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DAIRY MARKETING AND PRICING IN KENYA:
Are milk shortages the consequence of droughts or pricing policies?

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ABSTRACT

In this paper, production, consumption, marketing and pricing of dairy products in Kenya are examined and discussed. It is argued that there are severe irrationalities in the pricing of dairy products and that these have become an important constraint on the industry. At a uniform price between locations, transport costs are hidden and there is excessive stimulation to production far from the consuming areas. At a uniform price between seasons, the far greater production costs in the dry season are not incurred so that dry season milk shortages (annually blamed on the "drought") are now regular features. Wet season surpluses are in the meantime, enormous, involving the necessity for substantial processing capacity that remains idle for a good part of each year. Large financial losses are incurred by the KCC in the flush season when twice as much milk must be purchased at the same uniform price. A large percentage of this milk is then used for manufacturing and sold at a net loss. An excessive consumer price for liquid milk is meanwhile maintained which severely inhibits the growth of milk consumption, especially among the poor who would derive the greatest nutritional benefit from increasing their consumption.

A large part of the additional supplies in the smallholder areas are going into local consumption. Only when local demand is met at the supply price to KCC, can the surpluses from these areas be expected in the formal market. At a seasonally uniform producer price the supply fluctuations between seasons are particularly severe from these areas.

An alternative milk pricing system is proposed that would recognize that neither the production cost nor the financial or social value of additional milk is uniform between seasons and locations. In this system a floor price would be paid for all seasons with an ex post additional payout depending on the proportion of milk intake that is sold as fluid milk.

DAIRY MARKETING AND PRICING IN KENYA*

Introduction

Livestock accounts for some 30 per cent of Kenya's gross marketed agricultural products and about eight per cent of the country's total export earnings in 1971. Of the livestock exports dairy products constituted 24 per cent. In 1972, formally marketed milk amounted to 270 million litres valued at K£10.4. Dairy exports earned K£3.8 million from exports of milk and milk products. As milk sold in the formal market was only an estimated 26 per cent of all milk produced in the country, dairying is undoubtedly an im-ortant agricultural industry.

Commercial milk production is dependent largely on grade and exotic cattle (Bos taurus breeds) of which there were an estimated 416,000 mature cows in 1972, 485,000 in 1974 and with the number expected to reach 625,000 in 1978. 90 per cent of adult female cattle consists of indigenous zebu, Bos indicus breed, that yield very little milk. They are principally important for subsistence in the pastoral and marginal areas, where they provide meat, milk and blood, hides and skins. Table 1 shows the estimated cow population by breed.

Table 1. Grade cow population by Breed, 1974 Mature Cows.

Breed	'000	Per cent of total
Ayrshire	134	27.6
Guernsey	117	24.1
Friesian	105	21.7
Jersey	64	13.2
Zebu crosses	65	13.4
Total	485	100

Source: EAC Common Market Affairs Secretariat, Seminar on co-operation in Agricultural Development in East Africa. January 13-20, 1975.

34.6 per cent of mature grade cows are found in 12 districts: viz Meru, Muranga, Kiambu, Nyandarua, Nyeri, Nakuru, Kericho, Trans Nzoia, Uasin Ghisu and Laikipia. Table 2 shows the distribution of the dairy herd according to the type of producer. Although grade cattle population on smallholding has been increasing, the large-scale farm sector still accounts for about 60% of all commercial milk.

Table 2. The Kenya Grade Cattle by type of Farmer

Type of Farmer	Thousands head	Per cent share
Large - scale	164	33.8
Small scale: grade	140	28.9
Zebu crosses	65	13.4
Settlement schemes	116	23.9
Total	485	100

80% of the grade cattle population are located in the high potential areas. In the smallholder areas, improved cattle are steadily replacing unimproved types.

Most of the milk produced in Kenya is consumed by the farmer or sold in the local markets, with only perhaps 50 per cent of the milk produced by grade cattle and 2 per cent of the milk produced by the zebu herd reaching the formal (commercial) marketing system. In 1970, an estimated 75 per cent of all milk produced in Kenya was consumed on the farms on which it was produced.

Estimation of milk production

To reach some milk production figure, most authors use estimates of the number of dairy cows and multiply by some average presumed production per year, In most districts, reports stating numbers of dairy cows are not based on any survey results, but are instead guesses, hopes, or projections from some known or estimated baseline. Projections, furthermore, frequently show steady increases in the number of grade and zebu animals from year to year despite the fact that the area may be maximally stocked or even overstocked to begin with (at least given current management levels); i.e. carrying capacities are not taken adequately into account. Estimates of numbers of dairy animals may also take into account A.I. figures, calving intervals and mortality estimates but these too may be quite inaccurate. There undoubtedly is an increase in the number of grade dairy animals - almost a population explosion in some areas, but even here, most figures are estimates on which little reliance should be placed. An example of the death of information is the 1972 IBRD sponsored study of the availability of dairy breeding stock. It projected dairy heifers for sale to smallholders would be in excess by 1973 while in fact the opposite was the case.

The estimation of production per animal is equally problematic. There is a wide range of possibilities in terms of milk yield, depending only partially on genetic endowment, and equally or even more so on management and feeding practises. In any case, the actual production per cow is certainly far lower than the potential and, especially amongst less experienced farmers, also much lower than the economically optimal production level. There are many reasons for this: the main reason relates to feeding practises: poor or inadequate grazing with little or no supplement, no steaming up so that animals start their lactations in poor condition, and no provision for dry season feeding. (Reference will shortly be made to the dry season fall in production. It should be noted here that it is perfectly possible to main-

tain production levels in the dry season but that the costs of doing so are enormously higher.) Other reasons include late first pregnancies, long calving intervals, random calving not timed to take advantage of the rains, inadequate culling i.e. keeping cows to advanced age and failure to select out unproductive ones, and the failure to upgrade the stock by using the best genetic material available. Low grade bulls are used in some 60 per cent of the grade herd that is not covered by Artificial Insemination. In some cases, production may be consciously limited for lack of a market for the surplus.

Estimates of total production from various analysts and sources vary quite markedly. In computing table 3 the Ministry of Agriculture makes the following assumptions: the number of mature grade dairy cows was 320,000 in 1968, and increased, with some fluctuations, to 449,000 in 1973. The yield per cow per year was 1,340 litres in 1968, steadily increasing to 1,491 litres by 1973. (The actual yield per cow may instead be decreasing according to other sources with the rapid upgrading of zebu stock and the higher proportion on farms that are relatively poorly managed. SeeKenya Development Plan, p.248.) The number of zebu cows was 3.383 million in 1968, increasing to 3.707 million in 1973, with an estimated production of 120 litres per year over and above that taken by the calf.

Then assuming a grade dairy herd increase of 5.3% per year and a per cow yield increase of 32 L. per year, the total milk production would increase from 739.6 million litres in 1974 to 1,133.6 million litres in 1980.

De Jong (Economic Planning Division, Ministry of Agriculture) assumes much lower production figures. His estimate are given, for comparison, in Table 4. He assumes that the average cow on a small scale farm produces 516 litres per annum; on a settlement farm a grade cow is assumed to produce 730 litres and on a large scale farm, 1,133 litres, giving an overall average production of 855 litres per year. This gives an estimated production of 376 million litres by the grade cow herd in 1973/74 in contrast to 669.5 million litres using the other assumptions. Obviously, the paucity of data on Kenya cattle populations and their productivity is a significant problem in the planning process.

The current total milk production estimates of the Kenya Ministry of Agriculture are those given in table 3. They are broken down by grade and zebu animals and between large scale, small-scale and settlement farms in table 4.

Table 3

TOTAL MILK PRODUCTION IN KENYA (million litres)

	1968	1969	1970	1971	1972	1973
Total Grade cow milk produced	428.8	455.9	499.4	550.8	606.9	669.5
Total Zebu cow milk produced	406.0	414.4	422.9	430.0	437.4	444.9
TOTAL	834.8	870.3	922.3	980.8	1044.3	1114.3
Grade cow milk as % of total	51.4	52.4	54.1	56.2	58.1	60.1

Ministry of Agriculture.

