

A PROPOSED EXTENSION PLAN
FOR DAIRYING IN UGANDA

by

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INTRODUCTION

Mixed farming was not emphasised during the early stages of agricultural development in Uganda. Cattle were kept for beef by pastoral people. The majority of the population was engaged in crop farming. Dairying was developed after World War II. It was based on indigenous cattle, which later proved uneconomical because of low milk yield. Improvement in disease control and better animal husbandry could not progress beyond the genetic make-up of the indigenous cattle and resulted in only slight increase in milk production. This led to importation of European dairy breeds in 1959 and the beginning of commercial dairy farming.

Farmers in Uganda are convinced that exotic cattle are more productive than indigenous cattle. A nucleus in commercial dairying has already developed in the fertile, densely populated strip of land up to 100 km wide along the northern and western shores of Lake Victoria.

Since 1959 there has been a marked increase in the number of dairy farmers and the amount of milk produced. However, increase in milk production is not keeping pace with the steady increase in consumption. About 36,000 liters of milk are imported daily from Kenya. There is no surplus milk for manufacturing dairy products. Butter, cheese, cream, dried milk powder and sweetened condensed milk have to be imported. To be self-sufficient in milk and dairy products, Uganda must tackle the problems that are limiting milk production and its distribution. The major problems are farmers' lack of knowledge in dairy husbandry and disease control, poor marketing organisation and ineffective dairy extension service.

Development of the dairy industry calls for cooperation and hard work among the farmer, dairy extension specialist and the research worker. There is an interdependence among them. With the dairy extension specialist acting as a go-between, the other two must shoulder more responsibility and each must be well trained and conversant with his work.

PROBLEMS FACING THE DAIRY INDUSTRY

The economy of Uganda is based on peasant agriculture. Over 90% of the population live and work on their own farms of less than 4 ha, normally growing their own food and selling some produce, mainly coffee and cotton, to satisfy their cash requirements. Fluctuations in world prices and deteriorating terms of trade have hit Uganda very hard. The high price for milk coupled with low coffee prices have attracted many farmers to invest their money in dairy farming. In order to introduce an efficient dairy industry, it will mean a revolution in land use and farming systems. The change over from crop farming to dairying has created many problems, some of which are discussed below.

Capital Investment

Farmers who are taking up dairy farming require some financial support and incentive during the early stages. Loans or subsidies have to be sought from banks or government, but often not enough money is obtained due to lack of security or experience in dairying.

The dairying area is one of the densely-populated areas in the country. Price of land varies from \$125 to \$375 per ha.

Some of the land is either forested or swampy, which is unsuitable for crop farming. A large sum of money is needed for land clearance, fencing, planting grass, establishing water and effective tick control measures and purchase of dairy cattle.

Disease Control

The disease situation in Uganda is well summarized in the quotation below taken from the report of an economic survey mission to Uganda (16):

"The general control of diseases presents a formidable, though not insuperable task. Rinderpest and contagious bovine pleuropneumonia, two major epidemic diseases, have not been finally eradicated within the country. Rinderpest is always liable to be reintroduced into cleared areas from neighboring territories. Foot and mouth disease, only partially controlled, though only of limited importance to indigenous stock, will assume far greater importance with the introduction of exotic stock and the development of exports of meat. Endemic diseases take a tremendous toll, especially among young calves. East Coast Fever, by far the most important, is endemic throughout the whole of Uganda, except Karamoja district. Little has been attempted in the way of eradication though tick control through spraying is being popularised. Trypanosomiasis is wide spread in the country and losses are considerable Bovine tuberculosis is also wide spread."

The dairy industry cannot be developed without first control of "tick-borne diseases", in particular, the East Coast Fever, caused by a protozoan, Theileria parva. Its control can only be achieved by tick eradication. Many farmers know that East Coast fever is endemic in the country but they do not associate it with ticks. The basic approach to the problem then lies in teaching the farmer the role that ticks play in disease transmission and their general effect on cattle health.

The following essentials are required for an effective program of tick eradication (20).

1. An adequate stock proof circumferential fence, preferably a double fence.

2. Independent water supplies for each fenced farm and sufficient grazing and conserved forage to last through the year.
3. An effective spray race or dip.
4. An effective quarantine system to ensure that ticks are not reintroduced either by new purchases of stock or by imported feed or bedding.
5. Close grazing of fenced farm with East Coast Fever immune indigenous cattle and spraying them twice weekly with an effective acaricide to kill all the ticks collected. The farm can be free of ticks in about six months.

An alternative system practiced on small farms is stall-feeding of cattle with forage crops, such as elephant grass (Pennisetum purpureum) maintained free of ticks from the time of establishment.

Other diseases reported by the Economic Survey Mission are not too prevalent in the area where dairying is being developed. Epidemic diseases can be controlled through strict quarantine and vaccination of livestock. Tsetse fly, the vector that transmits trypanosomiasis, is found in 30% of the country. Infestation is light in the dairying area so trypanosomiasis can be controlled through curative and prophylactic treatments.

Parasites, mastitis and sterility in dairy herds pose a threatening problem to the dairy industry. At present little or no attention has been attached to them.

Experience in dairy farming

The Economic Survey of Dairy Farming in Uganda (33) reported, "59 percent of the farmers had kept Nganda cattle for many years before they

bought exotic cattle." It was also found, "In 27 instances the dairy farm owners, worked full time on the farm. In 21 instances the owner had another principal job. Some were teachers, clerks, mechanics, masons, salesmen, shopkeepers ... showing a great variety of occupation." Owners who have other jobs employ farm managers or the farm is managed by the wife.

Uganda dairy farmers have little experience in dairy farming, especially the feeding and management of exotic cattle. Secondly, they are like overseers. Few farmers realize that dairy farming is a full-time job where one is confined and has to work long hours. People employed as managers have limited knowledge of animal husbandry and economics of dairy farming.

Feeding and management of dairy cattle

Some farmers who buy exotic cattle have previously kept indigenous cattle. Many of them do not realize that exotic cattle, unlike the indigenous cattle, need a high level of feeding and management. Indigenous cattle being low milk producers often meet their feed requirement for both maintenance and production by grazing alone. Exotic cattle are then left to graze without supplementary feeding. This results in underfeeding leading to reduced milk production and weight loss. Likewise, management of exotic cattle is approached from the same angle as that of indigenous cattle.

Artificial breeding

An artificial breeding center was established in Uganda before exotic cattle were introduced into the country. It handles semen from both indigenous and exotic cattle kept at the Center. Semen is also imported

from foreign countries, mainly the United States of America and the United Kingdom. Artificial insemination centers have been established in dairying areas but are too far apart to serve efficiently. Sometimes farmers have a 20 to 30 km bicycle or car ride in both directions to obtain services of an inseminator. The inseminator may be on duty on other farms and so cows are not inseminated at the right time.

Milk marketing problems

There is a high demand for milk in most parts of the country. The lack of efficient means of cooling milk on the farm and its transportation to the consumer are problems. Milk should be cooled immediately after milking. Many farmers do not have electricity on the farms so they resort to cooling milk by immersing the can containing milk in cold water. This is a laborious and inefficient method of cooling milk. Farms are located far from the cities or big towns where milk demand is very high. Roads are poor and milk delivery is by bicycle, car or bus.

Extension service

The dairy industry is under the guidance of the Veterinary Department. Veterinary assistants serve as extension workers. There are no trained dairy extension specialists. There is a need to establish an effective extension service to advise the farmers on all aspects of dairy industry and to report to research workers the problems encountered in the field so that further investigations can be carried out.

PROPOSED PROGRAMS

Production Programs

Pasture improvement

In order to be economically viable, the dairy industry has to depend upon the availability of high quality feeds and fodders, fresh or preserved, to provide a uniform level of nutrition throughout the year. The existing grazing practices in Uganda cannot lead to pasture improvement.

