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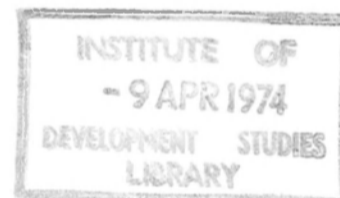
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SMALL HOLDER DAIRY FARMING IN UGANDA WITH
SPECIAL REFERENCE TO AN INTENSIVE DAIRY
SMALLHOLDING AT THE VETERINARY TRAINING
INSTITUTE, ENTEBBE.



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SMALL-HOLDER DAIRY FARMING IN UGANDA WITH SPECIAL
REFERENCE TO AN INTENSIVE DAIRY SMALLHOLDING AT
THE VETERINARY TRAINING INSTITUTE, ENTEBBE

by

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INTRODUCTION

Dairy farming is becoming a commercial enterprise for a growing number of farmers in Uganda. The Government of Uganda has encouraged dairy farming and dairy development through various schemes. Credit for dairy farmers and subsidies for making certain investments were instituted to encourage farmers to move into dairy production. In 1967, 19 dairy farmers in West Mengo received loans amounting to Shs.364,400 from the Uganda Commercial Bank, during the same period, 32 dairy farmers received Shs.367,200 from the same bank. (1, p.138). Subsidised equipment to livestock farmers was also made available by the Department of Veterinary Services and Animal Industry. Out of a list of 22 items, 15 were for dairy farmers.

The Second Five Year Plan projected an increase of milk production from 70 million gallons in 1965 to 105 million gallons in 1970/71. This goal was to be achieved by importing high quality exotic cattle, cross-breeding exotic with local cattle plus the introduction of better animal husbandry and management techniques. (2, pp. 71 and 72).

Artificial insemination service was started in 1962; in 1970 there were 24 pedigreed bulls of the Jersey, Guernsey and Friesian breeds at the Artificial Breeding Centre, Entebbe (1, p.47). Two years after the service began, 1665 inseminations were done on the 690 exotic dairy cows in the country. In 1968 there were an estimated 20,000 exotic dairy cattle and 8,648

inseminations were done, and during 1969/^{an} average of 1000 inseminations were done monthly. Since the service was started in 1960 over 50,000 inseminations were done and giving about 25,000 female exotic and exotic crosses offspring (1, p.48).

This estimate seems too optimistic because many times inseminations must be repeated before pregnancy occurs. Evidence from Kyaggwe county in 1965 shows that an average of 2.5 inseminations are necessary to produce a pregnancy. (7, p.179). If this were the case in recent years the estimate made by Nsubuga is too high.

There was an increase of 27.7 per cent of exotic inseminations during 1968. During that year, Nganda semen was withdrawn from distribution. Nearly 75 per cent of the 8,648 artificial inseminations in 1968 were from dairy breeds, including Jersey, Guernsey, Friesian and Brown Swiss bulls. In 1967, approximately 22 per cent of the inseminations were from Nganda semen, but in 1968 this was reduced to 3 per cent (3, p.14). The growing interest by Government and farmers in upgrading their dairy cattle has increased the demand for more dairy semen in the artificial insemination programme.

The introduction of high yielding exotic and cross-bred cattle on dairy farms generally requires a higher level of management than was needed with indigenous cattle. There is a need for trained manpower who can advise and work with farmers who are entering the dairy business. Farmers need to be taught these improved techniques of dairy herd and pasture management, so they can manage high yielding exotic dairy cows profitably. Small-holders will become more important in dairy production as diversification becomes more widespread.

This increases the need to have small-holding units at training centres as a means of training future field workers and also places greater demands on extension workers to have greater knowledge of dairy and pasture management.

This paper will briefly examine some of the recent research findings in small-holder dairy production in Uganda. The remainder of the paper will discuss the development and operation of the intensive dairy small-holding at the Veterinary Training Institute, Entebbe. This unit was used as a teaching unit for Training future Veterinary Assistants and Animal Husbandry Officers who will be employed as extension workers.

INTRODUCTION OF EXOTIC CATTLE TO UGANDA

The introduction of exotic or cross-bred cattle was necessary to make the commercial dairy farming in Uganda an economic enterprise. Exotic cattle were first brought to Uganda in 1928 on an experimental basis on research stations, but in a few months all died of one or several diseases. Cross-bred calves fared very little better. It was concluded that the climate and disease problems prohibited the existence of exotic cattle in Uganda.

The introduction of acaricides for tick control changed the emphasis in cattle management. In 1959 the Department of Veterinary Services and Animal Industry began a cross breeding programme using Jersey semen on Nganda cows, and reversed the old policy of breeding disease resistance in local cows (1, p.26-31). During the same year, pure bred exotic cattle were introduced on small scale African farms in Kyaggwe county and East Mengo District as pioneering work on tick control.