Table 4

ESTIMATED DISTRIBUTION OF GRADE CATTLE AND MILK PRODUCTION

	LARGE SCALE		SMALL SCALE		SETTLEMENT		NOT ALLOCATED		TOTAL
	No.	%	No.	%	No.	%	No.	%	
Number of Grade cows	177,000	39.2	159,000	35.3	114,000	25.3	950	0.2	450,950
Amount of milk produced (million litres)	207	55.1	82	21.8	83	22.0	4	1.1	376
Rural supplies (million litres)	31	27.7	41	36.6	38	33.9	2	1.8	112
Factory supplies (million litres)	176	66.7	41	15.5	45	17.0	2	0.8	264

(from de Jong, Economic Planning Division, MOA 1973, p.3)

Consumption and Marketing

The predominant marketing agency with a virtual monopoly on the formal dairy products market is the Kenya Co-operative Creameries (KCC). It normally handles an estimated 25 per cent of total milk production and 96 per cent of all milk passing through known commercial channels. The KCC is a commercial company, it is also a producer co-operative. In 1968 it had 1,469 supplying members (1,254 individuals and 215 cooperatives.) This has grown to a current (1975) total of about 5,500 suppliers (3,096 individual member suppliers, 294 cooperatives and 2-2,500 "temporary member" suppliers). The only other milk processors are the Mariakani Milk Scheme at the Coast and various other small producers who are licensed to sell milk in isolated rural areas.

The retail prices from this marketing system and the prices that it pays to farmers are controlled by Government. These prices are analysed later.

There have been a number of efforts to control the monopoly powers of the KCC but a powerful lobby has been built up and these efforts have not been successful. In 1965 the Kibaki Commission Report recommended that the KCC be nationalized into a Dairy Commission on similar lines as the Kenya Meat Commission (KMC) so that consumer interests could also be represented, but this proposal was defeated in Parliament. In 1970-71 an official working party, the Dairy Working Party, was set up to examine, among other things the pricing policy and competitiveness of the dairy industry. The members of the Dairy working party saw their duty as being to "formulate a pricing and marketing policy for the dairy industry that would encourage the growth of the industry in the 1970's in the national interest". Interesting debate took place among academics, producer interests and the KCC. While the working party was sitting, the KCC announced the abolition of independent dairy based on FAO (Tentoni) recommendation, thus further entrenching its own monopoly position. The economists on the working party eventually resigned on the grounds that economic issues and consumer interests were being ignored in considering structural and pricing policies for the industry.

The statutory authority set up to govern the industry, the Kenya Dairy Board, has similarly made a number of efforts to rationalize the pricing system and exert some control over the KCC. These efforts have not thus far been successful. The Dairy Board initially came into being at the instigation of the KCC, principally for the purpose of controlling non-KCC distributors of dairy produce. With the virtual abolition of non-KCC distributors that

could compete with the KCC, the role of the Dairy Board has been little more than that of an observer. The only powers it has had are licensing and other powers over the diminutive private retailers outside of the main urban centres. (Even here, the Board encounters considerable difficulty so that the control of unlicenced retailers is virtually non-existent.) Political considerations, particularly among producers, and the requirement that the KCC maintain financial viability in the face of the given producer price, have thus been the principal bases for pricing in the industry.

The net effect of the structural and pricing policies that currently exist is that there are enormous inefficiencies in the processing and marketing system which eventually raise the fluid milk price to the consumer. The effect of this is to reduce consumption of fluid milk to a lower level than it would otherwise have been particularly among poorer consumers (the dietary implications of this are obvious). More milk thus needs to go into manufacturing where the realized price per litre of milk is a very great deal lower. The losses involved in manufacturing milk, and in maintaining a very substantial capacity to do so (a capacity that is only utilized at the peak of the flush season) must again be re-couped from sales of fluid milk. (The pricing issue will be discussed in more detail in a later section of this paper.)

Table 5 gives a quantitative picture of milk intake and utilization by the KCC in recent years. Total milk intake has seen a steady increase in recent years with some dropping off in intake in 1974. (Preliminary estimates for 1975 are that intake is unlikely to grow substantially from the 1974 figure.) It is impossible that besides factors such as the changing composition of farms in the country, weather patterns, increased costs of production and so forth, the drop-off is a result of a decline in the real price of marketed milk (relative to the prices of other products) and a consequent increase in rural consumption.

The 1974-78 Development Plan projects that marketed milk production will increase from 270 million litres in 1972 to 400 million litres in 1978 for a 6.8 per cent growth rate per annum. The increase in production, the plan states will be entirely through a rapid increase in the number of dairy cattle. The "strategy is attractive because it is extremely easy to increase the size of the national dairy herd through upgrading stock using artificial insemination, while raising productivity through a combination of breeding and management is much more difficult and costly".

Table 5

K.C.C. MILK INTAKE UTILIZATION (Million Litres)

Year	Liquid milk INTAKE	Butter fat intake in milk equivalent	Total INTAKE	Liquid SALES in Kenya	Liquid Milk Exports	Total Liquid SALES	Liquid Milk intake manufactures	Liquid Sales as % of Total liquid intake
1968	129.6	79.8	209.4	69. 7	16.8	86.5	43.1	67
1969	141.2	68.9	210.1	76.7	13.7	90.4	50.8	64
1970	172.1	51.0	223.1	85.1	9.6	94.7	77.4	55
1971	195.4	18.6	214.0	89.8	9.3	99.1	96.3	51
1972	248.4	16.0	264.4	97.6	18.3	115.9	132.5	46
1973	265.6	9.0	274.6	103.8	29.9	133.7	131.9	50
1974	240.0	6.4	246.4	115.7	33.0	148.7	91.3	62
Average annual % change 1971-1974	8.1	-28.9	5.7	8.8	56.8	14.5	2.1	7.6

The KCC sales in Kenya have shown a steady growth around 8.8 per cent in recent years. The 1973 liquid milk sales were up by 54.6 per cent above the 1968 level. For the manufactured products whole milk products have recorded a growth rate of 18 per cent per annum and skim milk powder 23 per cent per annum over the 1970-72 period. With the abolition of the quota and contract system in 1971, the proportion of milk received by the KCC as liquid milk increased sharply. The greater proportion received as liquid milk (higher average price for milk received) led to a sharp decline in the percentage of liquid milk intake sold as liquidmilk and a severe financial squeeze on the KCC. The KCC did not, furthermore, have the necessary capacity to handle all the flush season milk. In Sotik, for instance, milk was skimmed and simply poured away. Partly as a result of the wide seasonal fluctuations in the use of that capacity, the KCC estimates a net revenue loss for virtually all items sold except liquid milk. A substantial profit must then be made on liquid milk sales to subsidise losses incurred in the productions of other products and thus help preserve KCC's financial viability. In 1974 a fortuitous combination of the decline in milk intake, the growth of local liquid sales and substantial exports to Uganda, raised liquid sales to 62 per cent of liquid intake and allowed KCC to recoup its earlier losses and go substantially into the black.

Tables 6 and 7 give the intake, utilization and sales projections used for the current Development Plan.

The pattern of consumption of dairy products in Kenya is not easy to document except for the sales through the formally organized marketing system (see Table 8). The vast majority of these sales have been in the urban areas, with Nairobi and Mombasa taking about 50% and 20% respectively.

A more detailed breakdown of exports of dairy products from Kenya is given in Table 9. The principal markets have been the other East African partner states, with milk sales - mainly to Uganda - showing spectacular growth. Payment problems and trade impediments, however, make a rreliance on these markets somewhat risky. (As with everything else, these States are eager to develop their own dairy industries. Uganda had expected to phase out milk imports altogether by 1970). Export sales outside the Community are generally undertaken only at a financial loss. Kenya is not, at current prices, a successful competitor with New Zealand and other significant dairy exporters. She cannot afford the costly subsidies of dairy exports that is practised by some more developed countries.