The common practice is for the cattle owners to graze their animals wherever grass is available. It is not unusual to have a certain area grazed by as many as five herds, in turn, during a day. There is no organized system for pasture improvement. Burning grass is a common practice during the dry season. Communal grazing makes disease control, pasture improvement, erosion control and improved animal husbandry impossible.

Grazing within fenced land is practiced by "progressive farmers". The drawbacks have been small paddocks on many farms, lack of organized rotational grazing and over-estimation of the carrying capacity of the pasture, resulting in overstocking.

Pasture improvement can be achieved through management of grazing, modification of flora, water conservation and improvement by fertilizing.

Management of grazing. Improvement can be brought about through properly organized rotational grazing. Farm planning whereby the farm is divided into fenced paddocks is the key to rotational grazing. Fencing enables animals to be grazed in certain paddocks for a specified time

while grass in other paddocks is growing. Animals can then graze young nutritive grass most of the time. Pasture rotation, by maintaining a high nutritional status in the animal, is an important factor in gastrointestinal parasite prophylaxis.

Modification of flora. Through lack of controlled grazing, communal grazing led to growth of undesirable grass species in pastures, Cymbopogon afronardus being the worst. Constant uprooting of Cymbopogon species followed by heavy stocking has, in many cases, led to growth of indigenous bottom grasses, Paspalum commersonii, Brachiaria decumbens or Cynodon dactylon (14).

Permanent grasslands have been improved on a few farms through planting grasses, Cynodon dactylon being one of them.

Using herbicides to destroy undesirable plants has not been practiced as yet but should be considered.

Water conservation. The average rainfall of Uganda ranges from 75 to 150 cm annually. The rain comes in form of heavy downpours lasting for short times. This leads to considerable run off, instead of water sinking into the soil. Since the country is hilly, soil erosion is a problem and water conservation is necessary if high forage yields are to be obtained. Shallow pits, about 5 m long, 0.6 m wide and 0.2 m deep, have proved effective in conserving water. Paspalum species are planted on the crest of pits to reduce soil erosion and also increase fodder production.

Improvement by fertilization. Application of farm yard manure or chemical fertilisers increases the yield and improves the chemical

composition of the herbage. Farm yard manure has been successfully used on grasses but other fertilizers are used only on government experimental farms. Applications of 900 kg nitrogen per ha led to dry-matter yield increases by Panicum maximum and Pennisetum purpureum of 300% and 294%, respectively. Yield of Cynodon dactylon increased by 200% when 225 kg nitrogen per ha was applied (14).

There is a great need for soil testing laboratories in the country. Soil tests will enable farmers to know exactly which fertilizers to use and how they should be applied.

It has been found advantageous to design dairy farms with cowsheds on the higher ground so that wash may flow by gravity to grasses in the paddocks. Cynodon species respond very well to washes from cowsheds.

Species. Chemical analysis and feeding trials done at livestock experimental stations in Uganda (Table 1), have shown that when well managed, the indigenous grass species have sufficient protein for maintenance and production of more than 4 liters milk. Indigenous grass species suitable for dairy cattle feeding are (4):

Elephant grass (Pennisetum purpureum)

Star grass (Cynodon dactylon)

Guinea grass (Panicum maximum)

Rhodes grass (Chloris gayana)

African foxtail (Chenchrus ciliaris) and signal grass
(Brachiaria species)

Elephant grass (Pennisetum purpureum) is a large perennial grass used extensively as soilage crop or for grazing. There are many varieties,

Table 1. The percentage crude protein and starch equivalent of dry matter in grasses in Uganda.

Grass Specie	Percent Crude Protein (14)	Starch Equivalent (13)
	%	
<u>Brachiaria brizantha</u>	4.2 - 9.4	--
<u>Brachiaria decumbes</u>	3.7 - 7.3	--
<u>Cenchrus ciliaris</u>	4.3 - 12.5	37.4 - 54.0
<u>Chloris gayana</u>	3.8 - 14.0	20.2 - 57.0
<u>Cynodon dactylon</u>	4.7 - 16.3	--
<u>Hyparrhenia rufa</u>	3.3 - 7.6	--
<u>Panicum maximum</u>	3.2 - 11.9	32.2 - 48.3
<u>Paspalum notatum</u>	3.4 - 16.6	--
<u>Pennisetum purpureum</u>	4.6 - 19.5	31.8 - 15.1
<u>Setaria sphacelata</u>	3.4 - 18.8	--

some being hairy, others are hairless. "Uganda hairless" and "French Cameroon" varieties are the most popular. It is readily established by planting canes or splits. Its leaves are readily eaten by livestock. Protein content varies from 8 to 16% in wet seasons and 6 to 8% in dry seasons. No serious disease of this herbage has been reported.

Elephant grass grown under good moisture conditions, without fertilizer, yielded over 15 tons dry matter per ha annually. Crude protein content varied between 7.2 and 11.3% (14). When it was fertilised with 900 kg nitrogen per ha and harvested at 60-day intervals, it yielded 50 tons of dry matter per ha annually (36). Crude protein content was 9.7%. Increase of 2 to 6 kg dry matter for each kg sulphate of ammonia has been recorded at Kitale in Kenya (3).

Guinea grass (Panicum maximum). Many varieties of this tufted perennial which is planted from splits occur in Uganda. Yields ranging from 5 to 12 tons dry matter per ha can be obtained depending on soil fertility and rainfall. Crude protein varies from 6 to 13% or more depending on the season. When fertilised at the rate of 900 kg nitrogen per ha, it yielded 36,750 kg dry matter annually with 9.6% protein (36). According to Whyte (37) Panicum maximum and most cultivated tropical grasses supply sufficient protein for production of about 9 liters milk per day up to 30 days growth, but their energy content limits milk output to about 5 liters per day.

Star grass (Cynodon dactylon). This stoloniferous perennial requires fertile soil. It grows naturally in areas where cattle have been kept for some time or where tall grasses have been cleared and heavily

grazed. It produces high yields of good quality herbage with 10 to 18% crude protein.

Rhodes grass (Chloris gayana). The "Mbarara" and "Masaba" are popular varieties of this stoloniferous perennial. It is an outstanding seeder which is commonly grown on government experimental farms. Yields of 14 tons dry herbage per ha, in the year of establishment are possible. According to Breckington (6), fertilization with either calcium-ammonium nitrate or ammonium sulphate increased dry matter production linearly up to 425 kg nitrogen per ha and reached 12 tons at 849 kg nitrogen per ha.

African foxtail (Chenchrus ciliaris) is a tufted, drought resistant perennial with rhizomes and is a valuable grazing grass in dry areas. Chenchrus ciliaris and Cynodon dactylon have the capacity to retain higher protein content into the dry season than their related species.

Signal grass (Brachiaria species). Signal grass occurs naturally as bottom grass with tall grasses like Hyparrhenia species or under trees. It forms good grazing swards, but is a poor seed producer. In addition to grazing, bottom grasses, such as Brachiaria species, Cynodon species and Paspalum species, play an important role in soil conservation, in helping to control the hydrological cycle and reducing dessication.

Pasture legumes. Centrosema pubescens, Vigna gracilis and Stylosanthes gracilis are the common pasture legumes used in leys. Moore (23), working with Centrosema pubescens showed that its inclusion with a giant star grass (Cynodon plectostachyus) resulted in higher levels of organic matter, total nitrogen and nitrifiable nitrogen in underlying soil.