Exotic cattle numbers have been increasing in Uganda. In recent years the government has pursued a policy of making the country self-sufficient in fluid milk production in order to eliminate foreign exchange drains spent for milk purchases, as well as using dairy farming as a means of introducing mixed farming in Uganda. Exotic cattle were imported from Kenya with the first lot of 100 in 1960, increasing to a peak of 2,100 in 1963, a total of 8,853 exotic dairy cows were imported from Kenya between 1960 and 1968 (1, p.44). These cattle became more difficult to obtain from Kenya as that country began to use more of its available exotic cattle to develop the dairy enterprise as part of the mixed farming programmes in resettlement areas. The importation of only 738 exotic dairy cows was negotiated in 1968 (1, p.44). Uganda decided ^{to} purchase cattle from overseas at a higher cost, including 300 Fresian and Jersey cattle from the U.K. in 1967 and 800 Fresians from Canada in 1970. See table 1 for present and projected numbers of exotic dairy cows in Uganda.

Table 1. Showing Estimates and Projections of Exotic Cattle and their Milk Production, Uganda 1968-74

Year	Exotic Cattle in Milk	Milk Yield (thousands)
1968	15,000	37,125 (litre) 8,250 (gall.)
1971	30,000	74,250 (litre) 16,500 (gall.)
1974	60,000	166,500 (litre) 37,100 (gall.)

Source: (1, p.35).

MILK PRODUCTION ON UGANDA FARMS

Milk yield records are hard to obtain, and when they are available they have limited validity. It is well known that production differences between indigenous and exotic breeds are great. Cleave and Grimble (6, p.29) stated that records

on farms where Nganda and exotic cows were grazed in the same herd, showed the average yield, per lactation, from Nganda cattle at 69 gallons in 195 day lactations, and exotic cattle produced 403 gallons in a 263 day-lactation. Data on comparative yields of Nganda and Fresian cattle at the Livestock Experimental Station in Entebbe showed more favourable yields for indigenous cows (see table 2)

Table 2. Production Records of Uganda and Fresian Cattle Livestock Experimental Station, Entebbe, 1967

Breed*	Number of females	Average yield of Milk P.A.	Calving Interval
Uganda heifers	19	126 gallons	
Nganda Cows	42	210 gallons	444
Fresian heifers	25	764 gallons	
Fresian Cows	33	706 gallons	409

Source: Annual Report of the Department of Veterinary Services and Animal Industry

* Average age at first calving - Nganda 42 months, Fresian 30 months.

Estimated average yield for indigenous cows is 126 gallons per lactation. The estimated total production for Uganda was 305 million gallons in 1970 from this source (1, p.42). Nsubuga estimated that exotic cows' contributed an additional 15 million gallons in 1970. This is twice the estimated yield in the 1966/71 Five Year Plan.

The East African Livestock Survey (7, p.179) stated:

"The plans for the future expansion of milk production in Uganda make no provision for change in the average yield per lactation of the exotic cows, but anticipate a four-fold increase (between 1964 and 1971) in their numbers. By this means it is anticipated that 7.5 million gallons of milk annually will be produced from the exotic and grade herd by the end of 1970".

SMALL HOLDER DAIRY PRODUCTION IN UGANDA

Commercial milk production on small farms is becoming more important in Uganda and this trend will increase with continued government encouragement of mixed farming. Nsubuga (1, p.13) compiled a list of all dairy^{farms}/in three districts near Kampala and found there were 225 dairy farms of various sizes. Seventy per cent of these farms had between 3 and 10 cows and the average size farm was 7.68 hectares (1, p.145).

Grimble (5, p.44) found that 37 out of 49 small farms in Kyaggwe country, with exotic or mixed herds possessed under seven cows. He also found that exotic cattle predominated on dairy farms in Kyaggwe and Bugerere countries. Only 7.2 per cent of the 642 cows on farms surveyed were Nganda and 5.0 per cent were Nganda-Exotic crosses. Guernsey and Jersey were the predominant breeds, making-up 36.4 and 27.6 per cent of the total, respectively.

The introduction of exotic of indigenous/exotic crossed cattle presents many new management problems to dairy farmers. Improved pasture management is important to provide adequate grazing for high yielding cows, supplemental concentrate feeding is necessary to maintain high levels of milk yield. Pasture management and concentrate feeding management are critical factors in producing milk at the least cost. All these factors were considered in the management of the intensive dairy small-holding unit at the Veterinary Training Institute (V.T.I.). The performance of/^{this}unit will be discussed in detail later but in this section milk yield on this unit will be compared with reported result from other research findings on small-holder dairy farms in Uganda.

There are few studies which give an indication of milk yields on small holder farms in Uganda. Grimble (5, p.12) showed that cows on small farms included in his study are produced an average 1.1 gallons of milk per cow daily. The stocking rate was 1.8 acres per cow unit.

Nsubuga studied a sample of three size group of dairy herds which are broken into groups including; 3-10 cows, 11-30 cows and 31-100 cows (1, pp. 141-178). The smallest size group is in the size range of the V.T.I. small holding unit. However the stocking rate was considerably lower on the local farms than on the V.T.I. unit; 1.6 per cow, a compared to .5 acres on the V.T.I. small holding. The average size farm was 7.68 hectares (18.9 acres), compared to the 2.5 acres in the V.T.I. unit.

