IRISH AID PROGRAMME IN MAHENGE - ULANGA

FEASIBILITY STUDY OF THE EXPANSION OF THE DAIRY CATTLE PILOT PROJECT

FINAL REPORT

June, 1999

BACAS
Bureau for Agricultural Consultancy and Advisory Service
Sokoine University of Agriculture
P.O. Box 3001, Morogoro
Tel: (056) 4617; Fax: 4562 or 3718; E-mail: SWMR@twiga.com

EXECUTIVE SUMMARY

1. Project description

The pilot dairy project which is financed by the Irish government in Vigoi division began in December 1996. Dairy cattle were distributed in two phases. Phase one involved 24 farmers who received F_1 heifers and phase two involved 32 farmers who received Boran cattle. The overall goal of the Project is to raise living standards in Ulanga district, especially of the poorer rural households.

2. Major findings and conclusions

i) Impact of the project

- Though it is too early to evaluate the impact of the project, preliminary results of the evaluation after two years of the project show increased income among farmers with cows which have calved down. Income has been earned through sale of milk, manure, animals and from bull service fees. In this respect the project has contributed toward poverty alleviation in the project area.

- In all households, introduction of dairy cattle has increased work load. The additional work load has more or less been evenly distributed to men and women. However, considering the fact that women already have more family obligations, it implies that their work load is still much higher compared to men.

- The project has, to some extent, reduced rural un-employment among youths, has increased milk consumption to an estimated figure of 74 litres per capita / per annum and thus improved human nutrition of the dairy producing households as well as the community. The project has imparted positively on environment in the villages where use of manure in crop enterprises enhance nutrient cycling. No negative impact on the environment has so far been observed.

ii) Animal Husbandry

- So far there have been low incidences of cattle diseases and mortalities. Milk production levels among F_1 and Boran cows are encouraging. Mean calving interval (of 516 days) is long yet comparable to performance in other similar dairy development projects in Tanzania.

- Artificial Insemination (AI) has been too expensive and should be abandoned. However the bulls bought were too few. Comparing the F_1 and Boran system of raising pass-on heifers, the latter has so far performed very badly because over 70% of them have not yet calved.

iii) Project management and training

There have been no project files nor meetings. There has not been even some regular internal evaluations. Both farmers and project staff have been trained but the training was inadequate. Project staff lack exposure on how to manage a smallholder dairy development project.

iv) New project sites

- Lupiro and Mwaya divisions have shown to have large milk supply deficits. Moreover there is abundant natural fodder and high potential for pasture development. The other two divisions Malinyi and Mtimbira, with high local cattle populations, have shown low milk supply deficits. They could still rely on local cattle milk supply. Fodder availability and development potential is lower than Lupiro and Mwaya.

3. Recommendations

i) Training

- Extension workers should visit Tanga smallholder dairy development project for one month to study dairy recording practices and monitoring.
- Farmers should visit Tanga or Moshi on a farmer-to-farmer exchange program. There should be on-farm field days where certain specific topics are discussed based on what they see on that farm. Further, VEOs could organize village seminars on identified topics at no cost.

ii) Selection of farmers

Selected farmers should be capable of investing on a good cow shed, basic equipment required in a dairy farm and on treatments. Distance between farmers be considered for ease of movement of bulls and VEOs.

ii) Low conception rates

- Monitoring of individual cows be strengthened by VEOs and farmers. More training is required on this aspect.
- Number of bulls to be increased from the current two to seven. Each village should have a bull.
- AI be abandoned till such a time when heat detection and management has improved or the project intends to raise replacement bulls from the farmer's herds.
- Supplementation for minerals especially phosphorus has to be encouraged.

iii) Input supply

- Organize farmers into a farmer association /cooperative which can buy a variety of inputs (minerals, drugs, concentrates, acaricides, syringes, etc) for all the farmers.
- To provide a revolving fund whose monitoring should be rather strict.

iv) Dairy cattle recording system

- Design a simple recording system which farmers and VEOs can use. VEOs and farmers can thereafter have a two days seminar to discuss in detail the introduced recording system.
- Regular project meetings be introduced. Across village evaluations be done to assess efficiency of VEOs.
- Measuring of milk yield be done volumetrically but it will be good if it will be standardized and recorded to the nearest half or preferably quarter a litre. The project can provide uniform plastic containers for that purpose.

v) Maintenance of exotic blood level in cows

There is undisputed evidence from the tropics that cows above 75% exotic blood do not perform well because farmers cannot offer them the management they require to exhibit their genetic potential. It is recommended that 75% exotic inheritance bulls be used on F_1 cows so that the progeny will have 62.5% exotic blood. Efforts should be made to maintain the exotic level between 50 and 75%.

vi) Feeding of dairy cows and pasture development

- Extension officers should frequently insist on proper feeding of cows including provision of ad lib water, mineral supplements and concentrates.
- Farmers be encouraged to use and store crop residues as a feed resource.

- Compared to Chloris gayana, elephant grass is a better grass species. Where water supply is plenty, Guatemala grass is recommended. Inclusion of legumes in pastures will improve soil fertility at the same time improve the nutritive value of the herbage.

vii) Disposal of bulls from project farmers

- F_1 bulls from Boran cows should (if possible) be sold at a young age or be raised for beef hence they have to be castrated.
- Bulls from F_1 cows will have 75% exotic blood but not all bulls will be good for breeding purposes. Good dam milk yields and good growth rate of the bull himself (based on heart girth measurements) could be good criteria for selection.

viii) Animals to pass on in the Boran system

Some farmers prefer to pass on the F_1 heifer born from the Boran cow rather than the Boran cow herself. Since the signed contracts state that the cow be passed on, at this juncture it may be wise to give farmers free choice between the two alternatives.

ix) Calf feeding system

Because of the advantages of partial suckling mentioned earlier, it is recommended that VEOs urge farmers to practice this method. It is even more important for farmers with Boran cows.

x) Expansion of the project

- It is assumed that the small deficiencies of the Vigoi project reported in this document can easily be rectified if the project management is determined to do so. Based on the survey results and the estimates of milk supply and demand in Ulanga district, it is recommended that the dairy project be expanded to Lupiro and Mwaya divisions.
- It is assumed that farmers will be well trained and monitoring will be coordinated from Mahenge office. It is recommended to reshufle some of the extension staff in order to balance new obligations and their training backgrounds. The extension officer at Mwaya is currently engaged in the dairy goat in Sali ward 29 km from Mwaya township. For Mwaya, the district livestock office should give due emphasis to the two alternatives of milk production.

- It is recommended that only 15 - 20 farmers in each of the two divisions (a maximum of 40) be involved at the start. Preferably F_1 heifers be given to farmers.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACKNOWLEGEMENTS

The members of the evaluation team acknowledge the high level of cooperation received from the Irish Aid, Ulanga District Livestock Department, Ulanga District Planning Office, government officials at divisional and ward level, Village Extension officers, key informants and farmers interviewed. The District livestock Officer (Mr. I.S. Mitondwa) and the assistant Project Manager (Mr. C.W. Kihiyo) who spent their time with the evaluation team during the field work. The District Planning Officer (Mr. Nkulira), District Agricultural Livestock Officer (Mr. P.J. Kicheleri) and Village Extension Officers and other staff are thanked for participating freely and frankly in discussions. The excellent arrangements for travel to the field enabled a great deal to be done in a short time. We are most grateful to the driver who drove us around tirelessly even during weekends. Without the full cooperation and frankness of the numerous interviewees, the team would have achieved nothing. We greatly appreciate receiving valuable comments from the Irish Aid Technical Advisor (Mr. Howard), District Planning Officer (Mr. Nkulira), District Agricultural and Livestock Officer (Dr. Dimosso), Village Extension Officers and others during the debriefing meeting.

1. INTRODUCTION

1.1 Background

Ulanga is one of the four administrative districts in Morogoro region. Administratively the Ulanga district is divided into five divisions, namely, Vigoi, Mwaya, Lupiro, Mtimbira and Malinyi. It occupies a total area of 24,560 square kilometers of which 30% is suitable for grazing. The District is comprised of three zones: lowlands, which accounts for 86% of the total land, middle altitude zone (6%) and highlands (8%). The lowland zone which is about 700 metres above sea level is subject to seasonal flooding. The middle altitude zone which is covered with natural miombo woodland is less fertile. Pastoralists graze their cattle in this zone. Highland areas offer the least potential for agricultural (crop) production due to poor stony soils, low temperatures and poor accessibility. However, the climate and abundant natural vegetation is conducive for livestock.

The district has a population of 58,724 head of cattle, 3,219 goats, 3,296 sheep, 403 pigs and 101,863 poultry Traditionally the indigenous people of Ulanga are not livestock keepers. Most cattle are kept by pastoralist immigrants from Northern Tanzania who have moved into Ulanga in search of grazing land. These include Maasai, Barbaig and Sukuma. Majority of the pastoralists are in Malinyi and Mtimbira divisions.

Dairy cattle comprise of a very small proportion of the cattle herd in the district. The history of dairying in Ulanga dates back to the pre-WW1 when a German dairy farm was established near Mahenge. At present several missions have small dairy herds. These include Kasita farm, Lugala mission, Munga mission, Itete Nazareti community, Itete Upendo sisters and Ruaha mission.

Recently the livestock department introduced dairy cattle through Irish aid as part of a pilot project. The idea for the dairy project was proposed by the Ministry of Agriculture and previously by a planning team from the Institute of Rural Dvelopment Planning in Dodoma. The overall goal of the Project is to raise living standards of people in the district, especially of the poorer rural households. The immediate objective of the project is to support the establishment of a profitable smallholder dairy industry in Ulanga. The pilot dairy project started in December 1996 with 24 F_1 heifers and 32 Boran heifers distributed to selected resource poor farmers in Vigoi division.

