well-being, until recently, little effort had been directed toward quantifying individual small farm output (MLD--Kakamega, 1982; MLD--Nyanza, 1982).

The Small Farms Systems Survey (SFSS) was initiated by SR-CRSP in late 1980. Livestock data (i.e., births, deaths, herd composition, milk production, feeding practices, and forage quality), crop yields, household demography, and other information were collected through separate surveys of the same households.

Selected first-year results (Sands et al., 1982; Sands, 1983) are summarized in tables 8 and 9.

TABLE 8. CHARACTERISTICS OF EIGHTY FARMS STUDIED IN KAKAMEGA AND SIAYA DISTRICTS

Location	No. of farms	Tribe	Avg. farm size	Avg. people /farm	Avg. people /ha
Siaya	40	Luo	1.09 ha	4.65	9.90
Kakamega	40	Abaluhya	.98 ha	7.95	15.36

Source: Sands, M. W., H. A. Fitzhugh, R. E. McDowell, and S. Chema (1982).

Sixty-two percent of the 80 farms studied in Siaya and Kakamega were smaller than 1 ha. A "typical" Siaya farm may be described as planting .36 ha of intercropped maize and beans, .18 ha of maize alone, .23 ha of cassava and smaller crops of sorghum, finger millet, sweet potatoes, bananas and assorted vegetables. Average yields were 528 kg of maize and 70 kg of beans per farm.

TABLE 9. 1981 CATTLE NUMBERS AND PRODUCTION FIGURES

Location	No. of farms	Total no. of cattle	Calving interval	Avg. lactation length	Milk yield /lactation
Siaya	40	117	21.3 mo	9.8 mo	302 kg
Kakamega	40	102	19.6 mo	10.9 mo	419 kg

Source: Sands, M. W., H. A. Fitzhugh, R. E. McDowell, and S. Chema (1982).

About half of the farms had livestock. A typical herd includes 2 or 3 cows, several sheep and goats, and 10 to 15 chickens (Sands, 1983).

A "typical" Kakamega farm had .41 ha of intercropped maize and beans and minor crops of maize alone, sorghum, bananas, sweet potatoes and assorted vegetables on an average of .3 ha. Average yields were 843 kg of maize and 382 kg of beans. Half of the families had 1 or 2 cows, 1 sheep, and a few chickens; only 1 family had goats (Sands, 1983).

The staple diet in both areas is a coarsely ground maize meal paste called ugali. This dish may be served alone or with fermented milk and(or) vegetables, meat, or fish.

Survey results regarding dairy consumption and production are presented in this section. Results from analyses of dairy products sampled in the research areas are also included.

METHODOLOGY

Surveys. Milk production data were collected from the Small Farms Systems Survey.*

The dairy product processing and consumption surveys (Appendix 1) were developed in collaboration with the SR-CRSP field staff. The survey questions were field-tested and revised twice before data collection began in Siaya and Kakamega research areas.

Dairy Product Sampling. Fresh and fermented milk and butter samples were collected from individual farmers in the Kakamega area. In Siaya, samples were purchased at an outdoor market. Goat milk samples were collected from farms collaborating with SR-CRSP dual-purpose goat field trials.

* For discussion of household selection and SFSS methodology, see Sands, M. W., H. A. Fitzhugh, R. E. McDowell, and S. Chema (1982).

Two samples of each product were placed in 40-ml Nasco sample bags; 1 sample was preserved by addition of a few crystals of sodium dichromate. Samples were dated, labelled, and transported on ice to the Maseno Vaterinary Farm.

The dichromate samples were placed directly in a refrigerator (about 4C), where they were held until they could be transported to a laboratory in the Rift Valley.

The nonpreserved samples were mixed well, then triplicate .2-ml portions were pipetted into clean test tubes. These tubes were covered with plastic food wrap, labelled, and frozen for later determination of lactose.

Titratable acidity was immediately determined on triplicate 9-ml portions of the nonpreserved milk samples.

Milk Sample Analyses. Nitrogen was determined by the Kjeldahl method and expressed as crude protein by multiplying by the factor 6.38. Fat was determined by the Gerber method, except for the butter samples, which were analyzed by ether extraction. Milk samples were held at 102C in the drying oven for total solids determination. Ash was determined by weighing the samples after holding them overnight at 500C in the muffle furnace. The titratable acidity method was described by Kosikowski (1978).

Lactose Analysis. Lactose was analyzed by the following modification of the Feitosa Teles method (Feitosa Teles et al., 1978).

1. Add 4 ml distilled water to .2 ml milk sample
2. Add .4 ml $ZnSO_4$ (5%)
3. Add .4 ml $Ba(OH)_2$ (4.5%)
4. Vortex
5. Centrifuge 1 min at 1500 g
6. Deliver .5 ml clear supernatant fluid to screw cap culture tube
7. Deliver 1.25 ml Teles Reagent
8. Incubate 10 min at 85C to 90C
9. Dilute with 10 ml distilled water
10. Read absorbance at 520 nm

0%, 2%, 4%, 6%, and 8% lactose standards are made up in distilled water.

Teles Reagent. 1 volume 1% phenol, 2 volumes 5% NaOH, 2 volumes 1% picric acid, and 1 volume 1% sodium bisulfite mixed in that order.

Chemicals used in these analyses were from the following sources:

1. $Ba(OH)_2$. BDH laboratory reagents. Glaxo laboratories, Bombay, India.
2. Phenol. BDH Chemicals, Ltd., Poole, England.
3. Lactose. BDH Chemicals, Ltd., Poole, England.

All other chemicals were purchased at either Howse and McGeorge, Ltd., or E. T. Monks and Co., Ltd. in Nairobi. These chemicals were packed and labelled by the above companies.

Statistical Analyses. One way classification analyses of variance were performed on survey data to test differences in production and consumption patterns between Siaya and Kakamega study areas.

RESULTS

Milk Production and Supply. The 1982 cattle numbers and production figures from the eighty research farms are in table 10. There are no improvements over 1981 figures; in fact, cattle numbers and average lactation lengths decreased.

TABLE 10. 1982 CATTLE NUMBERS AND PRODUCTION FIGURES

Location	No. of farms	No. of farms w/cows	No. of cattle	Mean lactation length (days)	Mean yield (kg/lactation)
Siaya	40	18	86	215.6 ± 63.84	295.0 ± 147.3
Kakamega	40	18	67	197.4 ± 122.10	430.1 ± 324.1

Average monthly milk yields during lactation on the Kakamega and Siaya farms were 55.02 kg and 35.10 kg, respectively. Production on the Kakamega farms was greater than on the Siaya farms ($p<.01$).

Six families in the Kakamega area and three families in Siaya claimed to obtain a "satisfactory amount" of milk from their own cows.* Thirty-four of the forty farmers in Kakamega purchased milk, at least occasionally. Eleven bought milk from KCC distributors, four of them on a daily basis.