The monthly milk production in the 3-10 cow herds in Nsubuga's study had a monthly production of 129.9 litres (28.6 gallons) per cow. The distribution of breeds within this group was, 20.5 per cent Nganda 50.9 per cent Channel Island; 9.5 per cent Fresian, and the remainder were other exotics with a few Nganda/exotic crosses. The V.T.I. herd consisted of 2 grade-Jersey and 2 Pure bred Jersey.

Table 3. Average Daily, Per Cow, Milk Yield Reported in Various Research Findings on Small-Holder Dairy Farms in Uganda

Research Project	Year Reporting	Daily Milk Yield (gallons)
Grimble	1965	1.10
Nsubuga	1968	.93
Kabanyolo Small-holding	1969	1.09
V.T.I. Small-holding	1969	2.04

Sources: Grimble (5, p.12); Nsubuga (1, p.148); Kabanyolo Small-holding (8, p.1); and V.T.I. Small-holder Unit (9, appendix Table 2).

Note: In all cases but the study by Grimble milk production date was extracted from milk production records and farmers were visited often over a period of time. The Grimble study was a survey and information was collected by questionnaire in a short period of one month of field work.

The 11-30 cow farms had nearly the same monthly production, per cow (132 litres or 2 gallons per cow). This group of farms had 13.0 per cent Nganda cows and 40.3 per cent channel Island breeds, but the milk production per cow was not significantly different in the small farms. On the farms with the largest herds (31-100 cows) milk production was 197.2 litres (43.4

gallons) per cow monthly. There were no Nganda cattle in these herds which consisted of 64.9 channel Island breeds, and 34.1 other exotic breeds.

The Kabanyolo small-holding milk production was comparable to the findings in Nsubuga's study. The Half-Jersey produced 482 gallons in her 4th lactation and 308 gallons in her 5th lactation, while the Fresian produced 610 gallons in her first lactation (8, p.1). The average production of the V.T.I. small-holding herd was 598 and 678 gallons in the 1st and 2nd lactations respectively (9, pp. 6-7).

THE NEED FOR PRACTICAL TRAINING IN DAIRY MANAGEMENT

The need for training agriculturalists as future field workers in the practical aspects of dairy and farm management is paramount. This has been recognized in the diploma level agricultural College and has been suggested for University students. The Visitation Committee Report (10, p.41) states:

Paragraph 145: "From our visit to Kabanyolo Farm and from evidence we received, we were not satisfied that practical training given to students both at the farm and elsewhere was sufficient. We think that one of the reasons for this anomaly is the fact that students are expected to have had sufficient experience before embarking on the course. We feel this is unrealistic and recommend that practical training should be an integral part of the curriculum."

There is, in fact, practical training included in the curriculum, though it may not be sufficient to produce practical farmers. This is what was suggested later in the paragraph. This may not be a feasible objective in the time available to degree students in agriculture.

In paragraph 146 of the Visitation Committee report it is suggested to implement at the University what has

been done at Bukalasa and the Veterinary Training Institute:

Paragraph 146 (10, p, 141-142)

"We therefore recommend that a model farm should be established at Kabanyolo, which would be run entirely by the students supervised by their teachers and the Farm Manager. This farm should work as a commercial enterprise with proper input/output analysis and should be designed to supplement the training of students not only in the normal husbandry practices but more particularly how to run a farm for profit. Furthermore, the model farm, its buildings and equipment should, as far as possible be modelled on what is practicable in Uganda now and in the foreseeable future and can profitably be used by farmers throughout the country."

Several experimental small holding units have been developed over the years in Uganda. These small-holdings were mainly centred around crop or mixed farming units. One experimental unit was the 10½ acre farm with 3 high grade Friesian cows operated by 13 casual labourers and 3 permanent labourers at Kwanda. There were also small farms attached to the District Farm Institutes which are larger than the average farm in the area.

The experimental small-holdings at Kabanyolo and Luteete are farmed by tenants for their own profit, with the usual constraints of labour and capital that all farmers face. These farms are approximately the modal size for the area and are organized^{as}/similar to local conditions as possible. Emphasis is placed on improved farm organization and management plus liberal amounts of extension advice as key factor to success. One of the farms at Kabanyolo is based on horticultural crop production, and the other on mixed farming with a stall feeding dairy enterprise being the major source of income; a third farm based on intensive dairy small holding is presently being developed. These farms are used to teach extension to university students and serve as a basis for developing farm management experimental data.

Small-holding farm management research has been carried on in other countries. Jolly (12) stated:

"The need for well controlled farm management experiments are generally underestimated particularly in the tropics, Agricultural Science is concerned essentially with the technical details of farming and not with the organization of them into efficient units."