Table 6

SALES PROJECTIONS FOR THE DAIRY INDUSTRY 1973-1978

UTILIZATION OF MILK		1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	Increase per annum
1 Liquid Milk (1000 l. per day)								
- Sales in Kenya		291.2	321.7	354.0	385.3	416.7	452.1	+ 9.2%
- Sales to Uganda & Tanzania		44.6	50.0	50.0	42.0	42.0	42.0	- 1.2%
- Sales outside E.A.C.		1.3	8.4	9.8	11.1	12.2	13.6	
SUB-TOTAL (1000 l. per day)		337.1	380.1	413.8	438.4	470.9	507.7	+ 8.6%
SUB-TOTAL (1000 l. per year)		123,000	138,700	151,000	160,000	171,900	183,300	
2 Whole Milk Products (1000 l, per year)								
- evaported		16,200	21,800	23,700	25,200	26,800	28,200	+ 11.7%
- powder		26,300	31,100	35,100	39,800	43,500	45,900	+ 11.8%
- cheese		4,500	5,400	6,200	7,000	8,100	9,300	+ 15.6%
- condensed		260	280	290	300	320	340	+ 5.5%
SUB-TOTAL E. Africa (1000 l. per year		47,260	58.580	65.290	72.300	78.720	83,740	+ 12.1%
- cheese exports (outside E.A.C.)		160	200	260	330	370	450	
- powder exports (outside E.A.C.)		1,900	1,300	1,580	1,120	1,410	1,700	
SUB-TOTAL (1000 l. per year)		48,420	60,080	67,130	73,750	80,500	85,990	)+ 12.2%
SUB-TOTAL (1000 l. per day)		132.8	164.6	133.9	202.5	220.5	235.4	
3 Skim Milk Products (1000 l. per year)								
- powder		37,700	40,650	42,650	46,150	50,000	54,100	
- condensed) and butterfat		520	550	600	600	630	660	
- others)		5,100	5,200	5,300	5,300	5,400	5,500	
SUB-TOTAL E. Africa (1000 l./year		43.320	46,400	48,550	52,050	56,030	60,260	)+ 6.8%
SUB-TOTAL E. Africa (1000 l./day)		118.7	127.1	133.0	142.6	153.5	165.0	
4 Allowance for wastages	(1000 l./year)	6,100	6,500	6,900	7,300	7,800	8,400	
	(1000 l./day)	16.6	17.7	18.8	20.1	21.5	22.9	
5 Total Utilization	(1000 l./year	220,840	251,680	273,580	293,100	316,230	337,950	)+ 8.9%
	(1000 l./day)	605,0	689.5	749.5	803.0	866.4	923.9	
6 Intake of Whole Milk	(1000 l./year)	246,200	269,800	290,000	309,400	329,000	348,600	
	(1000 l./day)	674.5	789.1	794.5	847.8	901.4	955.0	
7 Exportable surplus	(1000 l./year)	25,360	18,120	16,420	16,800	12,770	10,650	)- 9.6%
	(1000 l./day)	69.5	49.4	45.0	44.8	35.0	29.1	

Table 7

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INTAKE AND SALES PROJECTIONS 1972/73 to 1977/78

A. SALES PROJECTIONS FOR BUTTERFAT & MILK	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78
1. Resources of butterfat (in 1000 kg.)						
a. Butterfat from supplies	450	360	280	250	210	170
b. Butterfat from separation	3,610	2,452	2,469	2,597	2,614	2,695
c. Butterfat from standardisation	1,160	1,680	1,760	1,900	2,050	2,200
d. Butterfat from whey	16	15	15	15	15	15
TOTAL available Butterfat	4,286	4,457	4,524	4,762	4,889	5,080
2. Requirements of butterfat markets (in 100 kg.)						
- butter market	2,760	2,880	3,000	3,120	3,240	3,380
- ghee market	1,180	1,270	1,370	1,490	1,610	1,740
- cream market	50	50	50	55	60	60
TOTAL Requirements	3,990	4,110	4,420	4,665	4,910	5,180
- shortage or surplus *	+246	+347	+104	+97	-21	-100
*(Surplus to be converted to butter, shortage to be deducted from ghee)						
B. SUMMARY PROJECTIONS INTAKE & SALES OF MILK(1000 l.)						
a. Liquid milk sales	123,000	138,700	151,000	160.000	171,900	183,300
b. Whole milk products	48,420	60,080	67,130	73,750	80,500	85,990
c. For separation (butterfat & skim milk produc)	68,680	64,520	64,970	68,350	68,800	70,910
d. Allowance for wastages (2.5%)	6,100	6,500	6,900	7,300	7,800	8,400
INTAKE OF WHOLE MILK (TOTAL UTILIZATION)	246,200	269,800	290,000	309,400	329,000	348,600

Table 8

CONSUMPTION OF MILK & DAIRY PRODUCTS IN KENYA: 1969/70 - 1973/74 - 1974/75

YEAR	CHEESE Tonnes	BUTTER Tonnes	MILK POWDER Tonnes	GHEE Tonnes	LIQUID MILK Million litres	CASEIN Tonnes	CONDENSED MILK Tonnes	MALA MILK Million litres	EVAPORATED MILK Million litres
1969/70	290	2,151	2,809	421	81	14	n.a.	n.a.	n.a.
1970/71	256	2,168	3,110	353	87	13	267	0.4	3
1971/72	307	2,216	3,258	390	92	11	217	1.8	4
1972/73	312	2,142	3,693	442	95	14	178	2.2	5
1973/74	309	2,191	2,915	532	108	15	153	0.9	4
1974/75	267	2,210	3,629	469	112	1	20	little	3

Table 9

DAIRY PRODUCTS EXPORTS: 1968 - 1974

	CHEESE Tonnes	BUTTER Tonnes	MILK POWDER Tonnes	GHEE Tonnes	MILK in million litres
1968	210	2,140	943	451	17
1969	209	1,624	1,221	257	14
1970	197	1,596	2,310	327	10
1971	96	891	1,641	180	9
1972	324	2,399	3,900	359	18
1973	557	2,463	4,410	265	30
1974	267	1,742	1,273	155	33

Just as cattle are valued by most rtraditional societies in Kenya, milk and milk products are highly valued and, when available, are regularly consumed throughout the country. At the same time, milk may be considered something of a luxury food, and consumption is restricted because of the relatively high price of milk in both formal and informal markets. In his interpretation of the Nutrition Survey, 1964-1968, Radetzki concluded that almost half of the rural households studied did not have any regular consumption of milk (Radetzki 1972).

Income elasticity figures are difficult to derive but are clearly related (inversely) to income, so that a given percentage increase in income will lead to a far greater percentage increase in milk consumption if people are currently too poor to satisfy their demand for milk. Among higher income groups, milk consumption is not constrained by income levels and increasing incomes are unlikely to lead to significant increases in demand (i.e. demand is inelastic). While income elasticity figures for milk in rich countries are considerably less than one (implying that per capita milk consumption grows more slowly than incomes), there is little doubt that in Kenya it is substantially greater than one. If one assumes an elasticity of 1.2 and a growth in per capita income of 3%, the growth in demand for milk explainable by increased incomes is 3.6%. If to this is added the growth in demand explainable by a population growth rate of 3.3%, the estimated growth rate for the demand for milk is nearly 7%. This does not take into account factors such as increased availability, decreased price, changes in the population distribution, tastes, and so forth. When these are taken into account the expected growth in demand may be much higher. Commercial milk sales have in fact shown a growth rate of 9-10%. This undoubtedly reflects the high urbanization rates in Kenya and perhaps the more rapid growth of urban incomes.

Much of the increased production of milk in recent years has clearly gone into home consumption and informal local marketing channels. Especially in the small farm areas where grade cattle are a relatively recent innovation, there is as yet little milk that is exported from the area. The main mechanism that seems to be at work as production increases in the small farm areas is a price decline from the price at which KCC sells to the price at which KCC buys fluid milk. Milk in these low income communities has a very substantial price elasticity of demand (i.e. for a percentage decrease in price the percentage increase in milk consumed in high), and large production increases are absorbed by local consumers as milk becomes increasingly available and the price declines. The nutritional and welfare implication of this consumption increase is considerable.

When milk is scarce, consumers tend to come to the dairy farmers with their bottles. As production increases in the area the problem of sales tends to become more difficult and farmers have to become more aggressive hawkers. At this point (if not before) "societies" or marketing cooperatives tend to emerge. In the dry season these societies generally dispose of all their milk locally, but the KCC, of which they may be members, provides a floor price, and when surpluses develop they are sent to the KCC. At first deliveries to the KCC are strictly seasonal and in some areas they are likely to remain so. Even in areas where a permanent surplus is produced, however, the KCC tends to be the residual buyer with local demand met first at something of a premium price.

The implication of having a relatively fixed local demand which is met before supplies go to the KCC is that percentage fluctuations in KCC milk deliveries are very much greater. (If 15,000 litres per day are produced in one season and 11,000 in another and all are delivered, the increase in deliveries from the dry to the wet season is 36%. If the same production fluctuation took place but a delviery of 10,00 litres to a local market is maintained throughout, the change in KCC deliveries between the dry and the wet season is 400%.) This issue will be discussed further shortly when we consider the question of the producer price for milk.