Farmers in Vigoi have keen interest on the Project and there are requests to replicate the Project elsewhere in the District. Such expansion is only justifiable after evaluating the existing project and potential areas for expansion. The Bureau for Agricultural Consultancy and Advisory Service (BACAS) was commissioned by the Livestock Department in Ulanga District to evaluate the Project in accordance with the following Terms of Reference.

1.2 Terms of Reference

The main purpose of the consultancy was to evaluate the performance of the present pilot dairy development project in Vigoi division as a basis for expansion of the project to new areas in the district.
Specifically, the consultants were requested to study the following:

- Impact in terms of household incomes and expenditures, the local economy, the society within the project baundary (gender, inequality, jealousies and leveling mechanism), human health especially nutrition and the environment.
- Animal husbandry, especially management by farmers, including sickness, growth rates and milk yields and technical back up from project staff.
- Project management in terms of efficiency, effectiveness and accountability.
- Farmer and personnel training activities in the project.
- Sales and marketing focusing on supply and demand and sustainability issues.

The full Terms of Reference appear as Appendix 1.

1.3 Composition of the Evaluation Team

Ulanga District Council commisioned the Bureau for Agricultural Consultancy and Advisory Service (BACAS) to carry out the evaluation of the Project. BACAS put a team of two consultants: G.C. Kifaro, Animal Scientist and team leader and N.S.Y. Mdoe, Agricultural Economist.

2. METHODOLOGY

The evaluation team conducted field work between 1 and 17 January 1999 (see Itinerary Appendix 2). The team was accompanied by the Ulanga District Livestock officer and one VEO who is assisting the Project manager.

The field work involved i) collection of secondary data (ii) informal discussions with District, division, ward, village officials and other key informants, direct observations (iv) individual farmer interview.

2.1 Secondary data collection

Efforts were made to assemble secondary data from the district planning office, District Agricultural and Livestock Development office, Livestock Development office, Division and ward offices in Vigoi, Mwaya, Lupiro, Malinyi and Mtimbira divisions.

2.2 Informal Discussions

At the district level, discussions were held with the district planning officer, District Agricultural and Livestock Development officer, District Livestock officer.

At the division, ward and village levels, discussions were held with Divisional secretaries, ward Executives and village Chairman/Executives. More discussions were held with the following:

- VEPs in Project area and proposed new sites
- Hotel and restaurant owners in Mahenge town, Mwaya, Lupiro, Mtimbira and Malinyi
- Mahenge meteorological station workers
- Itete Nazareti community
- Upendo Sisters in Itete
- Ruaha Mission
- Munga Mission
- Teachers of Kipingo Secondary School in Malinyi
- Lugala Lutheran Hospital
- Teachers of Tumaini Secondary School
- Farm Manager, Kasita farm
- Traditional cattle herders in Mwanya, Lupiro, Malinyi and Mtimbira

The aim of the discussions with various key informants in Malinyi, Lupiro Mtimbira and Mwaya divisions was together information on:

- Potential demand for milk
- Available dairy animals in the divisions
- Present supply of milk, milk prices and patterns of milk consumption
- Availability of fodder for feeding dairy animals and potential for pasture development.
- Current strength of extension staff to main the project.

Informal discussions were held with individual village Extension officers (VEOs) in the Project area. The discussions aimed at understanding:

- Their training background
- Their role in the current project
- The type of recording and monitoring they were doing on routine basis
- The project administration
- Aspects they considered success and failures in the project
- Their views on what could be done to improve project performance

2.3 Direct Observation

Direct observations were made while visiting dairy project farmers to assess cattle housing conditions and health of their cattle. Also observations were made while visiting the proposed new project sites to assess fodder availability and potential for pasture development.

2.4 Individual Respondent Interviews

The evaluation team used a questionnaire (Appendix 3) to obtain information from individual farmers who received cattle through the project. The structured questionnaire was developed and designed to collect information on household size and structure, crop production, livestock numbers and herd structure, methods used for mating their cows and costs involved. Further, the questionnaire sought information on number of people and time that was spent on various dairy farming activities, inputs on dairy cattle, reproduction and disease incidences, milk marketing and processing. Finally farmers were asked to provide information on the type of training they had received from the project and the extension services they were being offered.

All Project farmers (except those within Epanko village) with F_1 dairy cows in Vigoi division were visited while a random sample of 16 farmers (out of 29) supplied with Boran heifers were interviewed. Besides following the questionnaire during the formal interview, informal discussions were held with the farmers to verify some of the crucial issues.

2.5 Measurements

Calf growth

No measurements on calf growth had been taken. A visual assessment of the calves' conditions in relation to the age and feeding regime practiced was made.

Milk yields

A few farmers had recorded milk yield daily throughout the lactation. In order to estimate lactation yields, mid-month records were taken, summed up and multiplied by 30.5. Since drying off dates were not recorded, lactation length had to be reported in months.

2.6 Data analysis

Information from questionnaires were coded separately for farmers with F_1 cows and those with Boran heifers. Data were entered into a computer and analysed by an SPSS statistical package. Results were summaraized as means, percentages and ranges.

3. FINDINGS: PILOT DAIRY PROJECT IN VIGOI DIVISION

3.1 Achievement of Project Objectives and Impact

3.1.1 Achievement of Project Objectives

The overall goal of the Project is to raise living standards in the district, especially of the poorer rural households. The immediate objective is to support the establishment of a profitable smallholder dairy industry in Ulanga.

According to the Project document, the pilot phase of the project would involve setting up 24 smallholder farmers milking crossbred cows, and loaning cows to another 32 farmers who will rear their own dairy heifers. Already 24 farmers have received F_1 heifers and 32 farmers received Boran cattle in December 1996. The number of dairy cows in Vigoi division has increased to 87 cows as a result of the project. Six female calves have been passed on. These have been passed on to extension officers. This is in accordance with the Project statement that extensionists should be given priority in the allocation of animals in order to gain experience and develop commitment to the the success of the project. Only two farmers out of the 32 farmers given Boran cattle have passed on the Boran cows to other farmers after getting female calves.

As stated in the Project document, the attainment of the Project objective would require the development of appropriate backup services such as breeding bull centre, a veterinary drugs supplier (private) and effective extension services. A breeding bull centre has not been established but 2 Ayrshire bulls have been purchased. The bulls rotate among the farmers. The farmers take full responsibility of caring for the bulls. The Project also introduced artificial insemination services to supplement the bull services provided to the project farmers. There is no private veterinary drug supplier. However a revolving fund for veterinary drugs and vaccines has been established under the District Livestock Office. Extension services are in place. Each village with project farmers has a village extension officer. Details concerning the bull services, artificial insemination, veterinary drug supply and effectiveness of the extension services are discussed under subsequent sections.
Whether the Project has managed to establish a profitable dairy industry (refer immediate objective) that will contribute to the overall goal of raising living standards in the district (especially the poorer rural households) will be discussed under impact of the project at the household level in the following sections.

3.1.2 Project Impact

In dairy production, initial investment is high and costs and revenues flow over the useful economic life of the cow. Thus, realistic assessment of profitability of dairy production should take into account expected future returns. The appropriate methodology to be used is discounted cash flow analysis (or benefit-cost analysis). Discounted cash flow analysis accounts for the element of time as the procedure of discounting enables the comparison of money values at various points in time. The estimation of expected income and costs of dairy production requires projection of the dairy herd using biological data such as herd structures (numbers of animals by sex and age class), calving rate, age at first

calving, mortality rates for various age categories, lactation offtake. The Project is only two years old and there is very little data to enable realistic estimation of some of the important biological data (e.g. mortality by age and sex classes, age at first calving). For this reason, the financial analysis is based on data for the two operational years of the project. No attempt has been made to project the dairy herd and discount the future return expected from the herd.

3.1.2.1 Financial Impact at Household Level

Sources of income from dairy include sale of milk, sale of live animals (culls, heifers, male calves, steers and bulls), manure and bull service fee. Almost all farmers who received F_1 heifers received income from sale of milk. Seven out of 19 (37%) of the farmers received income from manure. Some of the male bull calves born in early 1997 are used for service and three out of the 19 (16%) farmers with F_1 cows interviewed received mating fee for their bulls in 1998. Average prices of milk, manure and bull mating fee in 1998 were Shs. 300 per litre, Shs.214 (range 100-500) per tin ("debe") and Shs. 2000 per mating, respectively.

Table 1 presents annual income and expenditure on dairy inputs in 1998. Gross income (without considering expenditure) from sale of milk received by farmers with F_1 cows ranged from Shs 465,150 to Shs 789,419 with an average of Shs 597,587 per household per annum. Manure income ranged from Shs 600 to Shs 4000 with an average of Shs 2,086 while mating fee income ranged from Shs 4,000 to Shs 8,000 with an average of Shs 6,000 per household. Only one farmer with F_1 released income from sale of steer, sold at Shs. 60,000. Overall total net income (total annual gross income less annual dairy production costs) range from Shs: 26,683 to Shs 495,194 with an average of Shs 259,414 per household. Costs considered were fodder, veterinary drugs and vaccines, hired labour, AI, bull service, minerals, concentrates, equipment/tools and cowshed. Equipment and cow shed costs are fixed costs and these were amortized. Fodder costs formed the largest proportion of the variable costs.