Twenty-six of the thirty-eight farmers in Siaya** purchased milk, with nine buying occasionally from KCC outlets. None purchased KCC milk everyday. In both areas, non-KCC purchases were made from neighbors or at local shops or markets.

* All of these nine respondents said this claim was true only when there had been adequate rainfall and forage growth for maintenance of lactation in their cattle.

** By the end of 1982, one of the original forty farmers died, another had moved away.

Milk consumption. Eighty percent of the farm families in Kakamega consumed milk daily; 36.8% had milk daily in Siaya (table 11).

TABLE 11. FREQUENCY OF MILK CONSUMPTION

Frequency	Kakamega (no. of families)	Siaya (no. of families)
Daily	32	14
1 time/wk	6	12
Rarely	2	11
Never	0	1
Total	40	38

Average daily milk consumption per family in Kakamega (.82 liters) was greater than the .42 liters daily average in Siaya ($p<.01$). Table 12 has average daily consumption data from both districts.

In both Siaya and Kakamega, milk consumption was higher on farms with cattle than on farms without cattle (table 13).

Nine farms in Siaya and fourteen farms in Kakamega sold some milk in 1982. In Kakamega, the estimated average amount sold was 1.1 liters/day over a 130-day period of time. In Siaya, an estimated average of 1.32 liters/day was sold over 71.5 days. With few exceptions, milk was sold only after 1 liters/day had been reserved for family use.

TABLE 12. ESTIMATED DAILY MILK CONSUMPTION PER FAMILY

	Kakamega		Siaya	
Avg. daily consumption (l)	No. of families	% of families	No. of families	% of families
.00 - .10	1	2.5	6	15.4
.11 - .25	2	5.0	14	35.9
.26 - .50	14	35.0	15	38.5
.51 - 1.00	19	47.5	2	5.1
1.10 - 2.00	4	10.0	2	5.1
Total	40	100.0	39[a]	100.0

[a] One respondent died.

TABLE 13. COMPARISON OF DAILY MILK CONSUMPTION: FARMS WITH AND WITHOUT CATTLE

	Kakamega		Siaya	
	With cattle	Without cattle	With cattle	Without cattle
No. farms	18	22	18	22
Milk consumed, l/day				
Average[a]	1.07	.61	.65	.23
SD	.49	.28	.45	.14

[a] Differences between average consumption on farm with and without cattle were significant ($p<.01$) for both districts.

DAIRY PRODUCTS IN WESTERN KENYA

The most popular dairy products in western Kenya are fresh milk, which is predominately used in tea, soured milk, and butter prepared from fermented milk (table 14). The compositions of various dairy products sampled in the study areas are reported in table 15.

TABLE 14. DAIRY PRODUCTS CONSUMED ON SMALL FARMS IN WESTERN KENYA[a]

	Kakamega (40 farms)		Siaya (38 farms)	
Product	Farms using daily (%)	Total farms using (%)	Farms using daily (%)	Total farms using (%)
Tea	87.5	100.0	47.4	94.7
Fermented	5.0	72.5	15.8	65.8
Cooking	5.0	62.5	23.7	97.4
Fresh	17.5	60.0	7.9	28.9

[a] These figures include all farms that reported using the product, regardless of frequency of consumption.

Analysis of fresh goat and cow milk and sour cow milk show them all to be less than 3% protein (table 15). Lactose was just over 5% in the fresh milk samples and 4.66% in the sour milk samples.

Both fresh milk samples had mean fat compositions greater than 5%. Fermented milk samples averaged 3.61% fat.

Total solids of the fresh milk samples averaged over 15%. This was higher than predicted by measurement of individual milk constituents but could be due to extraneous matter in the milk and(or) improper sample weighing technique upon removal from the drying oven. The butter

TABLE 15. COMPOSITIONS OF DAIRY PRODUCTS SAMPLED IN SIAYA AND KAKAMEGA

	n	Lactose	Lactic acid	Protein	Fat	Total solids	Ash
Fresh cow milk	7	5.06 ± .86[a]	.19 ± .04	2.60 ± .52	5.21 ± 1.22	15.08 ± 2.20	.78 ± .23
Fresh goat milk	15	5.06 ± .71[b]	.18 ± .04[b]	2.89 ± 1.25	5.11 ± 1.43	15.62 ± 3.16	.91 ± .15
Fermented cow milk	7	4.66 ± 1.14	1.33 ± .46	2.47 ± .65	3.61 ± 1.34	11.67 ± 2.29	.70 ± .23
Butter	3	--	--	2.01 ± .89	62.97 ± 2.67	--	--
Fermented reduced-fat milk	1	4.31	1.26	2.71	.70	9.20	.77

[a] Six fresh cow milk samples were analyzed for lactose.
[b] Thirteen goat milk samples were analyzed for lactose and lactic acid.

samples had a mean fat composition of 62.97%, along with 2.01% protein. Total solids were not determined.

One reduced-fat sour milk sample was analyzed. The sample was only .70% fat and 9.2% total solids. The sample was 2.71% protein, 4.31% lactose, and 1.26% lactic acid.

MILK PRODUCT CHARACTERISTICS

MILK IN TEA

The most popular use for milk on respondents' farms was in preparation of tea. In both districts, but particularly in Kakamega, other products were often prepared only when families had more milk than that needed for daily tea preparation.

Preparation. Water is brought to a boil, then tea leaves are added (about 2 heaping teaspoons for every 3 cups of water). When this comes to a full boil, milk is added. The preferred milk to water ratio is approximately 1:2, but this can vary to 1:6, depending on the availability of milk. Frequently, sugar is added at the same time as the milk (about 67 g/l of beverage). This mixture is brought to a boil. All of the ingredients are heated together for about 5 to 10 minutes.* The tea is sieved before serving.

FRESH MILK (NOT IN TEA)

Fresh milk in both areas was generally consumed by children, although four families claimed that it was drunk periodically by nearly everyone in the family.

Sixty-five percent of the families in Kakamega and forty-two percent of the families in Siaya heat or boil their milk before drinking or processing.

SOUR MILK (MAZIWA LALA)

Sour milk is prepared by spontaneous fermentation of milk in a gourd called a calabash. The calabash, along with a round, flat-bottomed cooking pan, represent total milk processing equipment available on most of the farms.

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* Many respondents mentioned that preparation time varied greatly depending on the available fuel source.

Sour milk flavor development is unique to each calabash. Many respondents claim a strong preference for the flavor of the sour milk produced on their own farms. These flavors are very difficult to characterize and are nearly impossible to duplicate. Smoky flavor and extraneous matter are very common.

Preparation. Fresh milk is poured into the calabash, which is then plugged with a piece of wood or a wad of banana leaves. The milk is left to rest for about 3 days, but is generally consumed before the 5th day.