The marginal return to an innovation in a technically less advanced agriculture may be greater than from innovation in advanced agriculture. However, these innovations need to be tested in real situations. This was one reason for setting up the small-holdings at Kabanyolo, Bukalasa and the Veterinary Training Institute. Innovations may require some capital investment, but improved organization on the small-holding may be without cost and can lead to greater returns. The small-holdings at Kabanyolo and V.T.I. included a capital outlay, but attempts were made to keep them at a level of Uganda farmer can afford.

V.T.I. SMALL HOLDER INTENSIVE DAIRY UNIT

The experimental and teaching small holder units discussed earlier in this paper were based primarily on the use of improved farm organization and management of available inputs. There was no attempt to use large amounts of purchased inputs to raise the total production level. The V.T.I. unit was designed for high levels of production and income optimization through the intensive use of land and livestock, including large amounts of purchased inputs e.g. feed and fertilizer,

The objectives of this unit as a teaching tool were spelt out by Merinar (9) as follows:

1. To teach the practical aspects of dairy management.
2. To teach the practical aspects of pasture management.
3. To furnish an opportunity for staff members to evaluate students on their practical work.

4. To serve as a demonstration unit for farmers.

These objectives were more specifically related to one enterprise than those mentioned by Todd (11, p.177). The V.T.I. unit has incorporated as an objective the extension aspects, mentioned by Watts (4) in his discussion of the Kabanyolo small holding.

The V.T.I. small holding unit is an intensive dairy unit, containing only 2.50 acres of land, using student labour to carry out tasks and to make management decisions, under staff supervision. The unit was designed as a demonstration of the kind of unit some Uganda dairy farmers could duplicate. The buildings and fences were made of locally purchased material, which provided the students with practical demonstration and experience in construction of fences and buildings, and later in dairy management. Problems faced on this unit are similar to those they will face in the field.

The high rate of feed and fertilizer inputs allowed carrying capacity, or stocking rate, of two mature Jersey cows per acre. The projected performance is 750-800 gallons of milk per cow and a net return of Shs.6,000 from a 2.5 acre unit. This is considerably higher than the average performance reported in Nsubuga's study.

Prior to attending the Training Institute most students have had little or no experience with high yielding exotic dairy cows. The experience they gain in the day to day operation of this small holding will provide valuable expertise which they can use in the field upon graduation, on their entrance into the extension service.

They gain experience in dairy management as well as pasture management. The latter is very important if high yielding cows are to be used to full economic advantage. Most pastures in Uganda are not of good quality and are often not developed to full potential and are generally mismanaged. They, consequently, do not furnish the low cost source of high quality fodder that they could. The emphasis on high yielding dairy cows requires the maximum utilization of high nutrition fodder to minimize costs. Students have an opportunity to be involved the decisions relative to the production, management and rotational grazing of pasture in this intensive dairy unit.

Development and Management of the V.T.I. Dairy Unit

The funds for development were obtained in 1966 and work began in the middle of that year. All work, including land clearing, fencing, seedbed preparation, and construction was done by the students, under staff supervision, as part of their practical training in farm planning and development. The students gained experience in a wide variety of operations which will be useful later on the job, in their field work.

Land clearing included repairing and filling gullies which were the product of previous erosion, and the removal of large stone so the land could be ploughed. Soil samples were taken and tested to obtain proper fertilizer recommendations. The land was cleared of ticks with indigenous cattle which were sprayed once a week.

By May 1967 the pasture was fully established and cross fences were constructed to enclose the paddocks. The four Jersey heifers purchased in Kenya, were in place, with the first one calving in May and by December of that year the unit was in full production. The early development phase was now completed and students now had the responsibility of managing the cows and the pasture, under staff supervision. The practices which received most attention is listed below, but all are very important in a well managed dairy farm.

as a measure of the work done in the field during the year 1966-67

Feeding Practices

One of the most important elements in successful dairy management is proper feeding. The cows on this unit were fed individually for high production with major emphasis in maximizing an abundance of high quality pasture, which is the lowest cost source of nutrients. It is, however, physiologically impossible for a high milk yielding exotic dairy cow to obtain sufficient nutrients from pasture to maintain high production and to optimize milk yields. Supplemental concentrate feeding is necessary to have sustained high production throughout the entire lactation.

Energy supplied by concentrate meal is approximately 5 to 8 times as expensive as that from grass. The results at V.T.I. showed that approximately half the cost of producing milk was attributed to meal costs, therefore, wise management of meal feeding is very important. In young cows, (heifers in their first lactation) extra concentrate should be fed because they continue to grow during lactation. Concentrate must be fed in extra amounts, above maintenance and milk production, to ensure full body growth of young cows. Merinar (9) calculated the amount and cost of energy in the first and second lactations (see appendix tables 1 and 2). Concentrate meal was fed according to pasture condition and other factors which must be taken into account in good management practices.