Table 1 Average Annual Returns to dairy production by type of Cattle in 1998

Item	Farmers with F_1 Cattle	Farmers with Boran cattle
Average Annual Milk Yield (Litres)	1992 (1550-2631)	1380 (1217-1703)
Milk Price (Shs/litre)	300	300
Income from Milk (Shs)	597,587 (465150-789419)	416,100 (365000-511000)
Sale of Manure (Shs)	2,086 (600-4000)	400 (300 -500)
Sale of bull servies (Shs)	6000 (4000-8000)	-
Total Dairy Income (Shs)	599,303 (465150-797419)	416,160 (365000-511000)
Total Variable Costs (Shs)	333,017 (145867-515533)	270,525 (80100-411926)
Annual Gross margin (Shs)	266,286 (-23,017-501,027)	145,635 (-46926-303150)
Total Fixed Costs (amortized)	6,872 (2500-13667)	9,033 (2733-28500)
Total Costs	339,889 (150800-521767)	279,559 (83267-417026)
Annual Net Dairy Income	259,414 (-26,683-495,194)	136,601 (-52026-2999833)

Source: Evaluation Survey 1999

- Note: Figures in brackets are ranges

Dairy income data from the farmers who received Boran cattle were limited. Five out of the sample of 16 (31%) farmers with Boran interviewed had their cattle calved. Thus milk income data was available from only 5 farmers.The gross income from sale of milk for those farmers ranged from Shs 365,000 to Shs 511,000 with an average of Shs. 416,100 per household. Three out of 16 (19%) of the farmers with Boran sold manure for income in 1998. None of them had a bull that could be used for service as a source of income. The total annual net dairy income per household (for the 5 households) ranged from Shs -52,026 to Shs 299,983 with an average of Shs. 136,601 (Table 1). Again fodder costs formed the largest proportion of the variable Costs.

On average, the assessment of annual income from dairy production and annual expenditure on dairy inputs indicates that dairy production in Vigoi division is profitable. The average annual net dairy income was positive, indicating that dairying generated more income than expenditures incurred on dairy inputs. Only one farmer out of 19 (5%) with F_1 interviewed incurred higher expenditures on dairy inputs than the dairy income received. One farmer out of 5 (20%) farmers with Boran cattle

which have calved had lower dairy incomes than expenditures on dairying in 1998. All farmers with Boran cattle which have not calved had negative dairy income.

3.1.2.2 Use and Control of Dairy Income

A substantial amount of the dairy income estimated above was received as cash. The proportion of the total annual income received as cash ranged from 60% to 96% with an average of 86% for the farmers with F_1 cattle. The remaining percent of total annual dairy income was the value of milk consumed at home (non-cash income). For the 5 farmers with Boran cattle, the proportion of annual dairy income received as cash ranged from 57% to 94% with an average of 81%.

Most of the project farmers whose cattle have calved acknowledge that the cash income from dairy has increased their purchasing power. They have been using the money for buying clothes, paying school fees, food and other consumers goods. Because of the recent food scarcity most of the cash from milk sales is spent on food. One of the farmers started making burned bricks using the dairy income. Unfortunately her cow died after swallowing a nail.

It was difficult to know exactly who is controlling the income from dairy production in the household. Almost all the farmers interviewed indicated that the income was controlled by both husband and wife for the benefit of all household members. However, information given by the respondent concerning allocation of labour for the various dairy production activities (feed collection, watering animals, cleaning cow shed, milking and marketing of milk) show that men are more involved in the marketing of milk than women. Cleaning cow shed is normally done by women while feed collection/feeding of the cattle is a responsibility of both men and women. The fact that men are more involved in the marketing of milk suggest that they have access to the control of the milk income.

3.1.2.3 Social Impact

The project has potential impact on poverty alleviation, women's workload, employment and reducing inequality.

i) Poverty Alleviation

Poverty is defined as a condition of life that does not meet minimal necessities of education, nutrition, health and housing. Indicators of poverty include income and nutrition. According to Amani (1996) the people of Ulanga are poor with an average per capita household expenditure of Shs. 17,128. Per capita household expenditures for Uponera and Nawenge in the Project area in 1996 were Shs 21,316 and 20,639, respectively (Amani, 1996). These figures are slightly higher than the district average but less than one half of the national relative poverty line of Shs 46,170 per capita per annum in 1991.

The incidence of poverty in Ulanga is associated with low productivity in Agriculture. Yield data obtained from interviewed farmers show high productivity for both F_1 and Boran cattle with some F_1 cows yielding more than 3000 litres of milk per lactation and Boran cows yielding close to 2000 litres of milk per lactation. As indicated earlier, sale of milk, manure and bull services have increased incomes of the households who have received cattle. The income is used to improve their standards of living as indicate in section 3.1.2 above.

ii) Women's Workload

Almost all project farmers interviewed acknowledge that the introduction of dairy cattle has significantly increased the workload in their households. There were, however, differences in how the increased workload is distributed among household members. Eleven out of 35 (19 with F_1 and 16 with Boran) indicated that the workload of women has increased more than those of other members of the household. The remaining 24 out of 35 farmers indicated that the increased workload is

normally distributed equally among household members irrespective of sex. Given that African women are responsible for most household chores such as cooking, child care, collection of fuel wood and fetching water, women's overall workload has increased even in those households where the increased workload due to introduction of dairying is shared equally among household members.

In order to reduce the increased workload most farmers hire permanent and/or casual labour to undertake various dairy production activities. Twelve out of the 19 (63%) of the interviewed farmers with F_1 cattle and 5 out of the 16 (31%) of the interviewed farmers with Boran cattle hired labour for dairy related activities. Six out of the 12 (50%) with F_1 hired permanent labour while the remaining 50% hired casual labour. All the 5 farmers with Boran cattle who hired labour use permanent labour. Permanent labour is normally hired for all livestock activities while casual labour is mainly hired for fodder collection (cut and carry).

iii) Employment Generation

As indicated above farmers employ casual and/or permanent labour to reduce increased workload in their households. The absolute number employed people is small but is substantial in relation to the number of farmers with dairy cattle. Thus, the project has a potential impact on unemployment reduction especially among the youths. Permanent employees receive an average monthly pay of Shs 6,500 (ranging from Shs 4,000 to 9,000) excluding other benefits like free food and accommodation if the employee is staying with the farmer. Casual labourers involved in feed collection receive between Shs. 75-500 with an average of Shs 204 per bale of fodder. This provides incentive for the youths to remain in rural areas rather than migrating to towns.

iv) Inequality

The overall goal of the project is to raise living standards in Ulanga district, especially of the poorer households. Focusing on the poor has the potential impact of reducing inequality between the rich and the resource poor households. The project has really focused on the relatively resource poor households. None of the interviewed farmers can be said to be rich in absolute terms.

Some of the farmers particularly those with cows which have not calved cannot afford to pay for purchased inputs such as concentrates, minerals and veterinary drugs. Some have failed to pay for credit in kind given to them in the form of veterinary drugs. Inability to purchase essential dairy inputs imply poor cattle performance and one would wonder why give improved cattle to somebody who cannot afford inputs. Already there is a different thinking even among the VEOs that cattle should be given to farmers who can afford essential dairy inputs. This idea is acceptable if these people are not among the rich who can afford to buy heifers. Otherwise focusing on the rich will widen rather than reducing inequality. It is also contrary to the Project goal of raising living standards of the poorer rural households in Ulanga.

3.1.2.4 Impact on Nutrition

Milk production in Vigoi division has increased as a result of the project. The increase in milk production has improved human nutrition in the area since milk is one of the items with most of the essential nutritional elements. Almost all the farmers with cattle which have calved consume milk. Quantity of milk consumed by interviewed households with F_1 cows ranged from 0.5 to 2.0 litres per household per day with an average of 1.03 litres per household per day. This amount translates into per capita annual consumption ranging from 18.25 to 273.75 litres with an average of 74.73 litres of milk per person per year, well above the national per capita consumption of about 21 litres per capita per annum. Most of interviewed households indicated that they were not drinking milk before the project.

Apart from the household with dairy cows, other community members in Vigoi can easily get milk. They acknowledge that fresh cow's milk was a very scarce commodity. "The sick and the children can

easily get milk to improve their health. We do not have to go to Kasita farm for milk" said some of the non-dairy keepers talked to in Mahenge town.

3.1.2.5 Impact on Environment

The project has potential positive and negative impact on the environment. Dairying has beneficial environmental impacts in rural areas where farmers grow various crops. Mixing dairying with crop enterprises enhances soil fertility through increased cycling of nutrients which may otherwise be trapped for long periods in crop residues etc. Manure is widely used in the project area. All project farmers interviewed use manure in their crop enterprises. Some of the manure is sold or given free of charge to non-project famers. Manure use rather than continuous use of inorganic fertilizers improves soil structure and soil acidity is adjusted when manure is used with inorganic fertilizers.

The project has potential negative impact on the environment in the urban area (Mahenge town). Enviromental problems resulting from keeping dairy cattle in Mahenge town have not been realized because there is a small cattle herd in the town. Discussions on enviromental issues were held with the few farmers in Mahenge town who received cattle through the project. None of them indicated problems of disposing the cow dung. Also none of their neighbours has so far complained about their cattle polluting the environment.

Negative environmental impact of keeping cattle in Mahenge town cannot be ruled out in the long run if the number of cattle increases. The project should encourage expansion of the project to rural areas rather than Mahenge town.

3.2 Market Potential for milk and milk products

Milk produced at the project site (Vigoi) and proposed new sites (Lupiro, Mwaya, Malinyi and Mtimbira) is marketed through informal channels namely, (i) direct sales to individual consumers and small hotels (restaurants) and, (ii) sales to vendors who in turn sell the milk to individual consumers or hotels. The second marketing channel was observed in Lupiro, Malinyi and Mtimbira where vendors take milk from the traditional cattle owners to individual consumers and hotels. At the project site, producers sell their milk directly to consumers and hotels in the villages and Mahenge town. Most of the milk is delivered to the individual consumers and hotels. Majority of the producers interviewed had informal contractual arrangements with hotels and /or individual consumers.