The KCC is currently paying Shs.4.25 per gallon (Shs.0.93 per litre) for milk supplied to them. This includes the November 1975 producer price increase of Shs.0.50 per gallon (11 cents per litre). A survey of Livestock Officers from 18 of the country's dairy areas, asking them to estimate the dry season and the wet season informal market milk prices in tabulated in table 10. While these estimates are not necessarily reliable they are made by officers resident in the areas concerned. It will be seen that only two of the areas have an estimated dry season milk price that is below the KCC producer price.

If the consumption and marketing model outlined above is correct, those areas where the local milk price is below the supply price to KCC (i.e. the KCC price for milk delivered to them minus the transport costs of delivering the milk to the nearest factory or creamery) can be regarded as being "saturated" with milk for local consumption (at that supply price). Those areas where the local price is significantly higher than the supply price to KCC can be expected to absorb considerable additional supplies as production increases and the price goes down to the KCC producer price. Only when the price is driven down to that floor price can an area be expected to start sending supplies to the KCC. The KCC is, in other words, the buyer of the residual surplus once the local market is satisfied at the KCC producer price.

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ESTIMATES OF INFORMAL MARKET IN SEVERAL DAIRY AREAS OF KENYA

ESTIMATES MADE BY THE VETERINARY DEPARTMENT LIVESTOCK OFFICERS (AI)

Area*	Dry Season Price per gallon	Wet Season Price per gallon	Average Price per gallon
Nyeri	-	-	7.20
Kiambu	7.20	6.00	4.50
Kirinyaga	5.40	4.20	4.60
Murang'a	5.40	4.30	4.50
Tigoni	8.00	5.50	6.50
Embu	6.00	5.40	5.70
Machakos	6.00	3.00	4.00
Kitui	10	10.00	10.00
Kinangop	4.80	4.80	4.80
Naivasha	7.20	7.20	7.20
Nakuru	5.40	5.40	5.40
Eldoret	4.20	3.50	3.80
Kericho	4.80	4.20	4.50
Sotik	4.80	4.20	4.50
Nandi	4.80	3.60	4.20
Kisii	3.50	2.80	3.00
Kakamega	6.00	4.80	5.40
Busia	6.00	-	5.40

* (The area sometimes corresponds to a district, sometimes it does not.)

Milk pricing

The prices paid for fluid milk at KCC creameries and factories, and the prices of KCC marketed fluid milk, are given for the years since 1966 in Figure 1.

Prior to July 1970 there were announced prices for milk supplied under pool 1 (quota), pool 2 (contract), and pool 3 (for separation) categories, with pool 1 implying an obligation to supply a given volume every day of the year. These announced prices were not uniform throughout the country but varied widely with distance from the principal consuming areas. (see table 11.) In 1966/67, for instance, there was an announced price of Shs.1.80, 1.30 and 0.90 per gallon (Shs.0.396, 0.286 and 0.198 per litre) for pool, pool 2 and pool 3 milk respectively. The average payout for poosl 1 & 2 was Shs.2.67 and for pool 3, Shs.1.29, with an overall average payout of Shs.2.05 per gallon (Shs.0.45 per litre) for all milk received. This average payout is the price shown in figure 1 for the years up until 1970. The figures from July 1970 give the uniform price paid for all milk received by the KCC. With respect to the consumer milk price there was a de facto change in price when a switch was made from pint to half-litre packaging in July 1971, another rise in price in 1972 and two price increases in 1975.

The quota system in operation prior to July 1970, was a method for maintaining supplies of milk in the dry season by paying the quota owner a higherprice for a given quantity of milk that had to be supplied daily throughout the year, or the quota was forfeited. In effect a farmer was rewarded for maintaining his quota in the dry season by receiving a higher price for milk even in the flush season so that he had a strong incentive to maintain production even when this was done at a loss. While quotas are a fairly common method of maintaining off-season supplies, the problem in Kenya was that most of the quota were held by the large established farmers (mostly European) with the effect that they were seen to be getting a higher price for their milk than the smaller less established African farmers. While quota owners earned a bsaic price plus a 50% premium for the proportion of their sales used as fluid milk, producers with no quota received 22 cents per litre (Shs.1.00 per gallon) delivered to the factory. Indeed, for the small producers who marketed their milk through co-operatives, it was not unusual for the net farm price to be as low as 11 cents per litre (50 cents per gallon). The quotas were, of course, worth money and were, in fact, traded at a substantial price per gallon. Thus distribution of whatever quotas were available was based on the ability to pay for them as well as on the ability to maintain milk supplies. The other problem was that some of the newer, less

FIG 1

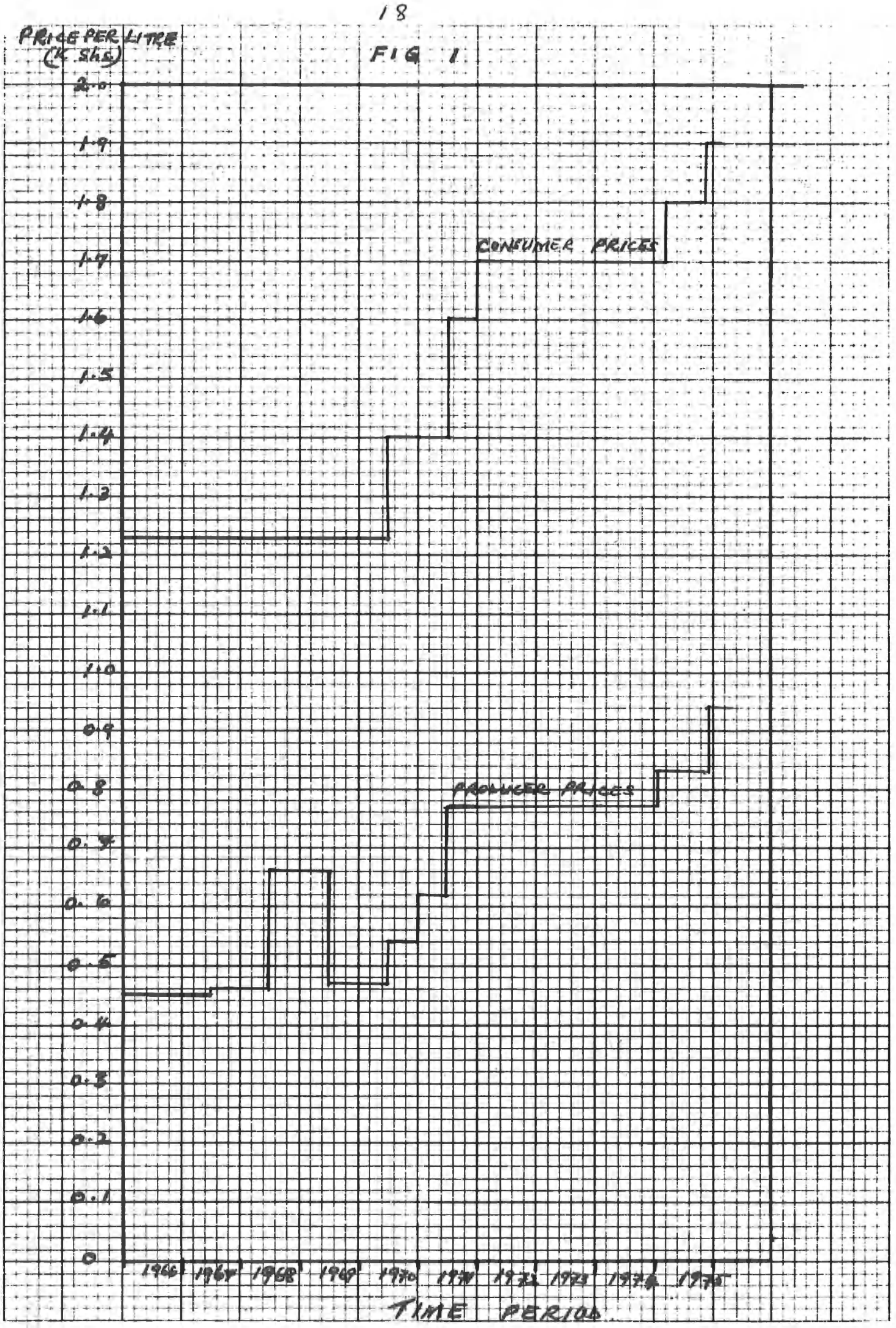
PRICE PER LITRE (K shs)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
CONSUMER PRICES
PRODUCER PRICES
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
TIME PERIOD

Table 11. IDS/WP 261

KENYA CO-OPERATIVE CREAMERIES LIMITED

MILK PAYOUT PRICES : MAY, 1968.