(1) The amount and percent of fat in the milk. High yielding animals require large amounts of nutrients for milk production and high fat content milk requires extra nutrients. Merinar (11, p.11) estimated that Fresian cows, with 3.5 to 4 percent fat in milk, require 2.5 lbs. of starch equivalent per gallon of milk, while Jerseys, with 5.0 to 5.5 percent fat, require 3.0 lbs. of starch equivalent per gallon of milk. Fat is a high energy storage and requires more to produce. Farmers should consider this when selecting breeds of cows because milk in Uganda is sold by volume and not on a butterfat basis. Fresians are generally higher milk producers but because of their larger size require more feed for maintenance. It is usually considered that the extra milk production more than compensates for the extra maintenance requirements.

2. Stage of Lactation is another important consideration in feeding practices. The practice used at V.T.I. is to feed concentrate above milk production and maintenance during the first two months of lactation. This practice, called lead feeding, consists of feeding 2 pounds of concentrate meal daily above maintenance milk production and growth (in heifers). This practice encourages cows to increase milk yield to their maximum level and to have a higher total level of milk production throughout the entire lactation. This practice is especially valuable in Uganda where the milk price relationship is so favourable.

3. Age of the Cow: Heifers that calve at an early age require nutrients for growth as well as maintenance and production. The Jersey heifers at the V.T.I. unit calved at approximately 2 years of age. During the first lactation they were fed 3 lbs. of concentrate (1.92 lbs. of starch equivalent) daily, above maintenance and production. This was reduced to 2 lbs. (1.20 S.E.) per day for the same purpose, in the second lactation.

It is also a good management practice to feed 1-2 lbs. of meal daily several months before calving. This practice is important to get the heifer or cow in good body condition before parturition.

4. Body Condition is important during lactation. Cows should be fed adequate amounts of concentrate to keep the body in fit condition. Unfit cows produce at a lower level and are more susceptible to disease and parasite infection. All the above considerations are important, as feeding is the key to high levels of milk production in cows with high yield potential.

Milking Practices

Milking proficiency and regularity of milking time are important factors in good dairy cow handling. The cows at V.T.I. were used to teach students how to hand milk, this, undoubtedly, had some lowering effect on milk yield. Care was always taken to minimize improper handling of the cows.

Table 4 Cost of Rearing Jersey Heifers Calves at V.T.I. Small-holding, 1967

<u>Growth</u> No. of Animals	Average Birth Weight	Weight at 30 days	Weight at 90 days	Weight at 180 days	Average Deity Gain
3	46.5 lbs	68 lbs	133 lbs	160 lbs	0.63 lbs

Feed Consumption and Cost for 180 days per Calf

<u>Item</u>	<u>Amount (lbs)</u>	<u>Cost (lbs)</u>	<u>Total Cost (shs)</u>
Milk	76	-/40 per lb.	30/40
Milk replacer	57	1/68 per lb.	95/76
<u>Concentrates</u>			
Young stock feed	91.7	shs. -/27 per lb.	shs. 24/76
<u>Dairy Cubes</u>	396.0	shs. -/24 per lb.	<u>shs. 94/45</u>
<u>Average Cost Per Calf</u>			<u>shs. 245/37</u>

The economics of rearing exotic heifer dairy calves may be sound if grazing is available and if they are reared in good condition which will produce high quality dams. At the present time high quality exotic cows are expensive and difficult to obtain in Uganda, but the opportunity cost should be carefully considered when rearing followers. The method used at V.T.I. was the least costly but Merinar (9, p.13) stated that the health and general appearance of replacer fed calves is not generally as good as milk fed calves. He states they are more susceptible to parasite infestation and nutritional deficiencies when reared on milk replacers.

Pasture Management

When the small-holding was developed, the grazing area was ploughed and seeded to high yielding grasses. Elephant grass was planted for dry season fodder in one of the 4 leys, but was later removed when this practice proved unnecessary. Paddocks containing grass mixtures provide fewer grazing management problems than elephant grass.

Fertilizer was applied to maintain high levels of grass growth for sustain^{ed} high milk production. The soil was tested once a year to determine acidity and nutrient levels. Phosphate and potash are applied as needed, usually once a year.

Nitrogen is the most critical element in maintaining high levels of grass growth. It is the most costly input and application should be managed to minimize cost and optimize grass production. The element was usually applied after grazing each paddock, at which time the grass was slashed and dung was spread. The amount of nitrogen applied depends on several factors, when grass is abundant, approximately 15 lbs of actual nitrogen per acre is applied. When greater response is needed up to 30.5 lbs. of actual nitrogen is applied. This is usually done near the end of the dry season to ensure maximum response and growth at the time when grass yields could be low or insufficient to supply plentiful grazing (9, p.14).

During the first lactation a total of 340 lbs. of actual nitrogen costing Shs.340/- were applied. This is a rate of 130 lbs. per acre or 81 lbs. per cow. During the second lactation a higher input of nitrogen was used, a total of 390 lbs. of actual nitrogen costing Shs.409/50 was applied. This amounted to 156 lbs. per acre or 98 lbs. per cow.