Information from the producers interviewed, individual consumers and hotel/restaurant owners talked to in the project area (Vigoi) suggest that the current milk supply in the area cannot meet the demand. Fifteen out of 19 (79%) of the farmers with F_1 cows interviewed had never faced problems of disposing off milk since they started milking. The remaining four out of 19 (21%) had few problems of disposing off milk especially evening milk. Only five out of the 16 (31%) sample farmers with Boran had their cattle calved and all of them had no problems of disposing off their milk. Similarly, few problems of disposing off milk were reported by the cattle keepers talked to in Lupiro, Malinyi and Mtimbira. These problems were reported by the traditional cattle keepers but they acknowledged that the problem is seasonal and within their locality. Disposal of milk from the traditional herd is normally a problem during the wet season when there is plenty of fodder and probably because calving of most animals take place during that season.

Projections of milk supply and demand were made to assess the market potential for milk in the project areas and the proposed new sites. The supply of milk in Ulanga is mainly dependent on local production. Imported milk and milk products which may influence supply are almost negligible in the kiosks and shops visited. The local supply of milk is mainly influenced by the size of dairy cattle herd, size of traditional cattle herd, milk yields, prices and access to support services. The demand for milk, like other food commodities, is a function of population size, income levels and its elasticity of demand for milk, retail price and to a less extent taste and preference over other related products.

Appendices 4 and 5 provide present and projected supply and demand up to year 2019. Estimation of milk supply was based on milk off-take of 200 litres per traditional cow per year and 1992 litres per dairy cow per year (the average obtained by the sample farmers raising F_1 in the project area). Two supply scenarios were analysed. The first scenario assumed that 45% and 70% of the traditional cattle herd and dairy cattle herd were lactating cows respectively. The traditional cattle herd and the dairy herd were assumed to grow at 1.7% and 6% per annum, respectively. The second senarior assumed that 30% of the traditional cattle herd were lactating cows. For demand, average annual per capital consumption of 26 litres was used to estimate milk demand in 1999 while annual population growth of 2.6% (see 1988 population census), income growth rate of 0.5% and 1% and an income elasticity of demand for milk of 0.08 were used to project demand.

According to the supply assumption of 45% of traditional cattle herd being milked and all the above demand assumptions, there are substantial shortfalls in milk supply in Vigoi and Mwaya divisions. The remaining divisions seem to have surplus milk. Under this assumption, Ulanga district seems to have milk surplus. Under the second supply scenario (30% of traditional herd being lactating cows), Vigoi, Mwaya and Lupiro divisions have shortfalls in milk supply and the overall demand for milk in the district (Ulanga) exceeds overall supply (i.e. milk supply deficit). These results suggest substantial market potential for milk and milk products in the project area (Vigoi) and Mwaya and Lupiro. All these divisions have few traditional cattle compared to Mtimbira and Malinyi divisions.

3.3 PERFORMANCE OF ANIMALS IN VIGOI DIVISION

3.3.1 Number of animals

F_1	heifers
24	heifers were bought at 350,000/= each
1	died, suspected to be poisoning
19	were bought as incalf heifers and have calved
15	have been mated at Mahenge and have calved
34	calvings have taken place

Borans

32	heifers were bought at 180,000/= each
3	died 1 due to amaplasmosis and trypanosomiasis
	1 had dislocation of fermur
	1 was strangled by a rope
3	came pregnant and have calved
5	have calved from Mahenge matings
2	have aborted
8	are eleged to be pregnant
13	(or 45%) are still empty

The distribution of the cows in diffent villages is presented in Table 2. Out of the 34 calvings from F_1 heifers 25 have been bull calves and only 9 female calves. The overall picture of the pass on effected so far in presented is Table 3. Two new farmers have received pass on Boran cows and six extension officers have got progeny from the F_1 cows. De Wolff (1997) has reviewed pass on rates in a number of heifer -in -trust (HIT) schemes in Tanzania and found low pass-on rates during the first 2 years. Though not very impressive but it is encouraging to see that new farmers have already received cows/heifers. The 3 Boran cows that came pregnant have calved down Boran progeny (one male and two heifers) which would be retained by the same farmers. To these farmers, it will take another year and a half to get F_1, progeny before they can pass on the Boran cows to next beneficiaries.

3.3.2 Reproductive Performance

Incalf F_1 heifers were brought to Mahenge in November, 1996. It is important to note that it took zero to six months for them to calve down. Ninteen calved between November, 1996 and July, 1997. These heifers came pregnant. Unfortunately 5 aborted and it is speculated to be due to transportation stress. Fifteen F_1 heifers have calved between August, 1997 and Janurary, 1999. Out of the 15 F_1 cows that have calved twice at Mahenge, only 11 had records available for calculating calving intervals. The average calving interval has been 516 days or approximately 17 months. This translates to a calving rate of about 71% and this should be considered as quite satisfactory.

As mentioned earlier 13 Boran heifers (or about 45%) had not conceived at the time of evaluation and two years had elapsed since they were brought to Mahenge. The 8 cows alleged pregnant should be taken with caution because one of them was supposed to calve down end of December 1998 but at the time of evaluation there were no signs of being heavy pregnant.

Table 2 Distribution of Project cows by villages in Vigoi division

Ward	Village	F_1	Boran	Total
Mahenge Mjini	Mahenge Mjini	3	4	7
Vigoi	Vigoi	3	3	6
	Mbagula	2	4	6
	Nawenge	3	4	7
	Epanko	3	3	6
	Makanga	3	4	7
Isongo	Isongo	3	4	7
	Uponera	3	3	6
Total		23	29	52

Table 3 Pass on of animals already effeted at the time of evaluation

Type of heifer	First farmer	Second farmer	Village
F1	A.Likunda	C.W. Kihiyo	Epanko
F1	S. Mtengule	J.P. Mkude	Nawenge
F1	Mrs. Mwarabu	S. Chilangilo	M. Mjini
F1	Zamda Said	S. Mhilu	Uponera
F1	Mrs. Kavira	P.J. Kichelevi	Isongo
F1	G. Kaonja	I.S. Mitondwa	Mbagula
Boran	L. Choma	Mrs. Livoga	Mbagula
Boran	M. Mlima	Mrs. Linuwatu	M. Mjini

Three problems were identified to contribute to the poor reproduction performance:

a) Farmers have very little knowledge and experience on heat detection
b) There are only two bulls to serve cows in 8 villages in which farmers are sparsely located. The distances between the furthest farmers is too big for bulls to be walked around .
c) Poor record keeping and monitoring. Dairy projects in Tanga and Kagera for example (see Houterman et al. 1993; Rutamu et al. 1994) put a lot of emphasis on record keeping and monitoring for fertility and lactation performance. This is important because a dairy animal will only be productive after calving. It is the prime basis for repaying the credit and harvesting of milk for better nutrition and income of the households.

3.3.3 Mating methods: Artificial Insemination (AI) versus use of bulls

It has been found that there have been (up to time of evaluation) a total of 25 conceptions among the cows in Mahenge.

5 Borans with normal calving
2 Borans have aborted
15 F_1 cows with normal calving
2 F_1 cows have aborted

1 Boran cow calved prematurely

Out of all these calvings 4 (or 16%) were from AI and 21 (or 84%) from natural mating using the two purchased bulls.

Costs involved:

a) The total coast of the two bulls 400,000.00

b) AI – Purchase of semen plus liquid nitrogen LN_2 450,000.00
- Transport costs 210,000/= x 4 trips 840,000.00
- DSAs 3 people x 4 trips 160,000/= per trip 480,000.00

Total AI Cost **1,770,000.00**

Two hundred and sixty doses of semen were bought of which only 53 (or 20%) were used, the rest were discarded. Each insemination was supposed to be paid for by the farmer at a rate of 2,000/= per dose. If all the 260 doses had been paid for, the project would have recovered only Tsh. 520,000/=. The 53 inseminations made should have recovered Tsh. 106,000/= but unfortunately only 13 farmers had paid for the service thus allowing the project to recover only Tsh. 26,000/= which was spent to fuel the project motorcycle.

The sad story is that out of the 53 inseminations only 4 cows conceived giving a conception rate of a mere 7.5% and 3 live calves have been born. Discounting fuel costs and depreciation for motorcycle and labour charges, then:

- cost per insemination (53) = 33,396/=
- cost per conception (4) = 442,500/=
- cost per calving (3) = 590,000/=

Clearly based on these costs there is no justification for continuing to use AI as a breeding method. On the other hand the two bulls brought by the project are too few considering the number of villages involved in the project and distances between farmers.

In the initial project write-up, it was proposed to rehabilitate a bull centre. It is good that the idea was not implemented. The project would have incurred costs of rehabilitating and maintaining the centre but the output would have been a disaster.

3.3.4 Breeding practices

Twelve (12) out of 19 (or 63%) of farmers with F1 cows used project bulls or bulls from Kasita farm for mating their heifers and cows while 69% of farmers with Boran heifers have used bull services. A small proportion of farmers (21 and 6% of farmers with F1 and Boran heifers, respectively) used AI and the rest used both AI and bulls. Fees for using bulls ranged from 2000/= to 3,000/=, the former was for project bulls and the latter for Kasita bulls.

3.3.5 The Boran versus the F1 system of producing pass-on stock

i) The Boran system:

The animals were bought as young stock (only 3 were pregnant) raised under ranching conditions. It was not wise to buy incalf Boran heifers mated to Boran bulls because:

a) They would calve Boran calves which cannot be used for dairy production
b) It would prolong the time of getting an F_1 calf from the same cow

There are advantages and disadvantages of the Boran system:

Advantages:

- It was cheaper to buy them by about 48%
- Though not dairy animals, the team was impressed with the amount of milk they produce.