The calabash is usually rinsed with water and left to dry in the sun after preparation of 2 batches of soured milk.

The residual culture remaining in the calabash, along with microorganisms already present in the milk, are generally all that is needed to start the next fermentation. Some respondents in Siaya reported adding fresh orange juice to reluctant batches of milk to speed souring. One Siaya family blends cow urine into the milk. Several people report adding a "traditional herb" to the calabash to aid coagulation. Attempts to identify this "herb" were unsuccessful.

BUTTER

Butter is generally prepared only when there is a relative surplus of milk available on the farm. Both the butter and the resulting reduced-fat milk are used in cooking vegetables. In addition, the milk may also be drunk.

Preparation. Butter is churned when the calabash is at least half full of 2-day to 3-day old soured milk. The gourd is shaken vigorously on the lap. Churning is continued until distinct lumps develop. The gourd contents are then emptied into a pan and the butter is separated from the milk.

VEGETABLES/PORRIDGE

Fresh milk, soured full-fat and partial-fat milk and butter each may be used as liquid stock for cooking vegetables. The use of milk in cooking is particularly popular in Siaya.

ADEQUACY OF CURRENT MILK SUPPLIES IN THE RESEARCH AREAS

Eighty-five percent of the families interviewed in Kakamega and 87% in Siaya complained that current milk supplies were inadequate for their needs.

The uses envisioned by these families for the desired additional milk are listed in table 16.

TABLE 16. PROPOSED USES FOR ADDITIONAL MILK

Product use	Kakamega (34 farms, %)[a]		Siaya (33 farms, %)[a]	
	1st choice	Total	1st choice	Total
Milk in tea	67.6	88.2	24.2	78.8
Fermented milk	5.9	67.6	0.0	36.4
Feeding children	17.6	44.1	33.0	15.2
Cooking	0.0	8.8	16.7	76.7
Sell	5.9	20.6	60.6	78.7
Fresh	0.0	5.9	0.0	20.0
Butter	0.0	2.9	0.0	27.3
Feeding puppies	0.0	0.0	0.0	12.1

[a] These data are first priority and other proposed milk uses obtained from farmers claiming inadequate current milk supplies.

GOAT MILK

Farmers were asked if they would be willing to include goat milk in their families' diets. In Kakamega, 77.5% said yes, 20% said no, and 2.5% were uncertain. In Siaya, 41% were positive, 46% were negative, and 13% were uncertain.

Anecdotes collected concerning the use of goat milk were often contradictory, and usually negative. Most were based on hearsay rather than experience with goat milk.

Several older people remembered milking goats 30 years to 40 years ago. They claimed that dairy goats "disappeared" from the region as emphasis was shifted to raising cattle for milk. Some of these people believed that, as a result of the growing prestige associated with owning cattle, consumption of goat milk became associated with lower social status.*

Many people claimed that goat milk is best used as a medicine; others claimed that consumption of goat milk caused certain diseases. A few of these people mentioned that milk of a black goat is sometimes used in casting witchcraft spells.

Three families in Siaya claimed that their religious sect, the Legion Maria, forbade consumption of all goat products.

* In Siaya, herdsboys consume small amounts of milk obtained from their native goat herds.

COMPARISON OF CONSUMER ACCEPTANCE OF GOAT AND COW MILK PRODUCTS

Consumer acceptance of goat milk products was evaluated as one aspect of estimating the potential adoption success of milk-meat goat systems in western Kenya. Acceptability of goat milk products was measured in reference to identically prepared cow milk products.

The criteria for selection of dairy products for consumer testing were:

1. Ease of preparation, using technology currently available on small farms
2. Reliable, consistently sanitary products
3. Maximization of nutrient yield
4. Economic feasibility
5. Pleasant flavor

Fresh, pasteurized milk, milk soured by addition of fruit juice, and a heat-acid coagulated white cheese were tested. Sources of milk were grade Ayrshire cows and Toggenburg cross goats on the MLD Veterinary Farm at Maseno.

PREPARATION OF TASTE TEST SAMPLES

Pasteurization of fluid milk products. Fresh milk was filtered into a clean pan and heated, with constant agitation, to 75C. This temperature was maintained for 30 seconds. The milk was covered and allowed to cool for about 15 minutes before being placed in a 4C refrigerator. When a freezer was available, the hot milk was chilled in the freezer for about 1 hr before transfer to the refrigerator.

Pasteurized milk soured with orange juice. Freshly squeezed orange juice was added to fresh, pasteurized milk until the texture of the milk became smooth and thick; about 1/2 cup (125 ml) of orange juice to a liter of milk.

Preparation of cheese.* The following method was adapted from Kosikowski (1978):

1. 2 liters of fresh, filtered milk were heated, with constant agitation, to 82C.

2. 1/3 cup (80 ml) of a commercially prepared 5% acetic acid solution was stirred carefully into the heated milk.

3. Heat was turned off, and the curds were allowed to mat for about 30 minutes.

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* For composition of a typical white cheese, see Appendix 2.

4. Whey was strained through a cheesecloth, which had been washed, boiled, and placed over a colander.

5. About 1 teaspoon of salt was stirred thoroughly into the curds.

6. Curds were carefully wrapped up in the cheesecloth and were pressed for several hours, usually overnight, at room temperature. The cheese press consisted of 2 flat boards that had been cleaned with boiling water. Pressure was contributed by a bucket of water placed on the top board.

TASTE TEST LOCATIONS

Formal taste tests were held in 2 local secondary schools and in 4 locations in Siaya and Kakamega.

Goat milk was heat-processed and informally distributed on a daily basis at the Maseno Veterinary Farm.

School #1 (Ebusakami). Students were asked to complete dairy product consumption questionnaries before the day of the test.

Although students were told that they were trying goat and cow milk products, identities of the individual products were revealed only after the tests were completed.

To avoid taste fatigue, tests were limited to four products: fresh, pasteurized goat and cow milks and fresh goat and cow cheeses.

Each product was assigned a symbol that was unlikely to bias the consumer (e.g., *, 0). All possible tasting orders for the four products were listed. One order was assigned, by use of the appropriate symbols, to each questionnaire.

Cheeses were cut into small pieces. Each piece was individually wrapped and labelled with a symbol. Paper cups were labelled with characters corresponding to the assigned milk symbols.

Each student was given a questionnaire and a pencil. Test instructions were repeated orally, in both English and Swahili. Students were encouraged to ask questions regarding test procedures. Samples were handed out only after all questions had been answered.

Each student was asked to taste the four samples, one at a time in the order indicated on his or her questionnaire. Each person was requested to assign each product a score from the following 5-point hedonic scale:

1 = Like very much
2 = Like
3 = Neither like nor dislike
4 = Dislike
5 = Dislike very much

School #2 (Vigina). The same procedures as for Ebusakami were followed except:

1. No dairy product consumption questionnaires were completed before the test. Instead, students were asked to indicate on their taste test forms only whether or not they consume milk.