Economic Performance of the V.T.I. Unit

Exotic dairy cows require inputs purchase for cash, in the form of concentrate feed and fertilizer for the pasture to maintain high milk yields. Many small holders do not maximize profits from their dairy cows because they do not have the cash available or have so many financial obligations to their household that they do not purchase the required inputs needed to reach that level. The V.T.I. unit was operated as a dairy unit without the usual family requirements for cash, so inputs were purchased as needed.

Milk yields per cow increased from the first lactation to the second, because the cows were mature during the second lactation. The average production rose from 598 gallons to 678 gallons per cow. (For individual cow performance see appendix tables 3 and 4).

Concentrate feed and pasture costs were calculated on a starch equivalent basis and values were applied to see the relative costs of concentrate and pasture feeds (see appendix tables 1 and 2). The first lactation required 4.3 lbs. of feed per gallon of milk because the cows

were given extra feed in order to maintain body growth above normal maintenance and production. The cost of concentrate per gallon of milk was Shs.1/03 (appendix table 1). These requirements dropped to 3 lbs. of feed per gallon of milk in the second lactation and meal cost had a subsequent reduction to Shs.-/759 per gallon (appendix table 2).

In the first and second lactations 59 and 66 percent of the starch equivalents respectively, were obtained from pasture. This reduced production costs because starch equivalent per gallon of milk which were obtained from pasture at a cost of Shs-/08 per pound during the first were reduced to Shs-/055 during the second. Starch equivalent cost for concentrate meal remained constant at Shs.-/40 over the period, however total energy cost per gallon fell because a greater proportion of the total feed input was supplied by grazing.

Total concentrate feed inputs were reduced from 10,095 lbs. to 8,806 pounds over the two years because the feed requirements for growth were reduced when the cows matured. During this period total milk yield increased from 2,392 gallons to 2,713 gallons (appendix tables 3 and 4).

Fertilizer costs were higher during the first lactation because there was an input of ca. and phosphate which were not needed the second year. The input of larger amounts of nitrogen and potassium the second year were needed to sustain the greater pasture requirements of four cows. Despite greater expenditures on these two elements, total fertilizer cost fell from Shs.646/- to Shs.532/- and feed cost per pound of starch equivalent were reduced. (see appendix tables).

Depreciation cost were included as a fixed item. The cows will be depreciated over 6 lactations. Buildings, and dairy equipment were estimated to have a ten year life and pasture was depreciated over four years. Annual depreciation cost was Shs.1150/- and accounted for 23 per cent of total cost (see tables 5 and 6).

Total and net revenue: figures were calculated for each individual cow. Milk prices were estimated at an average of Shs.3/50 per gallon, which is a bit lower than the standard price farmers receive. There was some variation in milk yield between the cows; thus total revenue varied accordingly. Concentrate inputs varied according to milk yield, but fertilizer and depreciation were averaged over the herd; the per gallon cost of milk production was inversely related to the level of output. The cow yielding 711 gallons of milk in the first lactation had a cost of Shs.1/84 per gallon and produced a net revenue of Shs.1/67 per gallon. On-the-other-hand the grade-Jersey which was the lowest producer (551 gallons on 1st lactation) had production cost of Shs.2/31 per gallon and produced a net revenue of 1/19 shillings per gallon.

Total concentrate feed costs were lower in the second lactation than in the first; average feed cost per gallon was lower because all cows (but one whose lactation fell when she was sick) had higher total milk yield. Another factor was the greater proportion of the starch equivalents where consumed from pasture which cost only one-eight as much per unit as when obtained from concentrate. Feed was the largest cost item. 51 and 48 percent in the 1st and second lactations, respectively. Fertilizer was only 12 percent of total cost and was the basis for the production of low cost grazing (see tables 5 and 6).

Table 5. Total and Proportionate Costs of Inputs During the First Lactation of the cows at the Small-Holding Dairy Unit at V.T.I. 1968.

<u>Item</u>	<u>Amount</u>	<u>Appx. % of Total Cost</u>
Feed	2,554/-	51%
Depreciation (cow)	960/-	19%
Misc. dairy supplies	672/-	15%
Fertiliser	647/-	12%
Depreciation (Buildings & Equipment)	130/-	2%
Depreciation (leys)	60/-	1%
	<u>5,023/-</u>	<u>100%</u>

Table 6. Total and Proportionate Cost of Inputs During the Second Lactation of the Jersey cows at the V.T.I. Dairy Small-Holding, 1969.