		Quota	Contract	Separation
ELDORET, NAKURU	Basic Price	1.90	1.90	1.00
AND NAIVASHA	Quota Premium	.50	-	-
	Total for month	2.40	1.90	1.00
T.FALLS	Basic Price		1.90	1.00
	Less Transport		.20	.20
	Total for month		1.70	80
NAIROBI,INCL.	Basic Price	1.90	1.90	1.00
THIKA.	Quota Premium	.50	-	-
	Geographic	.35	.35	.35
	Total for month	2.75	2.25	1.35
KISUMU.	Basic Price	1.90		
	Quota Premium	.50		
	Geographic	.20		
	Total for month	2.60		
KERICHO.	Basic Price	1.90	1.90	1.00
	Quota Premium	.50	-	-
		2.40	1.90	1.00
	Less Transport	.20	.20	.20
	Total for month	2.20	1.70	.80
MOMBASA.	Basic Price	1.90	1.90	1.00
	Geographic Premium		.65	-
	Special Premium		.50	-
	Past. & Dolvy Allowance		.45	-
	Additional Payment		-	-
	Total for month		3.50	1.00

experienced farmers who bought quotas had difficulty filling them in the drought consequently losing them. The quota system had further disadvantages based on the fact that the quantity for which a high price was paid was fixed; there was no incentive for the efficient producer to improve his methods of production and output once his quota objectives were met. The system thus tended to freeze the situation when there was a need for substantial expansion in milk output. The quota system eventually became a bone of contention and was abandoned in July 1970 in accordance to the recommendations of the Tentoni (FAO advisor) Report and the Kibaki Commission.

Quotas were replaced by a new pool pricing system involving a guaranteed minimum price of 46 cents per litre (Shs.2.10 per gallon) plus a bonus based on amount realized by the KCC from the sale of liquid and processed products. All producers except perhaps those who were selling large quantities of quota milk received an increased return. The producers were enabled to share more equitably in the relatively more remunerative liquid milk sales.

Since July 1971 the KCC producer price has been set by Presidential decree. In that year a factory door price of 77 cents per litre (Shs.3.50 per gallon) was set. This represented a boost of about 45 per cent which was such an enormous increase that substantial supplies were stimulated in the flush season. The requirement that the KCC purchase all supplies offered at that price became a source of a major financial crisis in the organization (involving a net loss of about K£ 800,000) that has only eased as a result of increased demand of fluid milk. /The recent producer price increase from 79.8 cents per litre (Shs.3.75 per gallon) to Shs.0.93 per litre (Shs.4.25 per gallon) is undoubtedly going to set the process of excess wet season supply and accumulated losses in motion again. Informal estimates put the anticipated deficits resulting from the price increase at Shs Six million per annum/.

Seasonal Fluctuations and the Location of Production

Predictably, the seasonal fluctuations in milk supplies to KCC increased markedly with the introduction of a uniform milk price. Table 12 gives monthly milk intake figures for the KCC between 1969/70 and 1973/74. The increase from the lowest monthly intake to the highest monthly intake was 28.7% in 1969/70. In 1973/74 the amplitude of the fluctuation was enormously greater, with a 102.4% increase in intake between the lowest month and the highest. The intake fluctuation for the two years is illustrated in Figure 2. For the highest month the intake is markedly higher in the latter year, but for the lowest month it is 4.2 million litres lower. This is the effrct that should be expected from a uniform price between seasons and the absence of any incentive to maintain supplies in the off-season. The uniform price is

Table 12

SEASONALITY OF MILK SUPPLIED TO K.C.C.

(Milk & Butterfat intake in Milk equivalent): Litres

	1969/70		1970/71		1971/72		1972/73		1973/74	
MONTH	p.m. mill.	p.day '000	p.m. mill.	p.day '000	p.m. mill.	p.day '000	p.m. mill.	p.day '000	p.m. mill.	p.day '000
July	17.9	577	20.6	665	22.5	726	25.0	806	25.2	818
August	17.3	557	19.1	616	22.2	716	25.5	823	24.1	777
Sept.	17.0	566	17.8	593	22.0	733	23.3	777	23.7	790
Total 3rd quarter	52.2	567	57.5	625	66.7	725	73.8	802	73.0	793
Oct.	17.0	550	18.2	587	22.2	716	23.6	761	25.3	816
Nov.	16.7	557	17.4	580	20.3	677	25.8	860	24.7	823
Dec.	18.1	584	16.6	535	18.7	603	27.8	897	23.1	745
Total 4th quarter	51.8	563	52.2	567	61.2	665	77.2	839	73.1	795
Jan.	17.1	552	14.8	477	19.0	613	25.4	819	18.3	590
Feb.	17.3	618	12.3	439	17.6	607	21.0	750	12.9	461
Mar.	17.7	571	10.2	329	19.2	619	21.6	697	12.5	408
Total 1st quarter	52.1	579	37.3	405	55.8	613	68.0	756	43.7	486
April	19.6	653	9.9.	330	15.6	520	16.7	557	18.1	603
May	21.5	694	17.8	574	19.1	616	20.7	668	24.0	774
June	20.6	687	20.6	687	23.7	790	24.1	803	23.4	780
Total 2nd quarter	61.7	678	48.3	531	58.4	642	61.5	676	65.5	720
Whole Year	217.8	597	195.3	535	242.2	662	280.5	768	255.2	700

(Kenya Dairy Board, 1975)

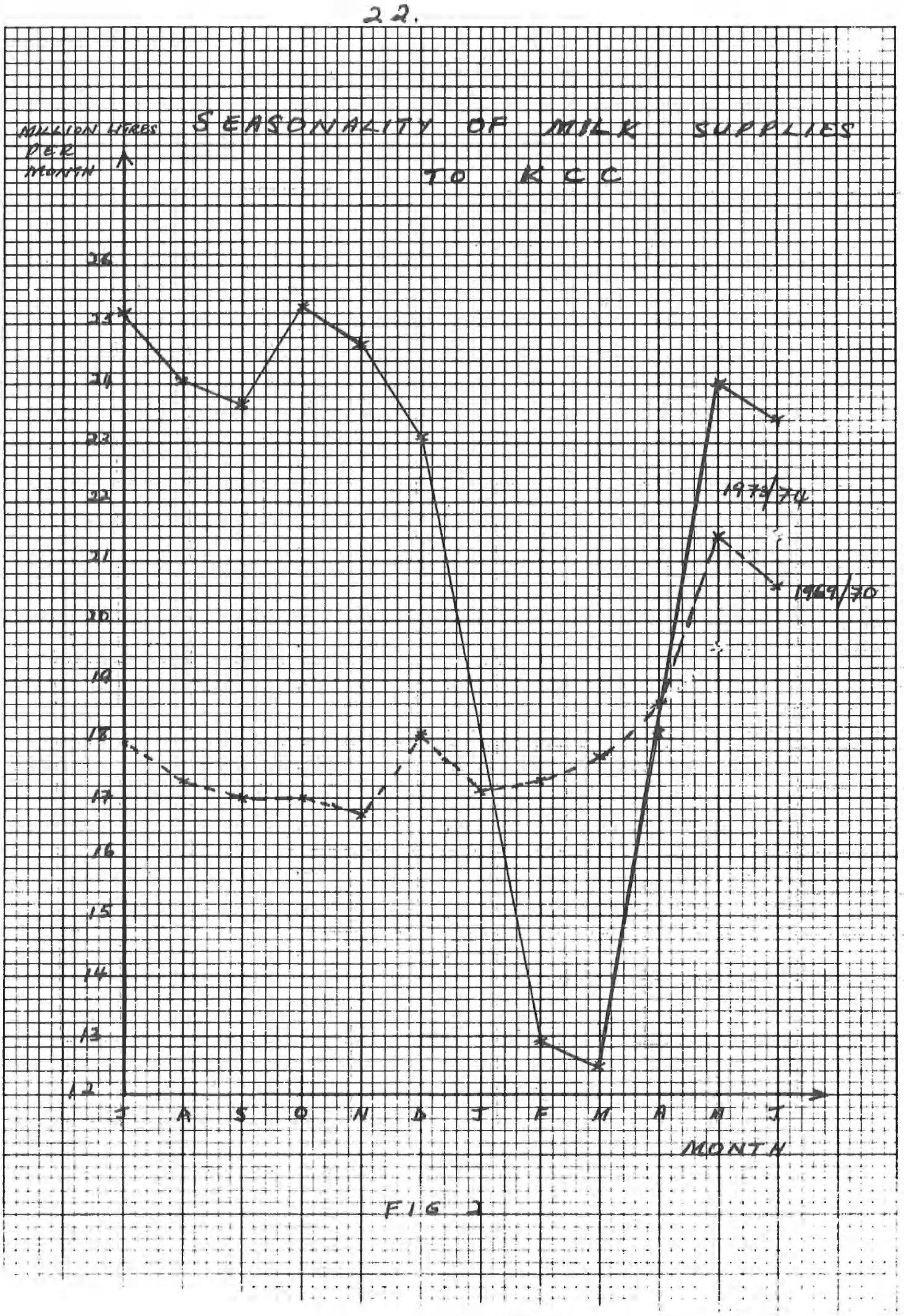
SEASONALITY OF MILK SUPPLIES TO KCC
MILLION LITRES PER MONTH
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
1973/74
1969/70
J A S O N D J F M A M J
MONTH