Disadvantages:

- As pre-mature stock, there has been an invariably long period of time between receiving the animal and the animal being ready for mating. For many farmers and even the extensionists it has been difficult to determine the time for first mating of the heifers.
- There is a risk of buying infertile heifers which will be useless and it may take a prety long time to detect that they cannot conceive.
- Considering it to be a loan (rural credit), it will definitely take a long time to pay a heifer and a few farmers may completely fail to pay it.
- These animals come from a ranch where they have been raised under ranching conditions. For farmers who have had no previous experience of handling cattle, taming the cows can be a difficult excercise for them. For example two farmers still had cows with very bad temperament at the time of evaluation considering the fact that they have stayed with those animals for almost two years.
- Besides the temperament issue, Borans generally have poor milk yields, so as soon as the calf is weaned, there is less likelihood of prolonged milking of the cow. This can also be attributed to the inherent failure of the cow to let down milk in the absence of the calf.
- The contract with farmers receiving Boran cows is to pass on the cow after calving the first heifer. To some farmers who have critically evaluated the system they have complained that:

    a) By the time they have to pass on the Boran cows they will have been used to the cow and probably still milking. They feel it will be unfair to part with the cows at that stage.
    b) They will not be certain with the fertility of the young heifer
    c) They will have to wait for the heifer to mature, mate her, wait for 9 months of gestation till first calving. The waiting period to next milking is just too long (see Figure 1).

Fig. 1 Comparison of the time lags the farmer has to wait to next milking

ii) The F_1 System

There is clear evidence from the project of the following advantages and disadvantages:

Advantages:

- Because the F_1 heifers were brought as pregnant animals, there is less risk of buying infertile cows
- A genetically better heifer (with 75% exotic inheritence) is born for pass on after a short period. In the Project area the waiting period ranged between zero and 6 months. Even if the F_1 calves a bull, the farmer can wait for 12 - 17 months for another chance.
- Irrespective of type of calf born, the farmer will enjoy milking the cow and reap other benefits
- Compared to the Boran system, farmers under this system will pay their loans faster
- It is the commonly practiced system in most dairy development projects in Tanzania.

Disadvantages

- Very expensive to buy incalf F_1 heifers (in this case they costed 350,000/= each)
- They are not readily available
- Experience from the Southern Highlands Smallholder Dairy Development Project show that cases of bad temperament among F_1 cows exist especially in first lactation.

3.3.6 Milk yields

Milk production has always been measured volumetrically but there have been a variety of units of measure used eg. Beer bottles, plastic containers. Often milk yield is recorded to the nearest half a litre and that is fair enough because they could not be more accurate than that. Note-books have been used to record milk yield. At farmers level that is fine, however it was expected that the extensionist would sum up the daily yields for the whole month and transfer the information into the cow card. The monthly production should have also been reported at the project office. In so doing the performances of individual animals and project would have been monitored. Some farmers have already lost their Note-books implying that the lost information will never be recovered.

From about 11 cows which have calved twice, lactation yields could be traced on only 3 cows as shown in Table 4. The fourth farmer had lost her note-book containing a large part of first lactation but records of the first six months of second lactation could be transcribed. The cow belonging to farmer No. 4 had rather low yields due to mastitis. No records on dry periods could be traced.

Table 4 Lactation performance from four well recorded cows

	First Lactation		Second Lactation	
Farmer Number	Yield (l)	Length (m)	Yield (l)	Length(m)
1	3081	14		
2	3021	11		
3	2051	11		
4	-	-	2272	6*

*Recorded during the first 6 months of lactation

The overall performance is impressive considering the fact that concentrate supplementation is minimum and erratic. Average lactation yields of F1 cows from Tanga and Southern Highlands are below 2000 litres. Though these results are based on scanty information, they show the potential of these animals. Extension workers should encourage farmers to properly feed the cows in order to attain high milk yields.

3.3.7 Calf viability and animal health

i) Calf viability

Eleven (11) out of 19 or 58% of farmers owning F_1 cows practice partial suckling while 42% bucket feed their calves. Eighty percent of farmers with Boran practice suckling of calves and 20% bucket fed. On average the amount of milk fed to calves was 2.1 litres (range of 0.5 to 4l/day). The average weaning age was found to be 4.4 months.

In most dairy development projects restricted suckling is advocated to farmers for several reasons:

- Calf growth rate and milk production is enhanced
- Less incidences of calf diarrhoea
- The udder is always completely evacuated and consequently fewer cases of mastitis.

Visual assessment of calf conditions in relation to their ages has clearly shown that most calves were in good body condition. It signifies that they are adequately fed. Minerals were rarely offered to calves and that is an area extensionists should put more emphasis.

There were a few cases of calf losses as shown in Table 5

Table 5 Cases of calf loses in the Project area

	Breed of cow	
Aspect	F1	Boran
Abortions	5	2
Premature birth	0	1
Deaths	2	0

Abortions took place in November and December, 1996 just after arrival probably due to traveling stress. One calf died after dystocia while the other died after eating sisal rope. So far the calf survival rate is good an indication that farmers are keen in calf management.

Weaning age of calves varied between 3 and 6 months. The latter is rather too late. This means the calf continues to be fed on milk which should have been consumed at home or sold. It is very expensive to feed calves on milk up to that age. Farmers should introduce solid feeds early enough (2 weeks post natal) to allow weaning to take place at about 4 months of age.

ii) Animal health

Farmers have inoculated their cows against trypanosomiasis (nagana) and contagious bovine pleuropneumonia (CBPP). Cases of dystocia and abortions have been reported elsewhere in this document. There have been a few cases of treatments against mastitis (two cases), CBPP (2 cases), trypanosomiasis (10 cases), anaplasmosis (2 cases) and excessive salivation (1 case). About 37% of farmers with F1 cows and 44% of farmers with Borans have dewormed their cattle. Based on this information it is apparent that trypanosomiasis and worms are economically the most important cattle ailments in the Project area.

3.3.8 Feeding of cows and pasture development

i) Feeding

The basic feed for cows has been green forages. Forages are usually cut far away from homesteads by either family members or hired labour. Farmers who sell milk spend part of their earnings to buy cut grass. The amount and quality offered to animals is as usual very variable. Almost all cows visited were in very good body conditions. After harvesting maize, beans, and groundnuts, the crop residues are transported back home for feeding animals . Before feeding stover, the stover is chopped and mixed with salt and water. This should be considered already as a good step toward crop/livestock integration.

The common feed supplement is a mixture of maize bran and common salt. Amount of maize bran offered vary from 1 to 10 kg per day. The mean is 4.6 kg. Generally concentrates were observed to be in short supply. The supply situation was serious in 1998 because of low maize supply. However only 1 out of 19 farmers with F_1 cows did not use maize bran in 1998. The rest used it though irregularly. Among farmers with Boran cows 11 out 16 (or about 69%) had used maize bran in 1998.

It was observed that only 26% and 6% of farmers owning F_1 and Boran cows, respectively had used mineral blocks in 1998. The remaining either used only common salt or nothing at all. Table 6 provides a better picture of the situation. Almost all farmers complained of either high price of mineral blocks or their in-availability. It was evident that farmers were prepared to buy small mineral blocks costing less than sh. 2,000/= a piece. Lack of phosphorus, for example, in dairy cattle rations can seriously impair fertility. Heifers will delay to reach puberty because of slow growth, for cows it may result into erratic oestrus, late post partum oestrus, more services per conception, poor appetite and lowered milk yield. It is important, therefore, that the project makes deliberate efforts to supply mineral supplements to farmers or organise farmers to get supplies from Morogoro town over 300 km away from Mahenge town.

Table 6: Use of mineral supplements to feed cows in the Project area

Farmers with	Used mineral blocks	Used common salt	Not used any mineral suppl.	Total
F1 cows	5 (26.3)	5 (26.3)	9 (47.4)	19
Boran cows	1 (6.2	4 (25.0)	11 (68.8	16
Total	6 (17.1)	9 (25.7)	20 (57.1)	35

* Figures in brackets are percentages

ii) Pasture development

Eleven (11) out of 19 (or 58%) interviewed farmers had established pasture plots with average area of 0.46 acres. The project had brought Rhodes grass *(Chloris gayana*) for establishment. Some farmers have planted Rhodes grass while other have preferred elephant grass ("mabingobingo" or "majani tembo"). At this point it is difficult to discuss which grass species is better under Vigoi conditions. The extension service should set demonstration plots and assess dry matter (DM) yields from different grass species which would later be recommended to farmers. Legumes have also to be introduced as they improve the nutritive value of the grass sward at the same time increase soil N and improve DM yield of the pasture plots.

3.4 Project Management

3.4.1 Selection of beneficiaries

Village committees were requested to nominate ten farmers who would be recipients of the cows. The major criterion used was that they should be resource poor farmers. At a later meeting of the division, seven farmers from each village were chosen randomly.

Through discussions with farmers and VEOs, it was evident that the procedure was wrong for several reasons:

a) Some of the farmers are not within easy reach

b) Farmers are sparsely located in the eight villages. This has resulted in difficulties to move the breeding bulls for long distances across villages.

c) Household interest and ability to incur initial costs before the cow generates some income was not taken into account. For the past two years some farmers have had to pay for concentrates, grass, inoculations, matings, treatment, etc. A few farmers are financially not capable to do that and that threatens even the survival of the cows.

3.4.2 Performance of farmers and project staff

With exception of one or two farmers, most of them were very keen with feeding of the cows and disease control measures. Recording was poorly done and that could be attributed to the fact that no recording charts had been developed nor was serious follow-up done. Heat detection has been a problem as a result of lack of experience and in-adequate training.

It was admitted that many or all extension workers have not previously worked with dairy development projects. The three weeks training at LITI Mpwapwa gave them the on-station exposure of managing dairy animals only but not the on-farm working with farmers. Consequently, most extension workers did not know their role in the project. Their advice to farmers concentrated on cow shed, cleanliness, feeding, pasture development and animal health aspects. A few VEOs said they gave advice on heat detection and recording, but practically no good results were seen in the field.

One of the VEOs who is also assisting the project manager was known by almost all the farmers and visited them frequently. It is a fact that he has been keen on the project, knows all farmers and hard working. If exposed to dairy cattle recording and monitoring, he could do a much better job for the project.