<u>Item</u>	<u>Amount</u>	<u>Appx. % of Total Cost</u>
Feed	2,227/-	48%
Depreciation (cows)	960/-	20%
Misc. dairy supplies	720/-	16%
Fertiliser	532/-	12%
Depreciation (Buildings & Equipment)	130/-	3%
Depreciation (leys)	60/-	1%
	<u>4,629/-</u>	<u>100%</u>

The total revenue was Shs.8372/- and Shs.9495/- in the first and second lactations, Variable Costs, consisting of feed and fertilizer and dairy supplies amounted to Shs.3872/- and Shs.3479/- shillings in the respective lactations, leaving a gross margin of Shs.4500/- during the first lactation and Shs.6016/- during the second. After subtracting the depreciation cost the net margins remaining were Shs.3350 and Shs.4,866, respectively (see appendix tables 3 and 4). This represents a higher net return from 2.5 acres of land than is generally experienced by most dairy producers in Uganda. An enterprise of this type could engage the resources of an entire family with a small landholding and provide a reasonable level of income, or it could be a supplemental enterprise on a mixed farm. The labour and management requirements are quite intensive and to earn returns equal to those on the V.T.I. unit, there should be the minimum amount of competition for these inputs. Labour and management are often considered the greatest constraints to intensive types of production.

Conclusions

The dairy industry in Uganda is growing rapidly and an increasing number of small-holders are entering commercial dairy farming. The potential for profitable small scale dairy production under intensive management is feasible. The key factor to success in such an enterprise is

dairy cow and pasture management, farmers who introduce exotic or crossbred dairy cows will usually have to raise their level of management, which includes an increase in disease control and in the purchase of inputs e.g. concentrate feed and fertilizer, if they want to optimize profits.

The experimental small holding used at training institutions, in the past, were primarily concerned with increasing income by better farm organization, wiser choice of crop and livestock enterprises and improved management. The intensive dairy small holding unit at the Veterinary Training Institute concentrated on teaching the techniques of exotic dairy herd management and pasture management. This included the purchase of large quantities of fertilizer and feed in order to optimize milk yield at minimum cost. Pasture management was emphasized because this is the least costly source of energy and is necessary to maintain sustained milk production. Grazing was only one-fifth to one-eighth as costly as concentrate feed.

The high level of management, control and relatively heavy cash expenditures for inputs related to the net margins is an illustration of the potential returns from a small area of land, intensively managed. This unit should illustrate to students possibilities for small holder dairying in Uganda and will be of value to them in the extension service. The V.T.I. unit is perhaps not the optimum but produced a better than average net return from a $2\frac{1}{2}$ acre area used for dairy production. The comparisons made in this paper, between the V.T.I unit and other small holder research findings indicate that the need for improvement in small holder dairy management is great, if the general level is to be raised to this level. The need for trained manpower and high levels of expertise in a developing dairy industry is important to the future dairy industry of Uganda. The V.T.I. intensive small holder dairy unit should make a valuable contribution in this area.

Appendix Table 1.

Source, Amount, and Cost of Energy Required During 1st Lactation
at V. T. I. Small-Holder Intensive Dairy Unit, Entebbe*

Milk produced = 2392 (gallons) x 3.0 (S.E./Gallon) = 7,176 lbs.S.E.
Maintenance = 1228 (Cow days) x 5.0 (S.E.Req./Maint./Day) = 6,140 lbs.S.E.
Growth = 1228 (Cow days) x 2.0 (S.E.Req./Growth/Day) = 2,456 lbs.S.E.

TOTAL ENERGY REQUIREMENTS = 15,772 lbs.S.E.

S.E. obtained from Meal = 10,095 x .64 = 6,460.8 lbs.S.E.

S.E. obtained from pasture = 9,311.2 lbs.S.E.

$\frac{9,311.2}{15,772.0} \times 100 = 59\%$ S.E. obtained from pasture
= 41% S.E. obtained from meal

41% S.E. Req. from Meal costing Shs. 2,554/- = .40/lb/S.E.
59% S.E. Req. from Pasture " Shs. 706/50 = .08/lb/S.E.

$\frac{\text{Gallons Milk}}{\text{lbs. feed}} \text{ Ratio} = \frac{1}{4.3}$

(Meal Cost per Gallon = Shs. 1/03)

Note: Requirements based on:

5.0 Starch Equivalent/Day/Cow/Maintenance
3.0 " " /Gallon/Jersey milk
2.0 " " /Day/Cow/Growth

*Source (9, P 9)

Appendix Table 2.

Source, Amount and Cost of Energy Required During
2nd Lactation at V.T.I. Small-Holder Intensive Dairy Unit,
Entebbe**

Milk produced	= 2710 (Gallons) x 3.0 (S.E./Gallon)	8,139 lbs.S.E.
Maintenance	= 1374*(Cow Days)x 5.0 (S.E.Req./Maint./Day)	= 6,870 lbs.S.E.
Growth	= 1374 (Cow Days)x 1.0 (S.E.Req./Growth/Day)	= 1,374 lbs.S.E.
TOTAL ENERGY REQUIREMENTS		=16,383 lbs.S.E.
lbs. S.E. obtained from Meal	(8,806 x .64)	= 5,636 lbs.S.E.
lbs. S.E. obtained from Pasture		=10,747 lbs.S.E.