2. Only fluid milk samples were formally compared in the taste tests. Upon recommendation of the headmaster, cheeses were left for curious students to try at tea time.

In both schools, students wishing not to participate were asked to sit quietly and not disturb their classmates.

Field Tests in Siaya and Kakamega. SR-CRSP field staff coordinated meeting times and places with families in the research areas.

Fresh, pasteurized goat and cow milk and soured goat and cow milk were tested in one Siaya location. Only sweet milk samples were tested in the remaining Siaya site and in both Kakamega areas.

After the respondents had assembled, each person was asked to step forward and taste each sample presented. After tasting, each participant was questioned closely to determine his reaction to the product. Responses were quantified on the 5-point hedonic scale.

All instructions were presented in English, Swahili, and the vernacular language.

Products were identified when the tests were completed.

Maseno Veterinary Farm. A hot plate, strainer, cooking pan, thermometer, spoon, lab book, and milk storage containers were installed at the Vet Farm Office. Office staff were instructed on milk handling and equipment cleaning and maintenance. Instructions were also clearly posted. Milk was brought into the office every day. Upon arrival, it was immediately filtered, pasteurized, then stored in the refrigerator.

The following data were recorded daily: date, amount processed, temperature, disposal, and comments.

STATISTICAL ANALYSIS

Analysis of variance was performed on taste test data from the secondary schools. Three distinct groups were tested at Ebusakami; therefore, data were blocked by date of study.

The data from the research areas were analyzed using the t test for paired samples.

RESULTS

School #1--Ebusakami. Dairy product consumption questionnaires were distributed to class members of 3 separate groups. Fifty-seven completed forms were collected.

Only 1 student indicated that she did not drink milk; the other 56 claimed to have milk products every day. None of the students had tried goat milk or any types of cheeses before. All students were between the ages of 13 and 19.

On test days, class attendance for the three groups was 27, 14, and 29. Out of these 70 students, 2 refused to participate, claiming an aversion to milk products. Two others only partially completed their test forms. Test data collected from the remaining 66 students are presented below.

Goat milk received a pooled mean score of 2.12; cow milk received 1.91. Goat milk cheese had a pooled mean score of 3.13, while the cow milk cheese mean score was 2.91.

There was no significant variation in scores assigned to goat and cow milk products.

A histogram of the scores reflects high student opinion of both milk samples (figure 2). Most of the scores received were 1s or 2s.

Cheese scores were more evenly distributed across the range than the milk scores (figure 3). The most common cheese score recorded was "no opinion, 3."

Ebusakami Secondary School. Combination of both comments and scores from the Ebusakami taste tests indicates that while students could differentiate between cow and goat samples by color, creaminess, etc., there was no difference in acceptability between the samples, for either the milks or the cheeses.

There is a significant block effect at all levels for the cheese and at the 10% level for the milk samples. Since the data were blocked by date of test,and thereby, batch of product and class of students, the variations could be due to one or more of the following:

1. Natural daily variation in the quality of the raw milk

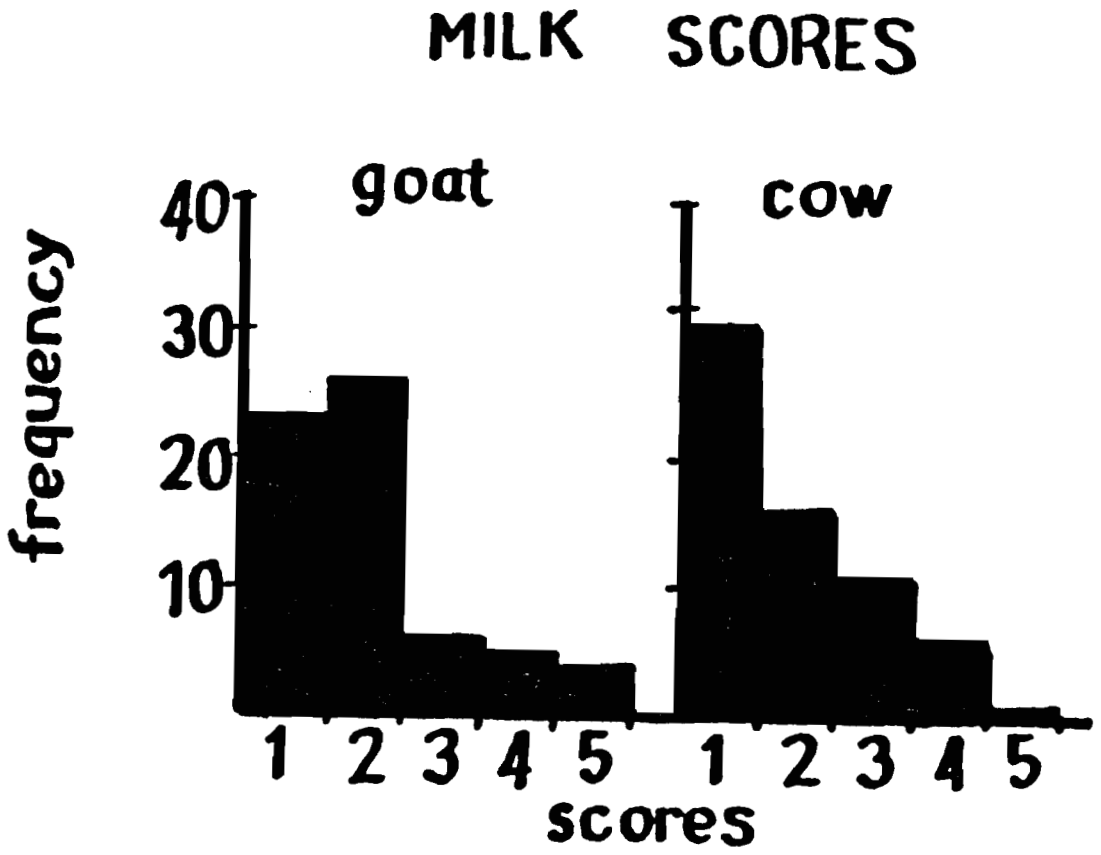

Figure 2. Milk scores of goat and cow milk products

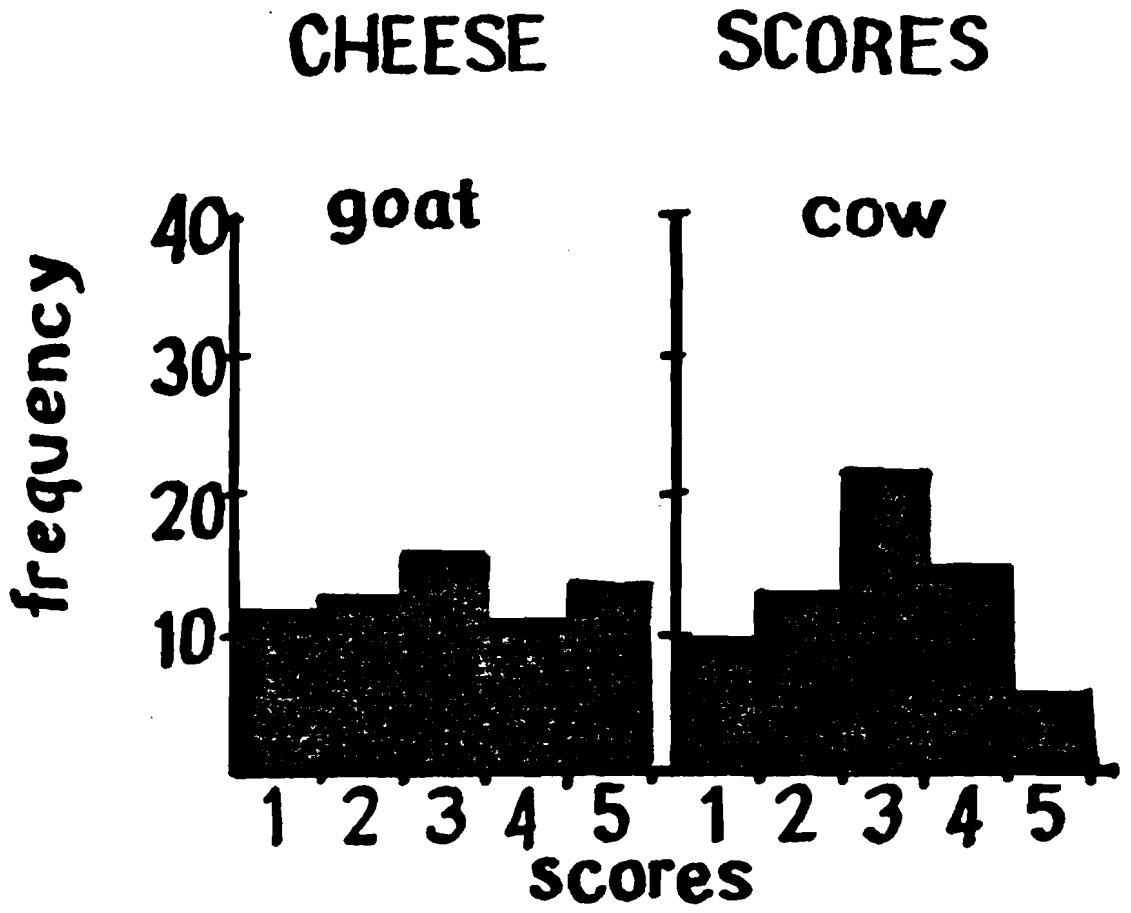

Figure 3. Cheese scores of goat and milk products

2. Variation in method of preparation of the samples (e.g., saltinesses of cheese, effect of heat treatment on milk flavors, etc.)

3. Attitude of each class toward experiment. Different classes varied in level of enthusiasm for participating in the experiment. This may have effected the overall scores awarded to products; however, the relative scores given to the goat and cow products did not vary between classes.

School #2--Vigina. All 30 students and the 5 teachers at Vigina Secondary School were asked to participate in goat dairy product testing. The students ranged in age from 12 to 19; the teachers were between 21 and 25.

Of these 35 people, 25 (including the 5 teachers) claimed to drink milk every day. Six reported consuming milk more than once a week and 4 claimed never drinking milk.

Thirty-two people tried fresh, pasteurized goat and cow milk. Three people refused to participate.

Mean scores for goat and cow milk were 2.94 and 2.47, respectively.

There was no significant variation in scores assigned to goat and cow milk samples.

Score distribution is reported in table 17.

TABLE 17. DISTRIBUTION OF SCORES ASSIGNED TO GOAT AND COW MILK (VIGINA SCHOOL)

	Scoring code					
	1	2	3	4	5	
Product	Frequency					Mean
Cow milk	10	10	2	7	3	2.47
Goat milk	4	9	7	9	3	2.94

The general response of the students at Vigina school was that the goat milk samples were whiter, sweeter, and creamier than the cow milk samples. Despite these detected differences, there was no difference in scores assigned to the goat and cow milk samples.

Field Tests in Siaya and Kakamega. A total of 286 people were asked to formally compare goat and cow milk products. Ages of respondents ranged from 1 year to over 80 years. Twenty people refused to taste the milk samples; 16 were women over 30 years old; 3 were teenage boys.

Goat and cow milk soured by addition of orange juice were tested at Site I in Siaya. There was no difference in goat and cow scores ($t = .19$). Mean scores were 1.67 for sour cow milk and 1.51 for sour goat milk.

Fresh goat and cow milk were tested at both sites in Siaya and Kakamega. Results are reported in table 18. No difference was found between fresh goat and cow milk scores (all t values were less than .50). The low mean scores, all less than 2, indicate a high level of acceptability for both products.

TABLE 18. FRESH GOAT AND COW MILK TASTE TEST RESULTS

Location	No. of people present	No. of refusals	Mean scores	
			Cow milk	Goat milk
Kakamega:				
Site I	68	5	1.95	1.90
Site II	88	8	1.33	1.46
Siaya:				
Site I	64	3	1.23	1.55
Site II	66	4	1.23	1.61

Milk samples were transported from the research station to the test sites in an ice chest. Samples had not yet reached ambient temperature for the first few taste comparisons. A few of the respondents indicated surprise upon tasting a cold fluid. While this may have affected overall scoring, it did not affect the relative scores assigned to the products.

One person indicated that the goat milk sample had a "goaty" taste and two men claimed that it was slightly salty. Both of these defects could have been due to the fact that the goat milk was obtained during very late lactation. Many respondents said the goat milk was "creamier."

Scores received in these tests were overwhelmingly 1s and 2s. All mean scores were less than 2, reflecting a very high level of acceptability for both milk samples.

Maseno Veterinary Farm. Most of the goat milk prepared on the research farm was used to make tea for the office staff. Visitors to the research station were also presented with a cup of tea or a small cup of fresh, cold milk.

Some selected comments from the lab book and office guest book were:

- "It was fantastic and everyone was asking for more." (Mary Odep, Clerical Officer, Maseno Veterinary Farm)

- "Goat milk tastes so much better than cow milk in tea that we should discard any traditional against it." (Dr. J. O. Ongare, Kabete Veterinary Labs)

- "It was my first time to taste mbuzi milk (goat milk). It is good and tasty and I highly appreciated its quality." (Andrew Ojunior Omumbo, Ekwanda Secondary School)

- "I am interested with milk, and I wish to have one goat." (Samuel Otiedo, Maseno Secondary School)

DISCUSSION

MILK SUPPLY

Average lactation yields in Siaya and Kakamega are low; 295 kg and 430 kg, respectively (table 10). Not included in these figures, however, are the amounts of milk suckled by calves.