FIG 2

clearly too high for the flush season, but too low for the dry season when both costs of production and the value of additional milk are both a great deal higher.

Locational and Seasonal Effects of a Uniform Milk Price

It is, in our view, completely clear that the existing KCC pricing structure of milk in which a uniform price is paid regardless of the location of the receiving point and regardless of the time of year, is in urgent need of review.

The uniform price paid in different areas of the country has the effect of hiding the transport costs involved in supplying milk to the consuming areas from the producers. The consequence is that, compared to an economically optimal location for milk production in the country, the most distant producers are given an excessive incentive and those nearest the consuming areas an inadequate incentive to produce milk. The total cost of both the production and transport of milk reaching the main consuming centres is therefore very different, depending on where it was produced. The KCC currently employs a fleet of large tankers to transport milk from the more distant milk supplying areas and this very substantial cost is not reflected in a lower price to producers in those areas. Production in the more remote areas, therefore, receives excessive stimulation and production in the areas where the hidden transport costs are either non-existent or a great deal less receive inadequate stimulation. Areas nearer the main markets are thus subsidising the areas that are more remote.

Processed milk products such as cream, butter, cheese and dried or condensed milk have far lower transport costs per unit of milk, but the realised per litre price is considerably less when milk is used to produce these products. Rational pricing systems for milk are complex, but if whole milk is being transported to an urban centre such as Nairobi, the value of milk at any given distance from Nairobi is the Nairobi price minus the cost of transporting the milk to Nairobi. In economic terms, surplus milk produced far from consuming centres has a lower value and therefore it justifies the establishment of processing facilities in those locations (if adequate supplies are forthcoming). Processing reduces the physical bulk of the product and enhances its value making it suitable for long distance transportation. Such processing facilities are bound to operate at a loss if a high price is paid for the milk, just as the marketing system must sustain a loss if high priced whole milk must be transported long distances to consuming areas.

The second clearly irrational element in the milk pricing system is its uniformity between seasons, to which reference has been made. The chronic surpluses in the flush season and the chronic deficits in the dry season that characterise milk supply in Kenya are a direct and inevitable consequence of this pricing policy. Producing milk in the rainy season, when grazing is abundant and has high nutritional value is a very great deal cheaper than producing milk in the dry season when grazing is scarce and of low nutritional value. A rational farmer's response to a uniform milk price is likely to be to calve seasonally, concentrate milk production in the flush season and aim to dry off his cows when it is expensive and difficult to provide them with the necessary feed to maintain yields. Year after year the dry season fluid milk shortages are blamed on the drought as if a dry season were an annual surprise. They are, to repeat, the predictable result of a uniform price, given the fact of seasonal rainfall variations.

In economic terms, the value of additional milk in the flush season and the value of additional milk in the dry season are markedly different. This difference is the consequence of the fact that demand for milk does not have the same seasonality built into it as supply.

It has already been mentioned that the so-called "realised price" per litre of milk is far higher for fluid milk sales than it is for processed milk products. The consumer pricing system of the KCC has been one of using the considerable profits derived from sales of whole milk to, in effect, subsidize the sales of processed milk products. Whole milk, which requires relatively minimal processing (though the packaging process used is, in our view,unnecessarily expensive) is sold at well over double the price that is paid for it. Processed milk products, on the other hand, are sold at prices that do not even cover the costs of purchasing and processing the milk. While the KCC's purchase price for milk stood at Shs.0.77 per litre (Shs.3.50 per gallon) net realisation estimates by the Economic Planning Division, once processing costs have been included are as follows:

		Shs. per litre	(per gallon)
Liquid	Liquid milk	1.02	(4.64)
	Whole milk products	0.58	(2.64)
	Milk for separation	0.50	(2.27)

(Taken from K. de Jong, Economic Planning Division, Ministry of Agriculture, 1973)

The KCC's own estimates are that a net loss is made with ten of the fourteen products they produce, with only fluid milk being a significant source of net revenue.

In the dry season, not only could the fluid milk market absorb additional supplies (as indicated by the milk shortages that are now becoming an annual phenomenon), the entire stock of equipment for processing milk products is substantially idle. There are some costs of this processing facility that are dependent on the throughout of the factories, but there are very substantial costs which are incurred whether or not the capacity is being utilized. The problem is that the capacity of the processing facilities must be capable of handling the peak output of the wet season, so the extreme seasonality of the supply necessitates investment in capacity that may be only utilized for short periods during the year.

The earlier intention of the KCC was to raise the price of off-season milk by paying producers a floor price throughout the year with a bonus on the basis of an ex poste monthly realized price for milk; if a larger proportion of the milk went into the whole milk market the realized price would be greater and those who produced milk in that month would receive more. The 1971 political announcement sharply raising the price of milk resulted in adequate (for that time) dry season supplies and large excesses in flush season supplies. The dry season premium was thus abandoned and since then a uniform price has been paid regardless of seasonal shortages or seasonal excesses in supply.

The result is that while enormous costs are imposed by the extreme seasonality of production, the producer pricing system is further encouraging that seasonality. Unless the price structure is changed, furthermore, the amplitude of the seasonal fluctuations is likely to increase. In small-holder areas the price of milk sold locally is generally more attractive than the KCC price, so that the KCC provides a floor price at which only surplus milk, over and above the total consumed at the supply price to KCC, will be sold. Management practices are such that considerable on farm seasonality is to be expected so that milk supplies marketed from many areas may dry up altogether in favour of local consumption within the area in the dry season, while very large surpluses are brought onto the market in the rainy season.

The position of the KCC in this situation is untenable. They are required to purchase all milk supplied to them regardless of whether or not it is financially appropriate. In general, large losses are made in the flush season where a large proportion of milk purchased must be processed and sold at a loss. In the dry season huge financial gains are made as virtually all milk is sold at a high price as whole milk, but during this time the very considerable processing facilities, necessary to handle the peak of flush season supplies, lie idle. An excessive consumer price for milk is maintained

and is deemed necessary to recoup the losses made in handling flush season supplies. This high consumer price markedly curtails consumption and forces the KCC to put milk into unprofitable processing channels. In the meantime pressures from farmers, who are themselves incurring substantial dry season losses, call for raising the milk price merely to cover their costs. In the context of a uniform price policy, this would worsen the flush season over-supply. Clearly what is needed is a recognition that neither production costs nor the value of additional milk supplies is uniform between seasons. Milk supplies can be maintained in the dry season, but only at a substantially higher production cost. To stimulate such production higher dry season revenues are necessary for farmers.