Total nitrogen content under pasture containing the legume was 280 kg nitrogen per ha higher than that under pure grass stand. Stylosanthes gracilis, "Stylo" is becoming important as a pasture legume in Central East and West Africa and in the wet tropical areas of Australia. It was found that "Stylo" with Chloris gayana increased the pasture yield 95% on no fertilizer plots and 252% on plots receiving phosphorus and sulphur (15).

Alfalfa (Medicago sativa) is being tested at government experimental farms but the results are not promising.

Grass can be utilized in one of the three forms, leys, soilage crop or as permanent grassland. In Uganda where cultivation on most farms is manual and farms are small in size, ley farming may not be practicable. Soilage cropping is practiced on small farms with few cattle. Elephant grass (Pennisetum purpureum) is widely grown for this purpose. Sugar cane tops, though not popular as cattle feed, support satisfactory milk production (8).

In Uganda, herbage is abundant for most of the year except during dry spells--December to January and July to August. During rainy seasons there is abundant luxurious forage with adequate protein and vitamin A contents. It soon matures and its nutritive value is reduced. Silage making is done only on government experiment stations. Sorghum, corn and elephant grass are used for silage (9, 22).

Bredon (5) reported that cows would not eat elephant grass more than 1.2 m tall while they still consumed 3 kg silage per day prepared from elephant grass 1.8 to 2.1 m tall. He also noted that addition of star grass or sweet potato vines improved the protein equivalent. His findings have a far reaching result in feeding dairy cattle during the dry season.

Sweet potato vines, star grass and elephant grass are popular cattle feeds in Uganda so the farmer should be persuaded to start making silage.

Whereas Sudangrass (Sorghum sudanese (Piper Stapf)) is widely used in many countries as a supplementary summer pasture (27), no research has been done with it in Uganda. In fact, Sudangrass and elephant grass could be valuable supplemental cattle feeds during the dry season.

The need to improve pasture so that it can be utilized to the maximum by grazing animals is shown by calculations carried out at Cornell University (26). It was shown that digestible nutrients in hay cost twice as much; in silage three times as much; in grain and commercial by-products six times as much as digestible nutrients in pasture.

Improvement of feeding and management

Roughages and concentrates are the two classes of feeding stuffs used for cattle feeding. Roughages in form of pasture form the basis of dairy cattle rations in the country. In fact, it is advisable to arrange for maximum dependence on green fodder--fresh or preserved--and a minimum reliance on purchased concentrate feeds. At present there is no high quality green fodder produced on the farms and so milk producers have to feed concentrates for at least part of maintenance and for all production. The urgent need is to feed those concentrates that are readily available in the country and which are not used as food for man. The greater percentage of concentrates fed to cattle, poultry and pigs is imported from Kenya. Prices are high because of freight charges and import taxes. It is essential to have feed mixing plants established in the country. These will act as stimuli to farmers to produce more raw

materials and ensure economic utilization of resources and optimal nutrition of dairy cattle.

The following feedstuffs are likely to form the basis of concentrate feeding in Uganda:

Basic grains: Maize and sorghum

By-products: Cottonseed cake, groundnut cake, soybean oil meal, meat and bone meal, blood meal, brewer's grains, molasses and coffee bean pulp

Other feedstuffs: Urea, mineral supplements, sunflower seeds

Maize. Maize can grow at a wide range of temperatures, rainfall and soils. It occupies 200,000 ha or 5% of cropped land. Yields of 1,685 kg per ha can be obtained without fertilizers. Maize does not enter into diets of people in Uganda, which makes it suitable for cattle feed. Unfortunately, its production has been discouraged by the Uganda Department of Agriculture because of fears that it is poor ground cover and so will promote soil erosion (1).

The East Africa Royal Commission (10) observed that it is in Uganda "that the greatest opportunity lies for specializing in maize production as a contribution to the economies of all three territories." However, no market for maize operates in East Africa. There are inter-territorial restrictions on movement of maize, so Uganda maize cannot be exported to Kenya or Tanzania. The high storage costs, and cost for hauling to the nearest port (1300 km away) makes Uganda maize noncompetitive in world markets. The solution lies in utilizing it as feed.

Sorghum (Sorghum vulgare). Sorghum is grown on one-quarter million ha. It is rarely used in the human diet. It is considered more satisfactory for beer-making than for food. The yield is high even on infertile soils or in areas of moderate rainfall and it is a drought-resistant. There is no market for excess sorghum so it can be utilized for livestock feeds.

Cottonseed cake. Cotton and coffee are the two major exports of Uganda. Cotton provides approximately 40% of the total value of the country's export earnings. The cotton crop produces on a normal year 142,240 tons of cottonseed, 18% of which is used for planting and the remainder for production of oil and oil cakes. The production of cottonseed cake is about 76,200 tons a year and is mainly exported to the United Kingdom for consumption as livestock feed (32). Very few farmers use cottonseed cake to feed their cattle.

The future of the cotton industry in Uganda is not too bright. In fact, the Uganda government is putting much effort on diversifying the agricultural economy instead of relying on coffee and cotton. Cottonseed cake is one of the high protein feeds in the country, but due to the uncertain future of the cotton industry, it cannot be recommended to form the basic high protein ingredient in cattle rations.

Groundnut cake. Groundnut is grown all over the country as a cash and food crop. It is mainly used for oil extraction and the by-product is sold as groundnut cake. Oil milling companies are more interested in oil and so the groundnut cake is of poor quality. There is a need to improve its quality. The future of groundnut production is promising as there are large overseas markets.

Soybean oil meal. Soybeans were first grown in Uganda in the 1940's. At first there was a good market overseas for soybeans but they have no market at present, so few soybeans are produced. The future of soybean oil meal as a basic high protein ingredient for dairy cattle rations is promising, provided feed processing plants are established to process the soybeans produced.

Feeding non-protein nitrogen such as urea or diammonium phosphate has not yet been practiced. Before farmers are advised to feed urea to cattle, they have to be taught the precautions required for its efficient utilization. Best and safest use of urea probably would be in commercial mixed feeds.

Blood meal, meat and bone meal. Plans to develop the beef industry are under way. Some areas of the country which were infested with tsetse flies (Glossina species) have been reclaimed and developed into beef ranches. One modern abattoir handling more than 200 carcasses a day is in operation. A second larger abattoir will be in operation in 1968. Manufacture of livestock by-products will be an integral part of the beef industry.

Brewer's grains. An economic survey of dairying in Uganda reported that 4 out of 55 farmers were feeding brewer's grains to their cattle (33). Although dairy farmers would like to utilize brewer's grains, there are two drawbacks that limit its use. It has to be fed wet which makes handling it difficult. Secondly, "The Uganda Breweries prefer to enter into a 12-month contract for the grains to be taken daily on a truck supplied by the customer" (33). The solution lies in formation of

farmers' cooperatives to handle cattle feeds and to start a brewer's grain drying plant.

Molasses. The sugar industry is well established in Uganda and in 1964 the production was 127,000 tons (24). In spite of that, little molasses is used as a cattle feed. Most dairy farmers are not aware of its nutritive value.

Coffee bean pulp is mainly used as a fertilizer for coffee and banana gardens. It is not used as a feed and no research has been done to find out its digestibility. In El Salvador it was found that coffee bean pulp is nearly as digestible as corn. Mixing it with molasses increases its palatability.

Sunflower seed. The possibility of growing sunflower for feeding to animals needs to be investigated. At present they are grown by a few people. They grow very well and, if taken care of, the yield can be high.

Dairy cattle management. The Uganda dairy farmer has to manage his cattle in an environment where ambient temperatures and humidity are high throughout the year. This means that he should take all economically justifiable measures that will reduce the total "heat load" of the animal or help to spread the "heat load" more evenly throughout the day. Methods of management, as practiced in Uganda, are based upon the temperate zone methods and so may be quite unsuitable to reduce the "heat load" of the animals.