3.4.3 Monitoring and evaluation

There was a clear evidence that all farmers were visited 2 to 4 times in a month during 1998. Discussions with VEOs also indicated that they visited farmers to enforce aspects mentioned above. However, there was nothing designed to collect records from the farmers and report them to the project office for compilation and subsequent report writing or evaluation. There were no project meetings as such though reports were superficially discussed during monthly training sessions (MTS). Lack of well designed monitoring and evaluation system (sometimes even checking the validity of the data collected by VEOs) could be partly attributed to inadequate training of project staff and/or lack of exposure. So besides getting the Mpwapwa training as a refreshal course, project staff should have worked with a similar ongoing project in Tanzania.

3.4.4 Weakness in Operating the Project

Weaknesses in operating the project can be extracted from section 3.3 on performance of animals in Vigoi division. Here it may be worthwhile to underscore a few points.

a) Farmers do not have the experience to manage dairy animals. So far farmer's records are poor and no due emphasis was given on this aspect. VEOs do not advice farmers based on records kept by farmers.

b) VEOs have not been monitoring performance of animals in their respective villages. Milk production level, conceptions and calving rates, disease incidences, calf growth rates through measurement of heart girths and supply of basic inputs such as concentrates, minerals have not been followed up.

c) At least three sets of recording materials should have been developed, those used by the farmers, those that the VEOs use to transfer records from the farmer to the project office and cards maintained in the project office. Aspects of importance in the recording include: reproduction, milk production, calf growth and survival, pass-on activities, feeding and pasture development and animal disease control and health.

d) VEOs need to produce monthly reports which give details of what is happening on individual animals (matings, calving, deaths, disease, animals passed on, milk yield, type of feeds fed). At project office village reports can be compiled into a project report.

e) The project office is therefore expected to have project files on correspondences, monthly village reports and project report. In addition there should be individual record cards for each animal (calves, bulls, cows). Project personnel should design the recording system and charts to use.

It is important to note that there is no universally accepted mode of operating a project. Mode of operation should be designed to meet project objectives in an efficient way.

3.5 CAPACITY BUILDING ACTIVITIES FOR FARMERS AND WORKERS

The following training activities were done by the project:

i) Farmers: 5 days training at Mahenge on various aspects of dairy production

ii) Workers: - 8 VEOs were trained at Livestock Training Institute (LITI) Mpwapwa for one month in 1996 on dairy cattle production - 3 VEOs were trained at the National Artificial Insemination Centre (NAIC) Arusha for 3 weeks in 1996

iii) Six farmers and one worker had visited a dairy development project in Pemba.

Farmers in the Project area have had no previous experience in managing dairy animals. So a five day theoretical training was very in-adequate. They needed more practical skills. In similar dairy development projects (e.g.under Heifer Project International, HPI; Tanga smallholder dairy development project and in Kagera) farmers are sent to a livestock training institute for 2 - 3 weeks where they are taught the theoretical aspects and in the mornings and afternoons they work with dairy animals (e.g. milking, cleaning, calf feeding, record keeping etc).

Similarly, the training for the extension staff was in-adequate in only one aspect, record keeping and monitoring. They have the basic knowledge on dairy cattle husbandry but not the practicability of handling a dairy development project. This could have been attained if at least two project staff had visited and worked with a similar dairy project (e.g. Tanga smallholder Dairy Development) for about a month.

4. A SUMMARY OF PROBLEMS OBSERVED IN THE VIGOI PILOT DAIRY PROJECT

4.1 Training of farmers and extension workers has been in-adequate as elaborated in section 3.4 above.

4.2 Reproduction of animals: There is an apparent lack of knowledge on heat detection among farmers. This is worsened by poor recording of matings. Bulls are too few to service the sparcely located cows. AI has had few but very expensive inseminations. Further, the conception rate has been very low. For Boran heifers, it is not known when they should be mated for the first time, consequently pass on rate for the Boran cows will be very low.

4.3 Un-organized recording and monitoring system. It is important to note that having initiated this heifer-in-trust scheme, monitoring will continue for many years. According to De Wolff (1997) the project can last for at least 20 years, that is when the revolving fund (the cows) will have eroded to zero. Basic recording and monitoring has to be initiated.

4.4 Un-organized supply of inputs especially drugs and minerals. Farmers have complained about availability of these inputs. The project should encourage farmers to start their own organisation or have a working revolving fund. From the outset farmers should be told that there is nothing for free.

4.5 Low level of incomes of cow recipients: To give cows to poor farmers is a risk to the survival of the cow and/or may result into low cow productivity. This has somehow been exarbated by the long period between receiving the cow and her calving. To most of the farmers to wait for over two years is just too long!!

4.6 Future of the bull calves is not certain to some of the farmers. Bull calves emanating from crossing of Ayrshire bulls to Boran heifers have low genetic merit for use in the project area or other villages. The 75% exotic blood bulls from F_1 cows can be used on other F_1 cows to produce 62.5% exotic inheritance progeny. This is fine. Project policy and advisory work on this issue needs to be defined.

5. FINDINGS: EXPANSION OF THE PILOT DAIRY PROJECT

All four divisions (Malinyi, Mtimbira, Lupiro and Mwaya) outside the project area were visited for the purposes enumerated in the methodology (Section 2). The following is a summary of the findings.

5.1 Malinyi

The human population was said to be around 16,800 people in five (5) villages (Malinyi, Kipingo, Lugala, Misegese and Igawa). Institutions around Malinyi township include Tumaini seminary, Lugala hospital, Kipingo secondary school and a few restaurants. There are only nine (9) dairy animals in the area. Most of the milk is supplied by Masai and Sukuma herdsmen selling at Tsh. 250/= per litre. Milk supply is seasonal with high supply of milk in the wet season. There is current demand for milk during the dry season. The potential for fodder production is low. Discussions with a few herdsmen revealed that the area has high incidences of trypanosomiasis and veterinary drugs are difficult to get.

There are three livestock extension officers in the division. One has a tse tse control certificate and the others have diplomas in Range management.

5.2 Mtimbira

Mtimbira ward has about 10,000 people in four villages (Mtimbira, Madibila, Munga and Kipenyo). The neighbouring Usangule ward has 7,865 people in Usangule and Karangakelo villages. There are 15 dairy animals at Itete mission and two at Munga mission. There is a health centre at Munga mission and a couple of restaurants in Mtimbira township. Milk is supplied by the Wasukuma at sh. 200/= per litre. Like Malinyi, milk supply is seasonal. There is high supply of milk in the wet season and current demand in dry season. Adulteration of milk is a common practice by milk suppliers. Some cattle are moved away from Mtimbira area because grazing conditions have deteriorated. Opportunities for fodder production at the moment are rather limited.

There are two livestock extension officers in the area. One has a certificate in Animal health and production and the other extension officer has a diploma in range management.

5.3 Lupiro

Lupiro ward has about 9,100 people (from Kinet project census of October, 1998) in Lupiro, Igita, Nakafuru, Igumbiro and Milola villages- Very close to Igota, there is Kichangani village with about 3,035 people. The whole area from Milola to Idunda is supplied with milk by the Wasukuma and Barbaig. Milk comes as far away as Kivukoni over 25 km from Lupiro. This usually results in late delivery of milk at Lupiro. A litre of milk is sold at sh. 300/=. The potential demand for milk is high at this place because of the Ndolo irrigation project, presence of workers of the Kilombero Valley Teak Company (KVTC), Igota secondary school and a couple of restaurants. There are no dairy animals in the area. The potential for fodder production is good along the valley of river Luli.

There are two livestock extension officers in the area. One has a certificate in Animal health and production and the other one has a diploma in farm management.

5.4 Mwaya

Based on 1988 census, the human population for Mwaya, Mbuga and Ruaha was about 6,290, 5,910 and 6,240 people, respectively. There are 11 head of dairy cattle at Ruaha mission. Milk for Mwaya townships is supplied by five (2 Barbaig and 3 Wasukuma) traditional herdsmen. Milk is sold at sh. 300/= per litre. The milk demand is high because of presence of a health centre, a cotton ginnery, primary school, about 6 restaurants and the head quarters of Selou Game Reserve some 9 km from Mwaya. Demand for milk is higher during June - December months when Mwaya receives many visitors coming to the game reserve. The dairy goat project has placed dairy goats in Sali ward 29 km from Mwaya. Herdsmen have complained of high incidence of CBPP and unavailability of veterinary drugs. There is quite good potential for pasture development along river Ruaha and Luhombero. Elephant grass is plenty in the valleys and roadsides.

There is only livestock extension worker in Mwaya with a certificate in Animal health and production who is currently engaged in the Sali dairy goat project though still stationed at Mwaya.

5.5 General remarks

In all divisions, milk is consumed fresh (whole or in tea) or as fermented milk (mgando, mtindi). Table 7 is an extract from Appendices 4 and 5 assuming only 30% of the traditional herd is milked and a 0.5% GDP growth. It is apparent from the table that areas with high milk deficit in descending order are Mwaya, Vigoi and Lupiro. As already mentioned, the deficit in these three divisions is mainly due to low numbers of traditional cattle (also see Appendix Table 6).

Based on:

a) The clear milk supply deficit in the three divisions

b) Distance from Mahenge town is only 40 km enabling the dairy project supervisor to visit Mwaya and Lupiro on regular basis on a project motorcycle,

c) The good forage supply and pasture development potential,

d) The assumption that corrective measures can immediately and easily be instituted in the Vigoi project, it is recommended that the project be expanded to Mwaya and Lupiro divisions first. Only 15 - 20 cows per division be introduced and preferably F_1 heifers.