In terms of proposals, the quota system, with its obvious problems and inadequities, should not in our view be re-introduced. The pricing system that we would recommend is a floor price for all seasons with an ex poste additional payout depending on the proportion of milk intake that is sold as fluid milk. When milk is scarce, and a high proportion of milk is sold as fluid, the total price received by the farmer would then be high. In the flush season the price would move down toward or to the floor price which should be the weighted average realised price for the milk and milk products sold in that season, net of all processing and handling costs. Just as with any other perishable, locally consumed commodity with seasonally fluctuating costs of production, the price would then vary by season depending on costs of production and factors of supply and demand. It is possible that the consumer price for milk should vary also to raise consumption in the flush season and reduce the need for manufacturing capacity to handle seasonal excesses in supply but even if the consumer price does not vary the producer price should. A further case can be made for a lower milk price for consumers on the grounds that this would bring new, more marginal consumers into the market with marked benefits for nutrition and for the long-run expansion of the more lucrative market for liquid milk.

Even if the consumer milk price does not vary seasonally, it is clear that that the producer price should. As with other perishable commodities, farmers would then be given an off-season price stimulus to incur the greater costs of production and increase the quantity supplied in the off-season. Fresh market prices would not, as a consequence, have to be paid for milk that was to be used for manufacturing. The price of fluid milk to the consumer could then be reduced, and the financial viability of the KCC maintained.

It is, incidentally, essential that the payout to farmers be on the basis of a clearly stipulated and well understood formula relating prices to KCC milk intake and fluid milk sales. This formula should be subject to reguaar review, perhaps six-monthly, but at least yearly. In view of the monopolistic and monopsonistic structure of dairy marketing (i.e. there is only one buyer of milk to be exported from a district, and effectively only one buyer of milk to be exported from a district, and effectively only one seller to urban consumers), the discretionary element in price setting must not be in the hands of the KCC alone. Only in this fashion will the lobbying and political pressures on milk prices be reduced (or at least balanced out, with both producers and consumers being represented). When there are milk shortages the or when all milk purchased by the KCC is sold as fluid milk the price paid to the farmer should rise up to the consumer price for milk less whole milk handling and processing costs. When milk intake is surplus to the fluid milk market requirements, the price paid to farmers should take account that surplus. The realized price per litre in the sale of that milk as milk products net of the pull costs incurred in the manufacturing process, would then be reflected in a weighted average payout price to farmers for that period. The final payout price to farmers would then exhibit a marked seasonal fluctuations ex poste, and this would reflect the wide seasonal differences in both the cost of production and the value of additional milk supplies.

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*George Ruigu, one of the co-authors of this paper has just embarked on a study of the Kenya Dairy Subsector. He shall be undertaking additional work on many of the issues alluded to in the paper. He shall be preparing his dissertation for the Ph D in Agricultural Economics, Michigan State University. A brief copy of the research proposal is included in the appendix.

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Appendix

An Economic Study of the Kenya Dairy Subsector: A Research Proposal

By

George Ruigu

Introduction

The term subsector will be defined as "the vertical set of activities in production and distribution of closely related set of commodities". We shall delineate the Kenya Dairy subsector to include production and distribution of important inputs to milk production at the farm level, the assembly of milk, processing, transportation and distribution, retailing and acquisition of milk and milk products by the consumer. The dairy subsector is also affected by a system of laws that govern the operation of co-operatives, statutory boards, Presidential decrees licensing and health regulations. We thus find several aspects of the dairy subsector straddling the Ministry of Agriculture, and of Health, Department of Co-operative Developments Office of the President, Agricultural Finance Corporation, Agricultural Development Corporation and private Companies such as feed processors and chemical firms. We shall seek to improve the understanding of how the subsector is organized and functioning and to increase our knowledge of why and how the system is changing, what the sources of change are, and where such change is taking us. Specifically we shall identify barriers to improved performance and problems facing the participants in the subsector and attempt to identify the means to remove the barriers as to solve the perceived problems.

Statement of Problem

Many important aspects of the Kenya Dairy subsector were reviewed in the working paper and will therefore not be repeated here. We attempted to identify important factors that influence the performance of the dairy industry. Suffice to recapitulate that the dairy industry has undergone substantial transformation over the last decade. From a vertically large-scale milk production we have reached a stage where

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This is a shortened version of type III Seminar Paper of the same title that was presented to the students and Faculty of the Department of Agricultural Economics, Michigan State University, East Lansing. 5th December, 1975.

smallholders now produce a significant amount of the total commercial milk. The industry can be said to be in a state of disequilibrium not only because of recent changes in pricing policies and changing patterns of land tenure but many farmers are learning (albeit with significant success) the art and skills of animal husbandry.

We alluded to the tremendous increase in the supply of fluid milk in flush season especially since 1970 (but at the same time noted that a slowdown appears to have set in 1974.) in response to favourable producer prices. The question of supply response is pertinent in this regard. There is the question of the response from a national and regional sense, its magnitude and the distribution over space; and how it varies among smallholders, large-scale farmers and farmers in settlement schemes.

The level of producer price has become a controversial subject. There are feelings in some quarters that price may be too high given the cost of production (at least in the flush season). It is argued that Kenya milk is predominantly produced on grass and most of it ordinary native grass. (There are only about 40,470 hectares (100,000 acres) of ley and 8,094 hectares (20,000 acres) of fodder. The question of costs of production warrants a thorough analysis taking into account of increases in prices of competing enterprises.

The other dimension of producer prices that is addressed in the working paper is the spatial aspects which will not be repeated here.

Associated with attractive producer prices necessary to stimulate greater production of milk has been the need to raise consumer prices. An assumption of inelastic demand appears to have influenced the pricing of milk and milk products. Consumption, (as noted in the working paper) has been growing substantially despite the price increases. The increase in demand is determined by such factors as income growth, population growth, improved education levels and rate of urbanization. Estimation of income elasticity of demand using time series and cross-sectional data (for major towns) will be attempted. A scenario of price elasticities and the impac s of various levels of prices may be constructed as an alternative.

A portion of the increased demand for milk has gone to exports predominantly to East African Community partner States. The loss incurred in exporting dairy products elsewhere was mentioned in

the working paper. Subjective judgements of the likely performance of dairy exports seems desirable in order to determine how much surplus milk above domestic requirements for liquid and manufacture should be produced.

Objectives of Study

1. The study will seek to fill some of the gaps of infomartion that exist in the Kenya dairy subsector and to highlight the major problems obtaining thereof.

2. To evaluate the supply response of output of commercial milk at the regional and national level, i.e. to establish the probable effect of producer price changes on milk output. Also to project the supply of milk ten years hence using various assumptions.

3. To estimate the consumption of milk and milk produces. To investigate the relationship between price and quantities of milk and milk products consumed in Kenya, i.e. price and income elasticities. To project demand for milk and milk products to 1985 and beyond using income, population growth, rate of urbanization etc. as explanatory variables.

4. Using estimates from (2) and (3) to determine what an appropriate pricing policy should be. At the same time evaluate the implications for surplus milk production over and above domestic demand, i.e., assess Kenya's ability to maintain exports of milk and milk products.

5. To evaluate an economically efficient pattern of production, consumption and interregional flows of milk given the existing dairy plants.

6. To identify barriers to improved performance of the dairy subsector from production and assembly through processing and distribution to the final consumer.

Justification of Study

The dairy industry is important in the Kenya economy. In 1972, marketed milk amounted to 270 million litres valued at K£ 10.4 million. This is estimated to account for about 26 per cent of all milk produced in the economy. In 1973, the dairy industry earned K£ 3.8 million from exports of milk and milk products to Uganda and Tanzania.

A case for this study can also be made on the basis of the expressed policy of the government of Kenya as laid out in the 1974-78 Plan. The policy adopted calls for increase emphasis on rural development. In this regard dairying and especially small-holder dairying is not only an important supplementary enterprise -- to the extent that it contributes farm income without curtailing other productivities --; complementary enterprise -- to the extent that it uses by-products coming from production of crops; and also as a major enterprise in its own right helping to generate income and employment.

The government's stated agricultural development policies will also be aimed at improved nutrition standards of the population. The 1974-78 Plan projects that marketed milk production will increase from 270 million litres in 1972 to 400 million litres in 1978 for an annual growth rate of 6.8 per cent. It will be met almost entirely by increased numbers of dairy cattle. The Plan argues that "this strategy is attractive because it is extremely easy to increase the size of the national dairy herd through upgrading stock using artificial insemination while raising productivity through a combination of breeding and management is much more costly". (p.246). There is very little concrete information regarding the basic production of small-holder milk production, and, to the extent that the research will generate some such data a case can be made for it.