In general, calves are allowed to suckle before milking, to stimulate milk let down. The farmer then removes a predetermined amount of milk, usually ranging between 1 liter and 2 liters per day. The calf is allowed to finish any remaining milk.

Milk production for family use, although important on small farms, seems to be just one of several objectives of cattle production systems in western Kenya. Increased milk production on these farms would require increased capital investment and(or) readjustment of management goals and techniques. Investment of large amounts of capital into livestock production systems may be beyond the financial capabilities of individual smallholders.

Further problems encountered when investigating the possibilities for improving animal production are illustrated by the following example.

Farmers in one area of Siaya are particularly suspicious of "development schemes." Several years ago, the neighbor of one survey respondent participated in a scheme aimed at increasing "improved cattle" numbers in his area. He received a fine dairy-type animal but did not understand that the cow represented a loan. The cow contracted a disease and died shortly after arrival on the farm. The farmer could not raise the cash to repay the cost of the cow and was forced to sell his farm to do so. Rumor and gossip spread quickly. The community still remains bitter.

A dilemma arises when, in the face of all of the obstacles to improvement of small farm milk production, 86% of the families surveyed indicated that their current milk supplies were inadequate for their family needs. Current estimates of daily milk consumption per family are very low; .82 liters in Kakamega and .42 liters in Siaya (tables 11 and 12).

The need for more milk is greatest on farms currently without cows (table 13). The reason most often given for low consumption of milk is prohibitive cost. The price of milk on informal markets varies depending on one's bargaining powers but can be nearly as high as the KCC consumer price (US$1.33/gal of milk in June 1983). In fact, production of milk for sale on the local markets is considered to be so lucrative that 60.6% of the Siaya respondents listed "to sell" as their first priority for use of an increased milk supply (table 16).

DAIRY PRODUCTS COMMONLY USED

Improperly handled dairy products can be a serious health hazard. Milk has been the medium for transmission of pathogens causing undulant fever, tuberculosis, typhoid fever, diphtheria, and various intestinal disturbances (Sieganthaler, 1972).

Preservation of high-quality milk is particularly difficult in warm climates. Additionally, lack of adequate cooling facilities, easily sanitized milk handling equipment, and clean water for washing equipment compound spoilage problems. The relatively high price commanded by milk at the market also tempts producers to try to increase income by adding water or other fluids to their supply of milk for sale. The hygienic quality of the added material may present an additional hazard.

Slightly over half (53.5%) of the surveyed families claimed to boil or otherwise heat treat their milk before consumption or processing. Souring of milk kills typhoid, paratyphoid, and coliform organisms, but brucellosis and tuberculosis organisms can survive for days, perhaps weeks, even at high acidity (Kon, 1972).

Fortunately, preparation of the most popular milk products, tea in both Siaya and Kakamega and milk as a liquid stock for cooking vegetables in Siaya, provides adequate heat treatment for elimination of pathogens. But the high temperature encountered during these processes may adversely affect the nutritional value of the milk.

Boiling milk can cause large losses of milk's heat labile compounds like thiamine and vitamin C. B_{12} can also become labile due to interaction with vitamin D in the presence of oxygen. More seriously, up to 14% of the calcium and protein (including about 75% of the soluble whey proteins) and up to 20% of the fat can be lost in the skin that forms on the top of the milk and the deposit that collects on the bottom of the pan (Kon, 1972).

Tea preparation may present further problems. The most important components of tea are its polyphenolic tea tannins (Eden, 1976). Tannins are known to form soluble and insoluble protein complexes that are poorly digestible (Arai, 1980; Bozzini and Silano, 1978). Phenolic compounds have been shown to bind with casein (Arai, 1980).

If such binding were to occur in the ubiquitous milk-tea drink, the effect could be reduced bioavailability of the milk proteins.

Perhaps the most significant step toward improvement of on-farm product quality would be the introduction of thermometers, accompanied by adequate instructions for use. Even a fairly foul sour milk can be converted to a safe starter culture by carefully heating the milk to 62C. The whey is separated from the curd, mixed with an equal amount of boiled milk and the mixture is allowed to rest at room temperature for 24 hours to 36 hours (Siegenthaler, 1972). This culture could then be added to heat treated milk, resulting in a product that preserves some

of the very unique flavors preferred by farm families, but with a higher margin of safety than an unheated milk product.

Until thermometers are introduced, however, the most practical recommendation would probably be to boil all milk and to make an effort to recover the resulting skin and deposit in the pan.

INTRODUCTION OF A NEW PRODUCT--WHITE CHEESE

A look at the uses for additional milk proposed by farmers (table 16) shows that a great deal of milk would probably be absorbed by increased use of milk in products that are already well established in the research areas. This is a factor weighing against adoption of a novel product like white cheese.

White cheese was initially selected for consumer testing because it is very simple to make. Curd can be obtained using vinegar, fruit juices, or yogurt. Processing to 82C eliminates pathogens and spoilage organisms and also causes the whey proteins to become insoluble. The resulting curd has very high quality protein. Lactose remains soluble and is left behind in the whey.

Pressed cheeses have reportedly been stored for up to two months without spoilage (Torres and Chandan, 1981). Brine storage (Siegenthaler, 1972) or aging in oil and vinegar (Anonymous, 1982) are two low-cost suggestions for increasing shelf life of the cheeses.

The white cheese received fair consumer scores during testing at Ebusakami Secondary School (figure 3). However, the milk supply available to smallholders in western Kenya will probably have to increase considerably before the need to introduce new products arises.

POTENTIAL FOR MILK FROM DUAL-PURPOSE GOAT SYSTEMS IN WESTERN KENYA

Results of double blind taste tests involving a total of 355 people show that when goat and cow milk were identically prepared, there was no difference in acceptability of products due to specie of animal providing the milk. The level of acceptability for all of the products was high.

A pilot study involving placement of 10 Toggenburg X East African does and kids in 10 farms in Siaya and Kakamega (Brown et al., 1983) showed that the goat milk produced on the farms was used in the same fashion as cow milk. All 10 of the farmers used the milk in tea, 6 used it for cooking vegetables, 5 fed it fresh to their children, 2 used it for cooking "ugali," and 2 soured it for drinking.

All of the farmers claimed to like the milk very much. Several reported a preference for goat milk over cow milk for use in tea preparation. They claimed that, because of its "whiteness and creaminess," less was needed for preparation of a "qualitative" batch of tea.

Follow-up questions in the research areas indicated that many people would use goat milk if it were available. Several added that goat milk would be used as a supplement to current cow milk supplies. Acceptability of goat milk, therefore, does not seem to be a constraint limiting adoption success of dual-purpose goat systems in the research areas.