Payne has suggested the following managerial practices as the ones likely to reduce heat load or spread it more evenly over the day (25):

"(a) Provision of rations that do not exceed optimal requirements particularly with regard to protein and fiber.

(b) Grazing only at night and not during the day and concentrate feeding during early morning or late afternoon.

(c) The provision of an adequate water supply both in the yards and on the grazings.

(d) Provision of natural or constructed shelter both in the yards and out of the grazings. It is essential to choose suitable material for shelter construction.

(e) Clipping of the coat of animals that are to be sheltered from solar radiation.

(f) Provision of water sprays, forced air fans, and a cooled water supply in the yards, bails or shelters, if the use of these practices can be economically justified."

Although for economic reasons it will not be possible to apply all the management practices suggested by Payne, some of them, in particular the first four, could be applicable in Uganda.

Calf raising. Calf raising on most farms in Uganda is unsatisfactory. Farmers rarely dry off a cow before she calves and secondly, calf feeding and management practices are poor.

Whereas a cow should be dried off two months before she calves, most farmers continue milking the pregnant cows as long as they still give milk. Thus cows are not allowed to make up their body reserves before they calve. Their ability to produce milk and suckle their calves is endangered.

According to Mahadevan (19), many Zebu cows refuse to let down their milk without the stimulus of the calf sucking and despite persistent efforts to draw milk from such cows, in absence of their calves no milk is obtained. This fact is well recognized by the farmers and has formed the basis of calf feeding practices in the country. Calves are allowed to suck for a few minutes and then cows are milked out. Usually calves are not given enough milk to satisfy their appetite so they become under-nourished.

Cattle improvement

Dairy farming is a business. To stay in business one has to make profit. In dairy farming this could be achieved through a combination of the following aspects:

Improving production through the control of diseases
and pests.

Improving production through feeding and management.

Improving production through breeding.

Improvement of production through control of diseases, pests, feeding and management has been dealt with in the previous sections. Even if diseases are controlled and feeding and management improved, still milk production cannot be economical unless the cows are good milk producers. This fact is demonstrated in Table 2. The cost of feeding one cow milking twelve liters is about one third less than the cost of feeding 6 cows each milking two liters.

The aim of every dairy farmer should be to have an efficient dairy herd composed of efficient cows. An efficient cow is considered to be

Table 2. Saving in feed required to produce 12 liters milk per day (37)

No. of cow	Yield per cow l/day	Feed requirement	
		S.E.* kg/day	D.C.P+ kg/day
6	2	21.96	2.32
4	3	15.66	1.88
3	4	12.51	1.56
2	6	9.36	1.24
1	12	6.21	0.92

*S.E. = starch equivalent

+ D.C.P. = digestible crude protein

the one which has moderately high milk production, drops her calf early, breeds regularly, is well adapted to her surroundings, has long life and passes all good qualities to her offspring.

As shown in Tables 3 and 4, the indigenous cattle of Uganda are low milk producers, and have a short lactation period when compared to the European breeds of dairy cattle. Even under improved feeding and management they still could not produce enough milk to be economical.(34). This led to introduction of the exotic dairy cattle, most of them being upgraded cattle and a few purebred animals. At present there is a rush for exotic cattle. This has led to many farmers buying scrub, low producing cows. As the price of milk is high, farmers still make profits from the poor yielders.

It is now the time to make farmers realize the importance of keeping only good producers. They can achieve this end by keeping records and selection for those traits associated with economic milk production.

Table 3. Means and variations of production traits of indigenous cattle in Uganda

Trait	Breed					
	Nganda (19)		Ankole (29)		Zebu (29)	
	Mean	C.V.	Mean	C.V.	Mean	C.V.
Age at first calving (months)	42	13	51.30	13	51.70	15
Length of lactation (days)	267	18	238	24	226	26
Length of dry period (days)	153	61	97	69	106	65
Length of calving interval (days)	420	21	342	14	347	14
Average daily milk yield (kg)	3.8	33	3.7	31	2.7	33
Lactation milk yield (liters)	1032	42	884	42	615	43

Table 4. Means and variations of production traits of European dairy cattle in Uganda (21)

Trait	Breed					
	Friesian		Jersey		Guernsey	
	Mean	C.V.	Mean	C.V.	Mean	C.V.
Length of lactation (days)	372.3	17.8	326.2	19.2	330.4	22.6
Length of dry period (days)	74.6	44.5	58.4	41.1	70.8	45.7
Length of calving interval (days)	446.9	16.6	378.6	17.3	401.3	20.2
Lactation milk yield (liters)	3199		2006		2309	

Indigenous cattle were on government experimental stations where standard of dairy husbandry is higher than on most dairy farms in the country. European cattle were on commercial dairy farms which is well managed.

Keeping of records. At present very few farmers keep performance records of their animals, even those who do so only keep milk records. In order to improve the milk production of individual cows, farmers have to keep history sheets of their cattle. A production chart shown in Figures 1 and 2 could provide the necessary information for both the farmer and the research worker. The information obtained acts as a guide in breeding, feeding, management and culling procedures.

Animal breeding plans. The Department of Veterinary Services and Animal Industry is trying to improve cattle through the following methods:

By distributing indigenous bulls of improved breeding to private, individual dairy farmers, often referred to as "progressive farmers".

Semen from improved indigenous bulls is used on indigenous cattle owned by progressive farmers.

Semen from exotic bulls is used on indigenous cattle for upgrading and on imported exotic cattle.

At the present stage of dairying in Uganda, it is not possible to recommend a definite plan of breeding to be applied all over the country. Standards of dairy husbandry differ in different areas. The possible approach to improvement of dairy cattle is to divide the country into two sections: The areas around Lake Victoria where standard of animal husbandry is advanced and the rest of the country where cattle keeping is nomadic. There is little information available from recently imported exotic cattle with regard to milk production and adaptation to environment. Grading up to European breeds proved successful in Kenya and is likely to succeed in areas around Lake Victoria provided disease can be controlled and animals fed and managed skillfully. Improvement

Details of transfer from farm to farm

Details of illnesses

MONTHLY MILK YIELDS

Year ____ Month	196__		196__		196__		196__		196__		196__	
	Milk kg	Fat %	Milk kg	Fat %	Milk kg	Fat %	Milk kg	Fat %	Milk kg	Fat %	Milk kg	Fat %
January												
February												
March												
April												
May												
June												
July												
August												
September												
October												
November												
December												

Figure 2. History sheet of cows

of cattle in other areas may continue to depend on distributing improved indigenous bulls or semen from these bulls for use on indigenous cattle. As the standard of animal husbandry improves, it may become possible to grade up with European breeds especially in areas around big towns and some parts in Eastern Province. The possibility of developing a new breed suited to Uganda conditions cannot be ruled out at this stage.

Milk goats

Dairying in Uganda should be approached with two objectives, namely:

To supply enough protein to the population and to enable farmers contribute to national income. The World Health Organization estimated that between 1 and 9% of the population up to the age of five years in developing countries suffer from "severe protein caloric deficiency disease", while it is estimated that from 30 to 60% of children between the ages of one and five years suffer from mild to moderate protein deficiency (37). Uganda is one of the developing countries and such conditions exist.

Milk goats can be a useful source of milk to the densely populated areas of Kigezi and Bugishu. Population is 150 to 350 inhabitants per km². These are mountainous areas where land for grazing is scarce. Tsetse fly infestation is light so goats can survive the infection. Unlike people living in other parts of Uganda, inhabitants of Bugishu and Kigezi use goat milk. Its introduction will not be a problem.

Anglo-Nubians and Toggenburgs were introduced in Kikuyuland of Kenya and they proved successful. Altitude and climate of both Bugishu and Kigezi are similar to those of Kikuyuland.