Finally, there appears to be very little work done on dairy supply response in Kenya. The little that there is very inadequate to meet current production and marketing problems in dairying. Nevertheless, we know that formulation of sound pricing and marketing policy requires adequate knowledge about supply response and demand relationships of the commodity in question. Without this type of knowledge the formulation of sound pricing and marketing policies is relegated to a hit or miss situation with no way of telling to what extent the various instruments have to be manipulated to attain a given output. Targets became nothing better than just a hope. To the extent that the current study seeks to contribute some such information, albeit in a small way, further justifies the research.

Literature Review

A detailed literature review regarding the Kenya dairy subsector will not be undertaken here. Nevertheless, there are several studies that specifically deal with the Kenya dairy industry Among these are "The Development of Dairy Industry in Kenya" (27)

"The Kibaki Commission","The Final Report of the Dairy Working Party" (16) and various reports of the Special Rural Development Programme outlining the difficulties smallholder dairy producers.

Several studies also exist concerning improved dairy cattle and traditional zebu breeds. Such studies include East African Livestock Survey (6) which was conducted under the auspices of the FAO, Animal Production, 1970-1980 and Beyond (18), the Agricultural Sector Study -- Kenya, and the "Study of the Availability of Fattening, Beef Breeding and Dairy Breeding Stock in East Africa (12). Each of these studies emphasize the importance of livestock and the dairy industry to Kenya.

There are other studies that have been carried out in the partner states of the East African Community. "Dairy Development in Tanzania, Implications for Nutrition Improvement, Product locations and Import substitutions" (28) contains a good review of the Tanzanian dairy industry and of its interactions and consequences of the Kenyan dairy industry on it. Nsubuga (17) discusses policy and institutional matters of the Uganda diary industry some of which are pertinent dairy industry some of which are pertinent to the current study.

Area of Study

The study will concentrate on the high and medium potential areas where all the nation's commercial milk is produced. The Kenya milk shed is concentrated in the Rift Valley and Central Provinces. The core of the milk shed coincides with the highlands, especially the areas within 875 mm isohyet of annual rainfall. It is estimated that the entire milk shed covers just over 103,600 square kilometers (40,000 square miles). Although small-scale and large-scale farms are found as separate entities in almost every district in the milk shed, Trans Nzoia, Uasin Gishu, Laikipia and Nakuru stand out as the most important large-scale areas. The latter two are also important beef producers. Nyeri, Kiambu, Nandi, Kericho, Muranga, Meru and Kakameg are important small-scale areas, while Nyandarua District is an important settlement-schemes district.

Data Sources

Most of the data used in this study will be derived from secondary sources but some primary data will be gathered as well. Secondary data will be obtained from the Ministry of Agriculture (MOA), the Central Bureau of Statistics (CBS) of the Ministry of

Finance and Planning (MFP), the Department of Co-operative Development, Ministry of Lands and Settlement, the Kenya Dairy Board (KDB) and the Kenya Co-operative Creameries (KCC).

Primary data will be gathered concerning the assembly and distribution costs of milk handling. For the assembly of raw milk cooperatives and their District Unions will be the primary targets for small-scale farm districts; Rift Valley Transporters and large-scale farmers will be contacted. Distribution costs of milk and milk products will be obtained from the KCC, the sole distributer, all other competitors having been abolished in 1970. Personal interviews with government and KCC officials will be conducted to gather more insights on general matters pertaining to the dairy subsector, including supply response.

Milk delivery by creamery will be obtained from the KCC and the Kenya Diary Board.

Regional Demarcation

Based on the availability of data, the district is undoubtedly the most reasonable basic unit. Each regional market or supply will by reprssented by a point which will be identified with one town in each area.

Methodology

We shall use linear programming to determine the probable supply response and evaluate the output changes that different levels of producer prices for milk will induce. For the small-scale farm sector we shall use data from the Integrated Rural Survey of CBS. The data is cross-sectional in nature and covers about 17 out of the 40 districts of Kenya. The data is gathered over a continuous basis with monthly visits to each farm in the sample. Certain entries such as capital stock, inventories, livestock numbers are filled in the questionnaire at the beginning of the period. Observations are made for each enterprise viz. improved and unimproved dairy cattle, local maize, Hybrid maize, coffee, cotton, pyrethrum and tea. For each enterprise labour inputs and all quantities of other inputs used, all output produced, the cash value of those outputs and the distribution of the outputs between home use and market, debt obligations are all recorded. Demographic characteristics and other socio-economic variables are included. Labour inputs are differentiated into family and hired labour. This data may be supplemented by a short survey in one of the smallholder dairy areas.

For the large-scale farms there is a separate Large Farm Surveys data from the CBS. The data will be supplemented by other data from Land and Farm Management, and Animal Production Divisions of MOA and from the work of the German Agricultural Team that is currently in Progress.

For programming purposes we shall stratify the farms into ecological zones such as star-grass zone, the coffee-banana zone and high-bracken zone of Central Province. We shall then program the representative farm, for both large and small-scale farms. Like Heady, et. al. (15) we can use the means and modes of several characteristics for constructing representative farms. The resource limitations and restraints used in programming optimal farm plans can be determined from averages of characteristics of sampled farms in each stratum.

Parametric programming will be carried out to investigate the variation of milk prices while holding all other prices constant This technique calls for discrete changes in production plans and outputs which result in a "stepped" supply function. We can then aggregate outputs from individual strata into supply functions. The supply function so obtained is normative. We assume optimal adjustmemts based on profit-maximizing motivations with perfect knowledge. Nevertheless, it gives sufficient guidance as to the expected output for given level of prices.

Supply Projection

We shall attempt several methods of projecting supply. (1) We can extrapolate observed trends, i.e., the amount of milk handled by the Kenya Co-operative Creameries and other associates of che Kenya Dairy Board. (ii) We can project the number of cows and the yield of milk separately using plausible assumptions. Then by multiplying the number of cows with estimated yield of cow we can determine the quantities of milk.

Demand for Milk

Consumption of milk falls into two categories, domestic end export. The bulk of fluid and manufactured dairy products as mentioned earlier go to Uganda and Tanzania but with smaller amounts going to Ethiopia, Rwanda and Somalia. Some manufactured products especially butter, cheese and milk powders are exported to UK. To project export demand we shall use several alternatives.

For domestic consumption we want to determine the magnitude of the parameters associated with the quantities of fluid milk, butter and cheese consumed, i.e., the price and income elasticities. We are faced with a situation where the price of milk is regulated at given levels for considerable periods and therefore time series data are inadequate. To circumvent this problem we shall use cross-sectional data available in published form of the 1969 Household Budget Survey. This survey covered urban households and covered the major towns of Nairobi, Mombasa and Kisumu. The data was gathered over a period of one year between December 1968 to October 1969.

The demand for milk will be represented as D = f (income, size of household, location, etc.). We can attempt several functional forms such as logarithmic, semi-logarithmic and log-inverse to estimate the income elasticity of demand. We can then generalize for the population.

In cross-sectional data it is assumed that prices and indeed other market variables are held constant, i.e., it is assumed that over a given time period of data collection, the whole sample faces the same "market situation." Prices paid, interests, wage rates and other variables can be said to be held constant over that period of time.[1]

For the estimation of price parameters we have either to result to use of scenarios but at the same time we can have indications as to likely magnitude of price elasticity of demand by using mathematical approach. We can use the homogeneity condition, i.e., we use the assumption that demand function is homogeneous of degree zero in money income and absolute prices. It follows therefore that the sum of price elasticity, cross elasticity and income elasticity is equal to zero, i.e.

$$\Sigma e_{ij} + E_i = \text{zero}.$$

2) Projection of Consumption

We need to project population and income before projecting demand. We would expect an increase in population to increase consumption by the same amount, ceteris paribus. We can use the estimated income elasticity of demand, since it is obtained from cross

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1. Lawrence Klein, An Introduction to Econometrics, p. 55.

sectional data it should be consistent with the long run. We can estimate the total demand by multiplying per capita demand by size of population projected for the years in question.

For the rural areas we shall assume that consumption is a function of population growth only.

Transportation Costs-

Assembly costs of milk will be estimated by the following equation

$TC = \alpha + \beta D$

Where TC = transporation costs per kilogram of milk

D = distance in kilometers.

The assumption is that transportation will be in trucks hired from District Co-operative Unions. We also assume that costs are independent of quantities of milk shipped, i.e., there are no economies or diseconomies of size.

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