Table 7 Estimated total milk supply and projected demand for 1999 and 2004 in all the divisions

		Division				
Variable	Year	Vigoi	Malinyi	Mtimbira	Lupiro	Mwaya
Estimated total	1999	92,906	2,074,385	1,501,176	639,240	212,964
Milk supply [a]	2004	120,960	2,296,171	1,662,168	705,790	237,847
Projected [b]	1999	-728,981	1,981,431	1,221,256	210,515	-964,175
Demand	2004	-818,618	2,185,084	1,343,505	210,895	-1,090,886

a) Assumed 30% of traditional cattle are milked
b) Assumed 0.5% annual GDP growth.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

6.1.1 Impact of the project

a) Though it is too early to evaluate the impact of the project, preliminary results show increased income among farmers with cows who have calved down. Income has been earned through sale of milk, manure, animals and from bull services. In this respect the project has contributed toward poverty alleviation in the area.

b) In all households, introduction of dairy cattle has increased work load. The additional work load has been evenly distributed to men and women. Considering the fact that women already had more family obligations, it implies that their work load is still much higher compared to men.

c) The project has, to some extent, reduced rural un-employment among youths, has increased milk consumption to an estimated figure of 74 l/annum and thus improved human nutrition of the households as well as the community. No negative impact on the environment has so far been observed.

6.1.2 Animal Husbandry

So far there have been low incidences of diseases and mortalities. Milk production levels among F_1 and Boran cows are encouraging. Mean calving interval (of 516 days) is long yet comparable to performance in other similar dairy development projects in Tanzania. AI has been too expensive and should be abandoned. However the bulls bought were too few. Comparing the F_1 and Boran system of raising pass-on heifers, the latter has so far performed very badly because over 70% of them have not yet calved.

6.1.3 Project management and training

There have been no project files nor meetings. There has not been even some regular internal evaluations. Both farmers and project staff have been inadequately trained. Project staff lack exposure on how to manage a smallholder dairy development project.

6.1.4 New project sites

In the short term, Lupiro and Mwaya divisions have shown to have large milk supply deficits. On the other hand, there is high potential for pasture development. The other two divisions Malinyi and Mtimbira with high local cattle populations could still rely on them for milk supply.

6.2 Recommendations

6.2.1 Training

- Extension workers should visit Tanga smallholder dairy development project for one month to study dairy recording practices and monitoring.
- During the initial training of farmers, they should be sent to a training institute for about 2 weeks. Farmers will be restless it the course duration exceeds 2 weeks. Skills to learn should include: cow shed construction, feeding of calves and cows, milking and milking and milking hygiene, pasture establishment and management, keeping and use of records and common diseases affecting dairy cattle.
- Farmers should visit Tanga or Moshi on a farmer-to-farmer exchange program. There should be on-farm field days where certain specific topics are discussed based on what they see on that farm. Further, VEOs could organize village seminars on identified topics at no cost.

6.2.2 Selection of farmers

In selecting farmers, it is important to carry out a survey in the villages ear-marked for starting the project. A structured questionnaire can be used in the survey. Otherwise guided discussions plus observations would suffice. The following criteria could be followed out:

- The farmer should have interest and if possible previous experience in managing livestock.
- Though priority is on the poor farmers, yet selected individuals should be capable of buying basic things such as building a good cowshed, and some equipments e.g. a knap sprayer, spade, fork, buckets, drugs and concentrates.
- The location of the farmer should easily accessible by the VEO and easen movement of bulls.
- The farmer should have a plot (at least one acre) where he/she can establish fodder.
- Available family labour to take care of the animal. It is not proper for the family to solely depend on hired labour. Literacy is important to at least one member of the family (husband, wife, son or daughter) to enable them to keep records and use them as a management tool.

6.2.3 Low conception rate

- Monitoring of individual cows be strengthened by VEOs and farmers. More training is required on this aspect.
- Number of bulls to be increased from the current two to seven. Each village should have a bull.
- AI be abandoned till such a time when heat detection and management has improved or the project intends to raise replacement bulls from the farmers herds.
- Supplementation for minerals especially phosphorus has to be encouraged.

6.2.4 Input supply

- Organize farmers into a farmer association /cooperative which can buy a variety of inputs (minerals, drugs, concentrates, acaricides, syringes, etc) for all the farmers.
- To provide a revolving fund whose monitoring should be rather strict.

6.2.5 Dairy cattle monitoring system

- Design a simple recording system which farmers and VEOs can use. VEOs and farmers can thereafter have a two days seminar to discuss in details the introduced recording system.
- Regular project meetings be introduced. Across village evaluations be done to assess efficiencies of VEOs.
- Measuring of milk yield be done volumetrically but it will be good if it will be standardized and recorded to the nearest half or preferably quarter a litre. The project can provide uniform plastic containers for that purpose.
- In section 3.4.3 and 3.4.4 the issue of monitoring and evaluation has been discussed. It is recommended that besides having the monthly reports, an annual report would be very useful in evaluating project trends in terms of calvings, milk production, disposals, pass-on rates, pasture development etc. It requires only tabulations of performance levels for different years to know the trends.

6.2.6 Exotic blood level in cows

There is undisputed evidence from the tropics that cows above 75% exotic blood do not perform well because farmers cannot offer them the management they require to exhibit their genetic potential. It is recommended that 75% exotic inheritance bulls be used on F_1 cows so that the progeny will have 62.5% exotic blood. Efforts should be made to maintain the exotic level between 50 and 75%.

6.2.7 Feeding of dairy cows and pasture development

- Extension officers should frequently insist on proper feeding of cows including provision of ad lib water, mineral supplements and concentrates.
- Farmers be encouraged to use and store crop residues as a feed resource.
- Compared to *Chloris gayana*, elephant is a better grass species. Where water supply is plenty, Guatemala grass is recommended. Inclusion of legumes in pastures will improve soil fertility at the same time improve the nutritive value of the herbage.

6.2.8 Disposal of bulls from project farmers

- F_1 bulls from Boran cows should (if possible) be sold at a young age or be raised for beef hence they have to be castrated.
- Bulls from F_1 cows will have 75% exotic blood but not all bulls will be good for breeding purposes. Good dam milk yields and good growth rate of the bull himself (based on heart girth measurements) could be good criteria for selection.

6.2.9 Animals to pass on in the Boran system

Some farmers prefer to pass on the F_1 heifer born from the Boran cow rather than the Boran cow herself. Since the signed contracts state that the cow be passed on, at this juncture it may be wise to give farmers free choice between the two alternatives.

6.2.10 Calf feeding system

Because of the advantages of partial suckling mentioned earlier, it is recommended that VEOs urge farmers to practice this method. It is even more important for farmers with Boran cows.

6.2.11 Expansion of the project

It is assumed that the small deficiencies of the Vigoi project reported in this document can easily be rectified if the project management is determined to do so. Based on the survey results and the estimates of milk supply and demand in Ulanga district, it is recommended that the dairy project be expanded to Lupiro and Mwaya divisions.

It is assumed that farmers will be well trained and monitoring will be coordinated from Mahenge office. It is recommended to reshufle some of the extension staff in order to balance new obligations and their training backgrounds. The extension officer at Mwaya is currently engaged in the dairy goat in Sali ward 29 km from Mwaya township. For Mwaya, the district livestock office should give due emphasis to the two alternatives of milk production.

It is recommended that only 15 - 20 farmers in each of the two divisions (a maximum of 40) be involved at the start. Preferably F_1 heifers be given to farmers.

7. REFERENCES

Amani H.K.R., 1996. Poverty Profile and Poverty Alleviation Report to the Irish Embassy, Dar es Salaam, October 1996.

De Wolff, J. 1997. Heifer-in-trust schemes. Monitoring. In: Proceedings of Tanzania Society of Animal Production Vol. 24: 105 - 114.

Houterman, J.F.; Lutalala, E.M.; De Wolff, J.; Nholope; D.J.K. and Stanslaus, D. 1993. The monitoring system of the Kagera smallholder dairy extension project. In: Proceedings of Tanzania Society of Animal Production Vol. 20: 216 - 231.

Rutamu, I.B.; Minja,F.N.; Munster, B.H.M.; Schooman,L.; Swai, E. and Zylstra,L. 1994. The sustainability of heifer-in-trust credit scheme: The Tanga experience. In: Proceedings of Tanzania Society of Animal Production Vol. 21: 96 - 113.

8. APPENDICES

Appendix 1 Terms of Reference for Feasibility Study of the Expansion of the Dairy Pilot Project

1. INTRODUCTION

Ulanga District lies in South-central Tanzania. It covers 24,560 square kilometres of which 30% is suitable for grazing. The District is comprised of three zones; lowland, which accounts for 86% of total land, middle altitude (6%), and highlands (8%). It has five divisions, namely, Vigoi, Mwaya, Lupiro, Mtimbira and Malinyi. The lowland which is 700m above sea level is subject to seasonal flooding. Where pastoralists graze their cattle in the middle altitude zone it is less fertile and covered with natural miombo woodland. highland areas offer the least potential for agriculture due to poor stony soils, low temperatures and difficult access. The climate and abundant natural vegetation is conducive to livestock development especially for dairy cattle.

The district has a population of 58,724 head of cattle, 3,219 goats, 3,296 sheep, 403 pigs and 101,863 poultry, as per census of 1994/95. Most of the animal keepers are immigrants e.g. Wasukuma, Wamasai and Wamang'ati. Dairy cattle have been reared at Kasita Missionary where there is farm. Vigoi division has 56 dairy cattle.

Recently the Livestock Department introduced 55 cattle and 2 Ayrshire bulls through Irish Aid as part of pilot project.

A number of requests have been received from throughout the District by people who are keen to replicate the project. It would be timely therefore to evaluate the pilot project before considering expansion.

2. OBJECTIVE

To examine the performance of the pilot project and to further recommend the viability and feasibility of expansion into new geographical areas. Sustainability issues are of particular importance. If appropriate, a budget for expansion should be prepared. Three key questions should be answered.