Viability of the milk-meat goat system on small farms is, however, subject to several other potential constraints. During this first pilot study, average milk production was 140.5 kg/goat over a 145-day lactation. About one quarter of this milk was fed to the kids.

A concurrent experiment on the research station determined that approximately 60 kg of milk were needed to raise kids to an appropriate weaning age (10 kg). Therefore, at current production levels, the amount of milk available for family use would only be about 64 kg to 94 kg/goat/year.

Several of the farmers lost enthusiasm for the experiment as their goat's milk production dropped off.

Several of the respondents, particularly in Kakamega, where there are relatively few goats, claimed that goats were "too troublesome" and could cause much damage, particularly in areas that were intensely cropped.

CONCLUSIONS

1. There are many obstacles for increasing milk production on small farms in western Kenya.

2. A demand for more milk exists in rural western Kenya.

3. The quality of dairy produce could improve dramatically by introduction of thermometers and suitable milk storage containers. Current milk handling practices, particularly adulturation of milk and souring of milk without prior heat treatment, may lead to production of hazardous products.

4. Results of taste test comparing goat and cow milk, as well as results from on-farm goat rearing trials, indicate that goat milk acceptability is not a constraint to establishment of dual-purpose goat production systems.

5. Despite the apparent acceptability of goat milk, without necessary additional investments by the farmer in adequate feed resources, housing, veterinary care and genetic selection for dairy-type animals, a dual-purpose goat system may not be viable for smallholders in western Kenya.

6. Since such a large quantity of milk consumed on these small farms is used in tea making, the nutritional quality of the milk proteins in the drink should be investigated.

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APPENDICES

APPENDIX 1. SURVEY FORMS

IDENTIFICATION _____

NAME OF RESPONDENT _____

DATE _____

ENUMERATOR _____

1. How often does your family consume milk? (Circle answer)

   1. Daily
   2. More than once a week
   3. About once a week
   4. Less than once a week
   5. Rarely
   6. Never

2. Is milk produced on Farm? How much? _____ Purchased? Yes/No/Sometimes. If purchased, where?
   1. Duka
   2. Market
   3. Neighbor
   4. Other _____

   Is purchased milk process by KCC? Yes/No/Sometimes

   About how much is purchased per week? _____

   Is purchased milk fresh/sour/powdered?

   If not produced and not purchased, why not (circle one or more)
   1. No milk producing animals on shamba
   2. Milk too expensive
   3. Family does not like milk
   4. Other _____

3. Who gets first preference for milk:
   0. No preference
   1. Children
   2. Women
   3. Men
   4. Pregnant women
   5. Other _____

4. Does anyone refuse milk? Yes/No

   If yes, Who? _____
   Why? _____

Are all milk products refused or just certain ones? _____

_____

Does anyone complain of vomiting, diarrhea, or stomach pain caused by drinking milk? Yes/No If Yes, Please explain _____

_____

5. Which milk products are used by your family?

Fresh milk (not in tea)
1. More than one a day
2. Daily
3. About twice a week
4. About once a week
5. Rarely
6. Never

Sour milk (Maziwa lala)
1. More than once a day
2. Daily
3. About twice a week
4. About once a week
5. Rarely
6. Never

Milk in tea
1. More than once a day
2. Daily
3. About twice a week
4. About once a week
5. Rarely
6. Never

Milk in vegetables
1. More than once a day
2. Daily
3. About twice a week
4. About once a week
5. Rarely
6. Never

Ghee
1. More than once a day
2. Daily
3. About twice a week
4. About once a week
5. Rarely
6. Never

Butter
1. More than once a day
2. Daily
3. About twice a week
4. About once a week
5. Rarely
6. Never

Other _____
1. More than once day
2. Daily
3. About twice a week
4. About once a week
5. Rarely
6. Never

Which products are made at home?
1. Maziwa lala
2. Ghee
3. Butter
4. Others _____

6. How are products made? _____

_____

_____

7. Are home produced products preferred to purchased ones? Yes/No
   If yes, which ones? _____

8. Is milk heated but not boiled before drinking? Yes/No

9. Is milk boiled before drinking? Yes/No

10. Is milk heated before it is made into Maziwa lala? Yes/No
    Other products? Yes/No

11. Is Maziwa lala made in a gourd? Yes/No If yes, how long can milk be stored in the gourd before it becomes bad? _____

    _____

    How often must a gourd be completely cleaned?

12. Are any home produced dairy products sold? Yes/No
    Where?
    1. Duka
    2. Market
    3. To neighbors
    4. Other _____

13. If milk is very limited, how would your family choose to use it? (Which products would be chosen?) _____

14. Has anyone in the family ever tried goat milk? Yes/No
    If yes, how was it prepared? _____

    _____

Respondent's Name _____

Cluster, Household I.D. _____

Enumerator _____

Date _____

1. Is the amount of milk available to you satisfactory for your family needs? Yes/No. Comments _____

2. If more milk were available to your family, how would it be used?

3. To your knowledge, did your grandparents/ancestors drink goat milk? Yes/No. If yes, how long ago did your family stop drink goat milk? _____

   Why? _____

4. Would you be willing to include goat milk in your family's diet? Yes/No. Would you be willing to drink goat milk instead of cow milk? Yes/No

   Comments _____

5. Have you ever heard any taboos or traditional beliefs (either good or bad) about drinking goat milk? Yes/No

FAMILY TEA PREPARATION

1. Does family take tea
   1. More than once a day
   2. Once a day
   3. Rarely
   4. Never

2. Does family drink tea with or without milk?

3. How is tea prepared? (Please answer at least the following questions in your description of tea making)
   1. When are tea leaves added to water and how many?
   2. When is milk added to tea and how much? (How does a person decide when there is enough milk?)
   3. When is sugar added and how much?
   4. About how long is the tea cooked?

DAIRY PRODUCTS EVALUATION

1. Please read the entire sheet, including questions before commencing the taste test.

2. You will receive 4 dairy products. Each sample will be marked with an identifying symbol.

3. On this paper, you will see the same 4 symbols arranged in a certain order. PLEASE TEST THE SAMPLES IN THE SAME ORDER THAT APPEARS ON THIS SHEET!

4. After tasting a sample, please give it a score between 1 and 5.
   Scoring: 1 = EXCELLENT!! (BORA!!)
   2 = GOOD (MZURI)
   3 = FAIR (SAWA SAWA)
   4 = DO NOT LIKE (SIPENDI)
   5 = HATE (NACHUKIA)

   SYMBOL SYMBOL SYMBOL SYMBOL

   SYMBOL SYMBOL SYMBOL SYMBOL

5. If you prefer one milk sample to the other, please state why, briefly. If you found no difference in preference, you may also comment.