Farm mechanization

The hoe is still the only tool used on most farms in Uganda. Unless the standards of farming are improved no progress can be made in developing dairying. Farm mechanization is one means whereby farming can be improved. An interest needs to be aroused in farmers towards use of farm machinery. This may range from the moldboard plow, a cart for transport of manure and harvested crops, a chaff cutter for chopping green or dry roughages for cattle to farm tractors.

The Department of Agriculture has some tractors which are hired by farmers. This system should be encouraged. Formation of farmers cooperatives is another approach to solving the problem of mechanising the farms. Machinery suppliers need to be encouraged to conduct trials and demonstrations of available machines.

Provision of credit for dairy farmers

Establishing a well-planned, productive dairy farm needs a large sum of money which most farmers in Uganda cannot afford. They have then to look for financial help which may be in form of credit from credit agencies or subsidies from the government. The form of credit sought may be short-term, medium or long-term credit depending on the purpose for which it is demanded. The purpose may vary from payment of wages, taxes, to purchase of livestock, land and its improvement or new farm buildings. Government subsidies are often given to farmers to enable them to purchase materials for fencing the farm, install water facilities on the farm or to purchase milk utensils. A farmer has to meet part of the cost.

There are two credit agencies in the country--private commercial banks and the government operated Uganda Credit and Savings Bank. Commercial banks are of little benefit to dairy farmers. This is due to the greater difficulty in conducting business with small scattered borrowers and the greater trouble and risk involved. It is easier and more profitable for commercial banks to do business with industries in urban areas.

There are strong reasons why banks find it difficult and risky to extend credit to dairy farmers. Banks have to consider the nature and adequacy of the security offered and the farmer's ability to repay the loan. These will depend on (2):

1. The market value of the assets pledged as security should it be necessary to acquire them, because the farmer fails to meet this obligation. The security commonly offered is land. Most times it is too difficult to assess its value as farmers may have many fragmented holdings.
2. Capacity of borrower to earn income beyond the basic needs for subsistence which will determine his ability to meet interest charges and eventually repay the loan.
3. Size of the farm. Most of the farms are small in size and so the income is also small. In addition the farming enterprise is more of a family enterprise and less of a business undertaking which further reduces the income from farm.

"The Uganda Credit and Savings Bank was established in 1950 to assist in providing credit to Africans, by reason of the type of security they can offer and the type of loan which they require, cannot obtain financial assistance from commercial institutions" The bank acts

as agent for African Loans Fund which was established in 1954 to enable farmers who have no land to offer as a security to get loans (30).

The source of credit for farmers is limited. It is now the time for the farmers and government of Uganda to develop cooperative credit societies to promote savings and provide loans. The credit societies may be of two types--those dispensing short-term and intermediate loans and those providing for long-term credit. The length of the term depends on the investment a farmer wants to make.

It is impossible for the cooperative credit societies to have adequate capital to start with so the government should contribute to capital and management in the early stages. Members should be encouraged to save money so that they eventually pay back money contributed by the government. Members can save money through "direct deposits" either voluntarily or as a condition of membership, or through indirect deposit--deposit out of income accruing to members before it is distributed to them.

The goal of the cooperative credit societies should be to link credit, marketing and supply, so that better and wider services are provided to members.

Marketing Organizations

Marketing involves both milk collection and its distribution. The following problems should be borne in mind when one is planning to organize collection and distribution of milk in Uganda.

Milk production on a commercial scale started about 8 years ago on a few small dairy farms. A large area has to be covered before a

reasonably adequate amount of milk is collected. In a recent economic survey (33), it was found that 8 farmers in an area of approximately 650 km² produced 105 liters milk earmarked for sale; another 5 farmers in an almost similar area produced 70 liters.

Some dairy farms are far from milk markets. Communication by roads is difficult especially during the rainy season. Table 3 refers to the findings of the economic survey of dairying in Uganda (33).

Table 3. Distance from farm to nearest tarmac road

	5 km & under	6 - 16 km	18 - 32 km	Over 32 km	Total farms
Number of farms	27	19	7	2	55
Percent of total	49	35	13	4	100

On most farms, milk is produced under low standards of hygiene and so its keeping quality is short.

Temperature is high all the year round (15 to 30 C) in which case cooling of milk to reduce rate of deterioration is necessary. Many farms have no electricity so efficient refrigeration cannot be achieved.

Although water is available on most farms, its cleanliness is unsatisfactory.

Milk collection

The first step in trying to establish efficient means of collecting milk is to have it cooled soon after production. The amount of milk produced on individual farms is too small to warrant installation of

cooling facilities on the farm. Collecting centers provided with mechanical refrigeration at which milk from the farms can be delivered within 4 hours of production is preferable to cooling on the farm. Tentoni (31) suggested a chain of 4 milk collection centers for warm, developing countries, namely:

- milk collection points,
- milk collection centers,
- milk refrigeration centers
- and factories for processing milk.

A survey to estimate the actual and potential production of milk within the collecting radius of collection point, refrigeration center and milk processing plant should be carried out before these are established. In order to make a reasonable estimation, the survey should study (37):

- Marketable surplus of milk within specified radius and urban requirements.
- Distribution of households according to the number of cows kept.
- Distribution of animals according to age, production, age at first calving, length of lactations and dry periods.
- Feeding, its kind, quality and cost.
- Breeding resources.
- Marketing channels for milk and price trends.
- Human population engaged in milk production and location of extension centers for development of rural milk production.

Milk collection points. These should enable a rapid delivery of milk immediately after milking. They should be located in about an hour's walk. The building should be simple, but water and fuel for heating it should be provided so that milk containers are washed before pickup. Each farmer's milk should be weighed and filtered.

Milk collection centers. The essential goal of these centers is to centralize a sufficient quantity of milk for economic transportation to milk refrigeration centers.

Milk refrigeration centers. Milk should be refrigerated within 4 hr after milking. Location of these centers will depend on topography of the region, quantity of milk to be collected and the distance from the center to the milk factory. The main goals of the refrigerating centers should be; to filter all milk received and cool it to about 4 C, to clean all the milk jars and lastly to deliver all milk received from centers of collection to the truck that will transport it to the milk factory.

Milk factories will receive milk from refrigerating centers and from individual farmers who can deliver their milk within a short time after milking.

Methods for cooling milk

The main objective of cooling milk is to prolong its keeping quality, not to substitute for general hygiene during production or cleaning and disinfecting of milking equipment. This means that the

following factors have to be considered before one decides which method of cooling is to be used (18):

1. The rate of growth of bacteria in milk during the first 4 to 6 hr after production. Many bacteria do not multiply immediately after they gain entry to the milk. There is a lag phase during which there is no reproduction and when no metabolic products of growth are produced.
 2. The period of time from production to arrival at the milk factory or one of the milk collecting centers.
 3. The extent to which milk is infected with microorganisms during production.
 4. The economic aspects of the cooling method to be used.
- Concentration of the production units in an area and the availability and cost of cooling equipment must be taken into account.

Milk can be cooled by either natural water cooling or refrigeration.

Natural water cooling can be by use of a surface cooler or by in-can cooling. In a surface cooler milk flows by gravity over one side of a metal surface, the other side of which is cooled by the passage of cold water.

In-can cooling. The cans are immersed in cold water. There are some devices which cause milk to be agitated and cooled by means of rotating coil and water is sprayed on the outer surface of the can at the same time.

Surface coolers are inexpensive and can be economically installed on some farms, then the improved form of in-can cooling can be installed at both the milk collecting points and centers.

Refrigerated cooling. It can be by use of surface cooler or by in-can cooling.

Use of a surface cooler is similar to using natural cold water but supplied with water or brine previously cooled by mechanical refrigeration.