$\frac{10,747}{16,383} \times 100 = 66\%$ S.E. obtained from Pasture
 $\frac{5,636}{16,383} = 34\%$ S.E. obtained from Meal

Cost of S.E. from Pasture = $\frac{592}{10,757} = .055/\text{lb.}/\text{S.E.}$
 " " " " Meal = $.40/\text{lb.}/\text{S.E.}$

$\frac{\text{Gallons Milk}}{\text{lbs. Meal Fed}} \text{ Ratio} = \frac{1 \text{ Gallon Milk}}{3 \text{ lbs. Feed}}$

(Meal Cost Per Gallon = .759)

(* Includes 45 day dry period)
 (per Cow)

* Source (9 P. 10)

APPENDIX TABLE 3. Showing Milk Yield, Cost and Returns from the V.T.I. Intensive Dairy Small Holder Unit,
Second Lactation, 1968.

Cow No.	MILK AND MILK FAT YIELDS								COSTS							RETURNS				
	Breed	Lact. No. and Age	Days in Milk	Milk Fat		Milk Yield		Feed		Fertiliser		Depreciation			Misc. Supplies	Total	Gross Margin*	Net Margin	Cost/Gall.	Net Margin/Gall.
				%	lbs.	Amt. in Galls.	Value	Amt.	Value	Amt.	Value	Cow	Elds. & Eqpt.	Past.						
1	Grade Jersey	1st.lact. @ 2 yrs. & 1 mth.	288	4.5	257	572	2002/-	2500	632/50	81.0 N Ca. 25.0 P 32.5 K	85/- 38/- 22/- 16/- 161/-	240/-	32/50	15/-	168/-	1249/-	1040/50	753/50	2/16	1/34
2	Grade Jersey	1st.lact. @ 1 yr. and 11 mths.	292	6.0	351	551	1928/50	2595	656/50	"	161/-	240/-	32/50	15/-	168/-	1273/-	943/-	655/50	2/31	1/19
3	Pure-bred Jersey	1st.lact. @ 1 yr. and 11 mths.	307	5.3	296	553	1953/-	2300	582/-	"	161/-	240/-	32/50	15/-	168/-	1198/50	1042/-	754/50	2/15	1/35
4	Pure-bred Jersey	1st.lact. @ 1 yr. and 8 mths.	341	4.9	348	711	2488/50	2700	683/-	"	161/-	240/-	32/50	15/-	168/-	1299/50	1476/50	1189/-	1/83	1/67
TOTAL			1288	Av. 5.2	# 1232	2392	8372/-	# 10095	2554/-	324.0 N Ca. 100.0 P 130.0 K	340/- 153/- 88/- 65/-	960/-	130/-	60/-	672/-	5020/-	4502/-	3352/-	Av. 2.11	Av. 1.39

Feed Cost @ -/253 per lb.; Milk @ 3/50 per gallon; Fertilizer Cost - Nitrogen = 1/05 per actual lb. N.
Phosphate = -/88 per actual lb. P₂O₅
Potash = -/50 per actual lb. K.

* Gross Margin was calculated by subtracting the cost of feed, fertilizer and miscellaneous supplies from milk revenues.

Appendix Table 4. Showing Milk Yield, Cost and Returns from the V.T.I. Intensive Dairy Small Holder Unit,
Second Lactation, 1969.

Cow No.	MILK AND MILK FAT YIELDS										C O S T S				R E T U R N S					
	Breed	Lact. No.	Days in Milk	Milk Fat		Milk Yield		Feed		Fertiliser		Depreciation		Misc. Supplies	Total	Gross Margin*	Net Margin	Cost/Gall.	Net Margin/Gall.	
				%	lbs.	Amt. in Galls.	Value	Amt.	Value	Amt.	Value	Cow	Blds. & Eqpt.							Past.
1	Grade Jersey	2nd lact.	327	4.5	307	682	2387/-	2036	515/-	97.5 N 62.5 K	102/50 30/50 <u>133/-</u>	240/-	32/50	15/-	180/-	1115/50	1559/-	1271/50	1/65	1/90
2	Grade Jersey	2nd lact.	35*	6.0	44.5	744	2604/-	2400	607/-	"	133/-	240/-	32/50	15/-	180/-	1207/50	1684/-	1396/50	1/62	1/89
3	Pure-bred Jersey	2nd lact.	295	5.5	315	*575	2012/-	2120	536/50	"	133/-	240/-	32/50	15/-	180/-	1137/-	1162/50	875/-	2/-	1/50
4	Pure-bred Jersey	2nd lact.	34 ^o	4.9	349	712	2492/-	2250	568/50	"	133/-	240/-	32/50	15/-	180/-	1169/-	1610/50	1323/-	1/64	1/86
T O T A L			1229	Av. 5.2	1417	2713	9495/-	# 8806	2227/-	390# N 250# K	532	960/-	130/-	60/-	720/-	4629/-	6016/-	4866/-	Av. 1.73	Av. 1.77

* Cow No. 3 - Production lowered during 2nd lactation due to throat infection

** Gross Margin was calculated by subtracting, the cost of feed, fertilizer and miscellaneous supplies from the milk revenue.

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