   _____

   _____

6. If you prefer one cheese sample to the other, please state why, briefly. If you found no difference in preference, you may also comment.

   _____

   _____

APPENDIX 2. COMPOSITION OF A TYPICAL WHITE CHEESE

Fat, 15%
Water, 51%
Salt, 2% to 3.9%
Lactose, 1.8%
Protein, 22.9%
pH, 5.3
Approximate yield, 11.6 lb/100 lb, 2.2% fat milk

Source: Kosikowski, F.V. 1978. Cheese and Fermented Milk Foods. F. V. Kosikowski and Associates, Brooktondale, NY. 2nd Ed. 2nd Printing.

APPENDIX 3. ANALYSIS OF VARIANCE

AVERAGE MONTHLY MILK YIELDS, 1982, SIAYA VS KAKAMEGA FARMS

Source	d.f.	S.S.	M.S.	F	Required F .10	.05	.01
Corrected total	42	27,290					
Treatment	1	4,252	4,252	7.57	2.84	4.08	7.31
Error	41	23,030	562				

AVERAGE DAILY MILK CONSUMPTION, SIAYA VS KAKAMEGA

Source	d.f.	S.S.	M.S.	F	Required F .10	.05	.01
Corrected total	78	16.63					
Treatment	1	3.10	3.10	17.22	2.77	3.96	6.96
Error	77	13.53	.18				

MILK CONSUMPTION IN SIAYA, WITH OR WITHOUT COWS

Source	d.f.	S.S.	M.S.	F	Required F .10	.05	.01
Corrected total	38	5.69					
Treatment	1	1.78	1.78	16.18	2.85	4.11	7.40
Error	37	3.91	.11				

MILK CONSUMPTION IN KAKAMEGA, WITH OR WITHOUT COWS

Source	d.f.	S.S.	M.S.	F	Required F .10	.05	.01
Corrected total	39	7.85					
Treatment	1	2.06	2.06	13.73	2.84	4.10	7.35
Error	38	5.79	0.15				

EBUSAKAMI SECONDARY SCHOOL: COW AND GOAT MILK

Source	d.f.	S.S.	M.S.	F	Required F .10	.05	.01
Corrected total	131	165.97					
Treatments	1	1.49	1.49	1.21	2.75	3.92	6.85
Blocks	2	7.38	3.69	3.00	2.35*	3.07	4.79
Error	128	157.10	1.23				

EBUSAKAMI SECONDARY SCHOOL: COW AND GOAT CHEESE

Source	d.f.	S.S.	M.S.	F	Required F .10	.05	.01
Corrected total	131	87.88					
Treatments	1	.49	.49	.83	2.75	3.92	6.85
Blocks	2	11.99	5.99	10.16	2.35*	3.07*	4.79*
Error	128	75.40	.59				

VIGINA SECONDARY SCHOOL: GOAT AND COW MILK

Source	d.f.	S.S.	M.S.	F	Required F .10	.05	.01
Corrected total	65	115.09					
Treatments	1	2.18	2.18	1.24	2.79	3.99	7.04
Error	64	112.91	1.76				

APPENDIX 4. FREQUENCY OF SCORES ASSIGNED TO FRESH GOAT AND COW MILK SAMPLES SUMMARIZED BY AGE, SEX, AND LOCATION OF RESPONDENTS

Kakamega Site I (Cluster 301)

	Cow milk					Goat milk					
Age, years	1	2	3	4	5	1	2	3	4	5	Refusals
Female Respondents:											
0 - 5		15					14			1	
6 - 10		7					7				
11 - 15		3					3				
16 - 20											
21 - 25	1	6				3	4				
26 - 45		5				2	2	1			4
46 - 60											
60+	1					1					1
All	2	36				6	30	1		1	5
Male Respondents:											
0 - 5		4				1	3				
6 - 10		5					5				
11 - 15											
16 - 20											
21 - 25											
26 - 45											
46 - 60											
60+		1					1				
All		10				1	9				
Children (sex not recorded):											
4 - 10		15				3	12				

Scoring Codes: 1 = like very much; 2 = like; 3 = neither like nor dislike; 4 = dislike; 5 = dislike very much.

Kakamega Site II (Cluster 302)

Age, years	Cow milk 1	2	3	4	5	Goat milk 1	2	3	4	5	Refusals
Female Respondents:											
0 - 5	22	1	2	1		22	1	2	1		
6 - 10	5					3	2				
11 - 15	4					3	1				
16 - 20		1				1					
21 - 25		1					1				
26 - 45	5	2			1	4	3			1	
46 - 60											
60+											7
All	36	5	2	1	1	33	8	2	1	1	7
Male Respondents:											
0 - 5	14	4	1	1		13	5	1	1		
6 - 10	6	1				6	1				
11 - 15	4					2	2				1
16 - 20	1						1				
21 - 25											
26 - 45	2						2				
46 - 60	1						1				
60+											
All	28	5	1	1		21	12	1	1		1

Scoring Codes: 1 = like very much; 2 = like; 3 = neither like nor dislike; 4 = dislike; 5 = dislike very much.

Siaya Site I (Cluster 331)

Age, years	Cow milk 1	2	3	4	5	Goat milk 1	2	3	4	5	Refusals
Female Respondents:											
0 - 5	6					6					
6 - 10	4	1				3	2				
11 - 15	6					3	3				
16 - 20	1		1				2				
21 - 25											
26 - 45	2	1			1	1	2	1			1
46 - 60	2						2				1
60+	2					1	1				1
All	23	2	1		1	14	12	1			3
Male Respondents:											
0 - 5	5					4	1				
6 - 10	11	2				8	5				
11 - 15	5	5				4	4	2			
16 - 20											
21 - 25											
26 - 45	2					1	1				
46 - 60	2						2				
60+	2					1	1				
All	27	7				18	14	2			

Scoring Codes: 1 = like very much; 2 = like; 3 = neither like nor dislike; 4 = dislike; 5 = dislike very much.

Siaya Site II (Cluster 332)

Age, years	Cow milk 1	2	3	4	5	Goat milk 1	2	3	4	5	Refusals
Female Respondents:											
0 - 5	5	4				5	4				
6 - 10	5	4				6	3				
11 - 15	5	1				1	5				
16 - 20	2						2				1
21 - 25	2						2				
26 - 45	5					1	4				
46 - 60	3						3				
60+											1
All	27	9				13	23				2
Male Respondents:											
0 - 5	7					5	2				
6 - 10	6	2				2	6				
11 - 15	2	1				1	2				
16 - 20	2	1				1	2				2
21 - 25	1						1				
26 - 45	2	1				1	2				
46 - 60											
60+	1						1				
All	21	5				10	16				2

Scoring Codes: 1 = like very much; 2 = like; 3 = neither like nor dislike; 4 = dislike; 5 = dislike very much.