In-can cooling. The can is immersed in a tank of water which is continuously cooled by mechanical refrigeration. A device as described under natural water cooling can be supplied with water circulated through a mechanical cooling system.

Use of surface cooler combined with in-can cooling. This form of cooling milk is suitable for use at the milk refrigerating centers.

Milk distribution

At the present stage of dairying, it is impossible to collect and pasteurise all the milk produced in the country. In some areas there is so little milk produced that it is uneconomical to operate a pasteurizing plant. In pastoral areas collection of milk is difficult because of the seasonal migration of the nomads. The problem of milk distribution can be approached in three different ways:

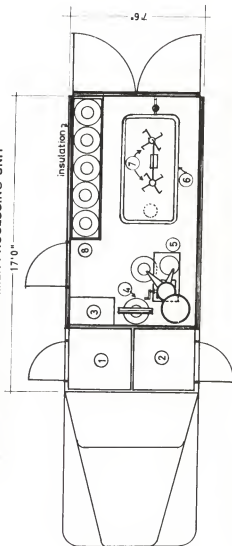
Area along the shores of Lake Victoria: Dairying is concentrated in this area. There are three pasteurizing plants each handling about 4,560 liters a day. The need is to organize milk collection as outlined

in the previous section and to establish more pasteurizing plants in big towns. In addition to pasteurizing plants, milk sterilization plants should be established. Sterilized milk can then be distributed to other parts of the country where milk supply is inadequate. Sterilized milk is easy to distribute as it can be carried over greater distances involving longer periods of time without provision of insulated or refrigerated vehicles.

Pastoral areas: It will take a long time to organize efficient milk collection and distribution in these areas. The nomads practice butteroil making as a cottage industry. This practice must be encouraged by establishment of butteroil collecting centers and refineries. Sterilized milk could be supplied to the urban population as a supplement to fresh milk sold by the nomads.

The rest of the country: The problem is to collect enough milk for pasteurization. Milk collection and distribution may be solved by using a mobile all-in-one milk processing unit fitted to a 5-ton truck (Fig. 3). This approach is used under bush conditions in Kenya (12). Organoleptic and clot-on-boiling tests are carried out on incoming milk. Milk which passes the test is cooled on surface coolers at rate of 360-450 liters/hr. Milk which is on point of turning sour is separated. Skim milk and cream are kept separate in five 45 liter cans on the side of the truck. Cream is cooled on the surface cooler after all milk cooling is completed. When the receiving tank is full, the steam is turned on and the milk is kept for 30 minutes at 63 C after which it is cooled to 7 C. Skim milk can be used for cheese making.

Fig. 3. MOBILE ALL-IN-ONE MILK-PROCESSING UNIT



- (1) Refrigeration
- (2) Steam raising equipment
- (3) Testing bench
- (4) 365/455 liters surface cooler

- (5) 275 liters milk separator
- (6) 1137 liters vat
- (7) mechanical agitators
- (8) Storage for 5 x 45 liters cans

Milk hygiene and regulations

Regulations concerned with milk do exist in Uganda but are rarely enforced. Many factors contribute to enforcement failure, namely:

Lack of trained staff and facilities. It is impossible say, to enforce "a 3.5% butterfat and 8.5% solids not fat for all milk sold in Uganda" unless there is a trained person to carry out examinations and a laboratory in which to do it.

Standards of education and hygiene of the public. The producer and any person distributing milk must first understand why certain standards of milk production and distribution must be attained. The consumer needs to understand what he buys and then demand it.

Before making regulations demanding milk distributors and farmers to attain a certain sanitary standard, it is important to first educate the public. Farmers and distributors will have to be advised and persuaded to improve sanitary standards of handling milk. Once their cooperation has been obtained, then regulations can be made. It may be more applicable first to enforce regulations on milk sold and distributed within urban areas and later in the rural areas.

Quality control of milk consumed in the country is not practiced. There is a need to start it as a means of improving the sanitary standards of milk handling and a basis for milk pricing. It can be started at milk pasteurizing plants and later on at milk collection centers depending on the availability of trained staff. Establishment of routine testing should start with the Ten-Minute Resazurin Test for quick rejection of unacceptable milk. Then as quality improvement progresses other tests can be carried out. These should include standard plate

count, fat test, sediment test, coliform tests and test for antibiotics.

Use of hydrogen peroxide as a milk preservative

Milk treatment with hydrogen peroxide and catalase is recognized as a highly efficient process of preserving milk (7, 11, 28, 31). It is cheap, requires no special equipment and permits consumption of milk without first cooling it. It meets the FAO requirements of an "ideal preservative". It could be recommended for use during the time of development of dairy industry in Uganda. However, there are strong objections against its use at the present stage of development.

As a milk preservative, it is recommended that hydrogen peroxide be added at the rate of 0.01% to 0.08% by weight, calculated as pure hydrogen peroxide. It is further recommended that to attain highest efficiency it should be added in the first hour after milking. Milk collecting points are the right places where it should be added to milk. It is very doubtful that farmers will have their milk preserved within an hour after milking.

Strict control measures are needed to ensure that hydrogen peroxide is kept in a cool place and that it is added to milk in the right proportion. Likewise routine checking has to be carried out at milk pasteurising plants to ensure that all hydrogen peroxide has been destroyed before milk is distributed. This is a costly administrative undertaking. It is preferable to use the money as subsidies to farmers to encourage clean milk production.

Farmers knowing that addition of hydrogen peroxide will increase keeping quality of milk may neglect clean milk production methods.

Likewise people concerned with collection and transport of milk may reduce the promptness with which milk is collected.

Addition of hydrogen peroxide to milk may give an impression that milk is free from all pathogenic bacteria in which case some people may consume it before boiling.

It is important that dairy farmers in Uganda be encouraged to produce clean milk. The government should allocate some money to subsidize farmers who install milk cooling equipment or any other equipment pertaining to production of clean milk.

Extension Programs

Education for dairy industry personnel

Uganda cannot hope to go far towards advancement in dairying unless it is prepared to train people to fill posts in all fields of the dairy industry. Every field of the industry needs trained personnel, but so far no dairy school has been established in the country. This need could be met easily by starting a dairy science department at the Veterinary Training Institute, Entebbe. This institute is in close proximity to the Animal Health Research Center and Livestock Experimental Station. The Veterinary Training Institute, Animal Health Research Center, the Dairy Industry and Livestock Experimental Station are all administered by the Veterinary Department. This would simplify its administration.

Students would take courses first in veterinary science, then some of them could be selected to take courses in dairy science and technology. On completion of these studies, they should be awarded a diploma in

dairying and posted as dairy extension workers or dairy personnel concerned with promotion of better milk production, handling and general milk sanitary standards. They could serve as milk inspectors at collecting centers and in factories.

During their training, students should be taught principles of human nutrition in addition to dairy science courses. This broadens the student's mind on the advantages of and importance of milk in human diet. With that knowledge, such students work effectively with women's organizations and schools in promoting use of milk in human diet.

The following points should be emphasized during training of students who will be dairy extension workers:

Their major objectives should be emphasized. They are concerned with communicating new ideas and practices in dairying from sources of origin, usually scientists, to farmers. Secondly, they have to try all possible methods that can lead to farmers adoption of those new ideas and practices.

As extension workers, they have to be well prepared academically and very conversant in their work. They should have an appetite for self improvement, that is, learning more knowledge from research in their fields and sorting out those new ideas or methods which could be applicable under certain circumstances.

They should work with the farmers, like them, and visit their homes. They should try to show the farmers that they are part of them. This makes farmers feel that extension workers care for their well being.

In working with the farmers, the dairy extension workers should find out the farmers' motives. After studying their motives they can then plan the program and the best way to get it over. In Uganda, generally the motives are economic security and education for the children. The extension workers should exploit those motives to change the farmer's methods of dairying. They should point out those factors that are limiting high milk production, such as diseases, poor feeding, breeding and management methods. They should be able to suggest alternatives, emphasizing the ones they think would be best but letting the farmer make his decision.

Extension workers should realize that farmers have different abilities, background, education levels and are in different age groups with varying experiences. Some farmers will readily adopt the new methods whereas others will be reluctant to do so. This means that extension workers have to develop educational programs to suit the majority of farmers in the country but these programs have to be within the framework of overall objectives.

It should be noted that the role of extension workers is to communicate with the farmers. For proper communication, one needs a source, a message, a channel, a receiver and a desired response. An extension message that fails to stimulate a response is wasted effort.

Programs proposed in the previous sections form the message which the dairy extension worker has to pass to the farmers. Many of the proposed programs are functionally interrelated. For example, an attempt to control tick-borne diseases as outlined under "Disease Control" section leads to pasture improvement which in turn can lead to improved

cattle feeding. Extension workers should aim at developing educational programs in such a way that accomplishment of one has a direct bearing on the next.

Extension workers will have to use various channels to disseminate the knowledge to farmers. The channels used will vary with the place and people. For example, at present the number of veterinary assistants working as dairy extension workers varies from one to five in a county. The approximate area of a county is 400-800 km². Consequently, direct communication with individual farmers is difficult. In some areas illiteracy is high, therefore teaching must be by audio-visual group methods--movies and colored slides.

Motivation of the farmers

Farmers have first to be aware of the new methods or practices. Then they become interested and so seek for more information about these methods. The information can be disseminated to farmers through radio broadcasts, television, farm magazines and newspapers.

Although mass media communication can make the farmer aware and interested in the new practices, it cannot make him adopt them. This can be achieved through organizing programs that can make the farmer evaluate the new ideas or practices, and then try them. Trial may be first on a small scale and later the farmer may accept them for full-scale and continued use. This is accomplished through organizing farmers' meetings, field trips, short courses and demonstrations, shows and competitions.

Farmers' meetings. Before meetings are announced, the extension worker should outline the program to a few influential people in the

community and try to get their support. These people should be mainly chiefs, clan officials, religious leaders and progressive farmers. Cooperation of chiefs, especially the village chiefs, is important if one has to communicate with the farmers. A series of meetings would be needed. It would help if meetings are well-publicized and well-timed so that maximum attendance can be achieved. The dairy extension worker should plan carefully every item before coming to the meeting. This gives him confidence in presenting the subject matter and at the same time he earns respect of the farmers. The first meeting would take the form of a lecture forum--information given out, followed by questions for clarification. Advantages that would result after adoption of the system should be emphasized. The fact that success largely depends on farmers' cooperation and hard work should be emphasized.

Field trips. Already there are some successful dairy farmers in the country. Arranging a trip to visit some of them would be easy. When planning the trip, the extension worker should make sure that farmers find it enjoyable and educationally stimulating. He should visit the dairy farmers well in advance. He could suggest to them some of the points he would like the farmers to emphasize to the visiting group. He should arrange for adequate transport, finance and meals. The main object of the field trip would be to stimulate desire and conviction that dairy farming is indeed their salvation. What they see should be clearly related to means of production, input, and corresponding output in terms of hard cash.

Short courses and demonstrations. There are thirteen district farm institutes in the country. These could be developed into dairy

farms so that short courses could be arranged for farmers. For example, a course may be arranged to enable farmers to acquire knowledge and appreciation of feeding elephant grass to stall-fed exotic cattle. During such a course, advantages and disadvantages of zero grazing elephant grass for exotic cattle should be pointed out. Emphasis should be put on height of grass to be cut, height above the ground to which it should be cut, frequency of cutting and amount to be cut for each animal per day. A visit to the stall unit should follow the lecture so that farmers observe the equipment and material used. The teacher should demonstrate the correct way of cutting the grass and chopping it into small bits. Each farmer should participate in cutting the grass and estimating amount consumed daily by the animal. A handout emphasizing the advantages of stall-feeding elephant grass and other important points should be distributed. It should also contain a complete input and output statement to illustrate the economics of the system.

Shows and competitions. Through competition and seeing what others can do, farmers can improve their standards of farming. The extension worker should try to secure finance from government and private organisations to purchase prizes and trophies for the winners. Winning farmers can then be motivated to work more on improving their farming methods. Shows should be organised at three administrative levels--county, district and national.

Young farmer's clubs. It is often difficult to persuade adults to change their ways of farming. It is important to develop youth programs. This can be achieved through organizing young farmer's clubs. Farmers with children participating in such clubs are likely to adopt new

farming practices. Schools should also be persuaded to establish dairy farms so that pupils develop a liking for the cow and her milk as well as an understanding for dairying.

A WORKABLE DAIRYING PROGRAM FOR UGANDA

Uganda can be divided into two distinct regions based on the present standard of dairy husbandry:

The Lake Victoria region: a strip of land 48 - 80 km wide extending around the shores of Lake Victoria. This is the region where revolution in livestock keeping has been started with keeping of the European dairy cattle. Out of 7,839 exotic cattle in Uganda, 6,463 are kept in this region.

The rest of Uganda where traditional methods of animal husbandry still prevail, cattle are kept primarily for social and prestige purposes and owners rarely realize their economic value.

Lake Victoria region

Now that a nucleus in commercial dairying has been started in the Lake Victoria zone, it is important that farmers should be helped and encouraged to start a sound dairy farming program. In fact, there are strong reasons why dairying in this area is likely to succeed, namely:

There is a good market for milk. The biggest cities, towns, schools, hospitals and industries are concentrated into this area. The people are relatively rich (24).

Formerly, farmers in this area depended on coffee for their income. They are now badly hit by the low coffee price and they are ready to invest heavily in dairy farming.

The climate favors herbage growth throughout the year. Rainfall is 1 to 1.8 m a year. Mean maximum temperature ranges from 27.5 C to 30 C and mean minimum temperatures are 15 C to 17.5 C.

Land tenure, unlike other parts of Uganda, is freehold in which case it is likely to promote an interest in productivity of the farm on a long-term basis.

The road system is far better than in other parts and so transport is easier.

Electricity is available.

Trypanosomiasis is not a serious problem. Glossina palpalis is the only tsetse fly specie occurring in this area. It transmits Trypanosoma vivax that causes a mild infection, so the presence of Glossina palpalis does not always prevent the keeping of cattle (32).

The artificial insemination service center with 10 subcenters is located in this area. Veterinary services are readily available. Tick eradication schemes are in progress.

Cooperative organizations are firmly established in the area. Such organizations are important in developing the dairy industry in Uganda.

Most farmers in the Lake Victoria region would like to own exotic cattle as they are more profitable than the indigenous cattle. They should be allowed to do so provided they fulfil all the requirements leading to effective tick eradication as outlined in section on "Disease Control."

In the past farmers have divided their farms into paddocks which are too small to lead to effective rotational grazing and farm mechanization. The time has come when the Departments of Agriculture, Land Surveys, Veterinary Services and Animal Husbandry should work together and establish an effective farm planning unit. The unit should be

charged with planning of farms to ensure orderly layout for maximum labor economy, mechanization and adequate rotation of livestock.

Farmers should be encouraged to improve the pastures through uprooting of undesirable grass species and planting nutritive grasses such as star grass (Cynodon species), Guinea grass (Panicum species) and Rhodes grass (Chloris gayana). Planting of elephant grass (Pennisetum purpureum) should be made a must on every farm for soilage especially during the dry season.

Application of fertilizers to induce increased grass yield is essential but should only be done under expert's advice. The agricultural department should open up soil testing laboratories at its divisional headquarters so that farmers who can afford to fertilize their land can do so.

No efficient milk production can be expected from underfed cattle. Importance of feeding is well-illustrated in a study carried out on dairy cattle in New Zealand. It was found that improved nutrition accounted for 57.4% in the improvement of butterfat production per cow over a 25-year period (26).

As little information is available on feeding of dairy cattle in Uganda, the pamphlet by Bredon, "Feeding of Livestock in Uganda" (5) will prove useful in working out cattle rations. In the past, the government has laid more emphasis on introduction of Channel Island breeds of cattle (Guernseys and Jerseys) which now form more than 75% of exotic cattle in Uganda. In this case the Guernsey Rationing Ready Reckoner shown below will be a useful guide for cattle rationing in the country. It was worked out by Barrett and is based on conditions existing in the tropics.

A Guernsey Rationing Ready Reckoner

Calculations are based on assumptions that a Guernsey cow weighs 455 kg with a 4.5% butterfat.

Type of grass	Liters of 4.5% butterfat milk (daily yield)								
	5.0	7.0	9.0	11.0	14.0	16.0	18.0	20.0	23.0
1	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	5.75A	8A	11A	14.5A
3	--	--	4B	8.5B	11B	14B	16B	20B	23B
4	2B	5B	7B	10.5B	13B	15.5B	17B	21B	22.25C
5	4.25C	7C	8.5C	10C	11C	14C	16C	17.5C	21.5C

Ration A

80 parts of cheap cereal such as corn and cob meal or
 48 parts of sunflower seed unhulled
 20 parts of an oil cake, such as cotton seed cake.

Ration B

25 parts of cheap cereal or
 15 parts of sunflower seed unhulled
 10 parts oil cake
 10 parts of cereal offal such as bran

Ration C

10 parts cheap cereal		8 parts sunflower seed unhulled
10 parts oil cake	or	7 parts oil cake
10 parts cereal offal		9 parts cereal offal

3% of a mineral mixture is added. The mineral mixture recommended for East African conditions is composed of the following ingredients

Ingredient	%
Bone meal	67%
Common salt	33.6
Copper sulphate	.4
Cobalt salt	.1
Potassium iodide	.01

Grasses

- No. 1 Grass at its highest feeding value, irrespective of species, 10 cm high and actively growing
- No. 2 A growing ley 15 - 25 cm high before it has reached the flowering age
- No. 3 Good grass in the middle of the growing season, after flowering
- No. 4 Fairly good grass after flowering or good grass in the early dry season
- No. 5 Standing hay in a 90 cm annual rainfall.

For cows whose milk yield is nearer 5% butterfat, 1 kg of feed is added. Those whose milk is only 4% fat are fed 2 kg less.

All rations fed with type 5 grass presuppose that 10 kg of "Maize and Legume" silage or grass is fed each day to a cow.

Management practices should aim at reducing the "heat load" from the animal. In this case it may be advantageous to provide shelters in the field for the animals. Shelters can be in form of shade trees

planted in an east-west direction or cheaply constructed barns. Farmers with few cattle could be advised to carry out indoor feeding. Whatever form of management is practiced, water should be available all the time.

A gap exists between amount of milk produced during the wet and dry seasons. This gap can be bridged by:

Advising farmers to make silage and to plant soilage crops, like elephant grass, so that animals get sufficient feed during dry season.

Spacing the breeding program so that few animals calve during the dry season.

The rest of Uganda

The urgent need is to make cattle owners realize the disadvantages of communal grazing. A step in the right direction would be persuasion to fence their land. Then, they could start practicing basic animal husbandry, such as pasture improvement, feeding, management and breeding. They should be advised to breed only those animals giving high milk yield. A few progressive farmers could be selected and provided with improved Nganda bulls to use on their high milk producing cows. It is hoped that such progressive farmers will form the nucleus of dairying in different parts of the country.

The urgent need to develop modern dairy farming in Uganda can be seen from the figures reported by the Permanent Secretary, Ministry of Animal Husbandry to the International Dairy Congress (17).

In 1965 milk and dairy products imported from Kenya were as follows: (35):

Liquid milk	14,675,000 liters
Fresh butter	521,000 kg
Dried milk powder	198,000 kg
Ghee	96,000 kg
Sweetened condensed milk	69,000 kg
Cheese	63,000 kg
Cream	12,000 liters

Estimated annual milk production is 364 million liters from indigenous cattle and 9 million liters from exotic stock. Exotic stock is about 3.5% of the cattle population. The population of Uganda is estimated to be 7,367,000 (1964) in which case milk consumption is about 52 liters per person annually.

There is no standard milk consumption that has been worked out by specialists in human nutrition in Uganda. Supposing the requirement is based on 284 ml per person daily as suggested in India (37) Uganda needs to double both the milk production and amount imported from Kenya. Although the situation looks grave, a solution can be found. It is through the combined effort of the farmer and the people responsible for planning the development of dairy industry, that Uganda can have enough milk and dairy products for its population.

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Proposed programs looking to development of dairying in Uganda were divided into three major groups: production, marketing and extension programs. Objectives of the programs were to find solutions to the factors limiting milk production and its distribution. Included in the production programs were improvement of pasture, feeding and management practices, farm mechanization and provision of credit for dairy farmers. Farm planning to enable rotational grazing, uprooting of undesirable grass species and increased use of fertilizers were suggested as the means whereby pasture should be improved. Use of elephant grass (Pennisetum purpureum), star grass (Cynodon dactylon) and rhodes grass (Chloris gayana) should be promoted as well as the commonly grown pasture legumes--Centrosema pubescens, Vigna gracilis and Stylosanthes gracilis. To supply enough feed to cattle during the dry season, use of elephant grass and sudangrass as silage crops and making silage from sorghum, corn, elephant grass and sweet potato vines must be encouraged.

Concentrates should be fed to increase production but maximum dependence should be on grass. Establishment of feed mixing plants is proposed to reduce feed importation and to encourage more production of feed ingredients. Corn and sorghum should form the basis of the ration while cottonseed cake, groundnut cake and soybean oil meal furnish supplemental protein. Feed ingredients should be those not used as food and more research into this field is suggested. Feeding molasses and brewer's grains should be encouraged.

Calf husbandry and management practices need to be improved. Provision of adequate water supply, shelters and night grazing are some of the management practices suggested to reduce the heat load of the animal during the day. Milk production records should be kept for the cows. Information obtained

from the record can be used for breeding, feeding and management decisions.

Formation of farmers' cooperative credit societies shall be encouraged. During early stages, the government should contribute to capital and management of the societies. Later, the farmers should pay back the money invested by government. Small isolated farms, poor roads, high temperatures and poor sanitary standards on farms are the factors limiting efficient milk collection and distribution. Establishment of milk collection and refrigeration centers would facilitate milk handling. Use of surface coolers at milk collection centers and a combination of surface cooler and in-can cooler at the refrigeration centers is suggested. Milk pasteurizing and sterilizing plants should be established in dairying areas. Areas where milk production is low, could be supplied with sterilized milk while dairying is being developed. A mobile all-in-one milk processing unit fitted on truck is suggested for use in collection and distribution of milk in areas where production is widely scattered. Use of hydrogen peroxide to preserve milk is not recommended.

Dairying could only advance if there were trained staff to manage the industry. Establishment of a dairy science department at the Veterinary Training Institute is recommended. It is emphasized that a close cooperation among dairy extension specialists, dairymen and research workers is needed for the development of dairy industry. Farmers could be motivated to adopt new ideas and practices through meetings, field trips, short courses and shows.

It is proposed that commercial dairying based on cattle of the European breeds should be developed in areas around Lake Victoria. Farmers in other areas should be encouraged to fence their land and base their dairying on improved practices with improved indigenous cattle.