A. Have the original project objective been achieved, if not why?
B. What lessons have been learned and what changes should be made for any future projects?
C. Should the project be replicated elsewhere?
D. Are the new geographical areas proposed suitable, and what modifications might have to be made to integrate the project into new environments?

Impact

1. What has the financial been at household level? This should be quantified within a valid sample. An assessment of expenditure as well as income should be made.
2. What has the economic impact been within the project area? This should also be quantified.
3. What has the social impact been, particularly with respect to poverty, gender, and inequality?
4. Has the project imparted on the environment either positively or negatively?
5. Has the project contributed to any improvement in human health, particularly nutrition?

Animal Husbandry

1. To examine calving intervals and analyse patterns
2. To assess feeding standard against milk production of the cows
3. To tabulate growth rates of all calves
4. To compare the natural mating method against artificial insemination including cost/benefit comparisons
5. To compare the Boran versus the F1 system bearing in mind costs and benefits
6. To assess patterns of animal health including preventative treatment, sickness patterns, and health care provision
7. To analyse and tabulate milk production yield

Project Management

1. Assess the performance of project staff and select farmers
2. Assess the farmer selection method and make recommendations
3. Assess administrative systems of project staff and farmers
4. Assess M & E systems and make recommendations if appropriate

Capacity Building

1. Assess training component of the pilot project for both farmers and project staff
2. Recommend future training requirements of both farmers and project staff

Sales and Marketing

1. Assess demand and calculate financial and economic value at project site and proposed
2. Assess supply potential at project site and proposed sites
3. Predict market saturation point at all sites
4. Recommend strategies for product diversification, if appropriate
5. Recommend strategies to create an 'enabling environment' for the private sector, particularly with regard to the supply and sale of inputs
6. Recommend appropriate courses of action to farmers on the most efficient use of manure.

3. BACKGROUND TO THE PROJECT

With support from Irish Aid, studies were carried out on the establishment of profitable small holder dairy in Vigoi Division. The study included an assessment of climatic conditions, the calculation of farm income and a review of nutritional levels.

Women were prioritised as beneficiaries

The project started by training & staff at LITI Mpwapwa for 3 weeks, on dairy cattle husbandry practices.

Farmers were then selected and trained in the construction of appropriate cattle sheds and cattle management adoption a zero grazing system. 24 farmers received improved breeds and 32 farmers received Boran cattle.

After training farmers built holding facilities at their respective sites before acquiring the cattle.

Other activities related to the project were the purchase 24 in calf, improved heifers from Sao Hill and 32 Boran heifers from Mruazi Tanga.

2 Ayrshire bulls were also purchased. Lately the programme has introduced Artificial Insemination services.

To date, 26 calves were calved down by improved breeds, including 18 bulls and 8 heifers. From Boran cattle a total number of 4 calves, 1 bull, and 2 female calves

(1 improved and 1 indigenous).

4. ISSUES TO BE STUDIED

1. Impact in terms of household incomes and expenditures, the local economy, the society within the project boundary (gender, inequality, jealousies and levelling mechanisms), human health especially nutrition, and the environment.

2. Animal husbandry, especially management by farmers, including sickness, growth rates and milk yields, and technical back up from project staff.

3. Project management in terms of efficiency, effectiveness, and accountability.

4. Capacity building with respect to what has already happened and what might happen in the future.

5. Sales and marketing focusing on supply and demand and sustainability issues

5. PLAN OF WORK

The consultancy will be for 28 days including travel from Dar es salaam. It is proposed that the Consultant start work in early September 1998. One day at the beginning is allocated for introduction, discussion and reading. One day before leaving is set aside for feed back. It is suggested that field work including visit to the interested institutions is divided roughly between the 5 divisions of Mwaya, Vigoi, Malinyi, Lupiro and Mtimbira. Two technical veterinary staff will be available to the Consultant during the visit.

A number of methodologies will be employed including formal and informal interviews, literature review, physical examination, socio-economic survey, and the utilisation of financial and economic tools such as cost/benefit analysis.

6. EXPERTISE

Possibly two Consultants will be required, one with a background in dairying and small scale business development, and a social scientist with considerable experience in household data gathering.

7. REPORTING

A preliminary report is expected 14 days after the field visit and the final report 4 weeks after the visit. A summary in Kiswahili would be appreciated the feed back session prior to leaving can be brief and presented orally. During report writing should the need for clarification arise it is suggested that the Embassy of Ireland be used for easiest communication (radio, letters, or occasionally telephone) Contact Dr. Lugeye Agricultural Advisor phone 255 52 666 348/666211/667816.

8. TIME SCHEDULE

20-9-1998	-	Travel from Dar/Morogoro to Mahenge
21-9-1998	-	Introduction, discussion and reading
22-26-9-1998	-	Field study in Vigoi division
27-1-10-1998	-	Field study in Malinyi division
2-6-10-1998	-	Field study in Mtimbira division

7-11-10-1998	-	Field study in Mtimbira division
12-14-10-1998	-	Field study in Mwaya division
15-10-1998	-	Rest
16-10-1998	-	Discussion and prepare for feedback session
17-10-1998	-	Feedback
18-10-1998	-	Travel to Dar es salaam / Morogoro
18-10-198	-	Final report

Appendix 2 Itinery of Field Work

31.12.1998 Travel from Morogoro to Ifakara
Car problems with tyres spend a night at Ifakara

01.01.1999 Travel from Ifakara to Mahenge
Preliminary discussion with Mr. Mitondwa, I.

02.01.99 Visited 6 farmers with F_1 dairy animals

03.01.99 Visited 7 farmers with F_1 dairy animals

04-.01.99 Visited 6 farmers with F_1 dairy animals

05.01.99 Visited 11 farmers with Boran heifers

06.01.99 Visited 5 farmers with Boran heifers

- Discussions with 6 project VEOs
- Discussions with Mr. P. Nkulira, planning officer

07.01.99 Discussions with project manager Mr. S. Chilangilo

- Travelled to Malinyi division

08.01.99 Discussions with ward Executive Mrs. Avelina Ngaziwa, Diwani and Division Agric. Extension officer Mr. Filbert Nkunta

- Visited Tumaini Seminary, Lugala hospital, Kipingo secondary school.
- Had discussion with Mr. Simba (VEO), several herdsmen and owners of restaurants.

09.01.99 Travelled to Mtimbira, visited and discussed with 2 Wasukuma herdsmen.

- Visited Munga mission and had discussions with Mr. Nyange (VEO).

10.01.99 Travelled to Lupiro via Itete mission. Had discussions with Mr. Donald Senga (VEO at Kivukoni) and Mrs. Gittu Manonga a Mang'ati livestock keeper.

11.01.99 Talked to Mr. Aziz Kaloya Lupiro ward executive, Mr. Job Mchalu – Diwani and Mr. Tuzike Likangage village executive for Kichangani.

- Also had discussions with owner of Aruza restaurant at Kichangani.
- Travelled to Mahenge

12.01.99 Went to Mwaya

	-	Discussions with Mr. Denis Goha (ward executive, Mr. Robert Mahenge (VEO), Mr. Salum Bori (Mwaya village chairman), Mr. Abdul Mlindoko (Community development officer) and Mr. Patric Sanga (owner of Sokomoko restaurant).
	-	Visited Mr. Semi Maganya (Sukuma heardsman), Mwaya mission with exotic dairy cattle and discussed with Mr. Salvatory Mbarouk (farm manager).
14.01.99	-	Discussions with Mr. Kihiyo, C.
	-	Visited one farmer in Vigoi for additional data
	-	Collection of secondary data in office
	-	Summarizing data, entry of data in computer
15.01.99	-	Discussions with Mr. A. Mlinga (Vigio division secretary)
	-	Collection of secondary data in office
	-	Visited Mahenge weather station
	-	Data entry and analysis
	-	Preparation of a feedback
16.01.99	-	Briefing Session
	-	Travel back to Morogoro

Appendix 3 Ulanga District Council

FEASIBILITY STUDY OF THE PILOT DAIRY PROJECT
FARMER QUESTIONNAIRE

A: BACKGROUND INFORMATION

1. Interviewer ----------

2. Respondent name ----------

3. Village ----------4 Ward ----------

5 Division ----------

6 Gender of household head ----------7 Age of household head----------

8 Age of wife----------9 Education level ----------

10 Household size ----------11 Adult males----------

12 Adult females ----------

B LAND AVAILABILITY AND USE

13 Give acreage of plots owned and/or rented

Plot No	ACREAGE	Owned=1 Rented=2	Rental fee if rented
1			
2			
3			
4			
5			
7			
7			
Total			

14. Please indicate land allocated to major crops and livestock related enterprises in 1997/98 cropping season

Crop/fodder	Acreage
Maize	
Beans	
Paddy	
Sorghum	
Millet	

Planted fodder	
Grazing land	
Fallow land	
Others (mention)	

C. LIVESTOCK PRODUCTION (INCLUDING DAIRY)

15. Indicate the number and breed of the following animals in your farm:

Animal type/category Adult cows (3 years and above	Number	Breed
Cows in milk		
Dry cows		
Heifers (1-3 years)		
Female Calves (0-12 months)		
Bulls (3 years and above)		
Steers (1-3 years)		
Male calves (0-12 months)		
Goats		
Sheep		
Pigs		
Chicken		
Others (mention)		

16. If dairy cattle are raised, indicate source of breeding stock and purchase prices. Source ----------
---------- Price per animal ----------

17 What are your breeding practices? (a) Bull use (b) AI (c) a and b-------

18 Mating fee for bull---------- AI Charges per insemination-----

19 Indicate the cost incurred in cow shed construction and related structures----------
20 Indicate the number of people involved and time spent in the following activities:

Activity	Number of people	Male=1 Female=2 Both=3	Time spent
Grazing			
Watering			
Fodder cutting/collection			
Stall feeding			
Sanitation (cleaning)			
Veterinary care			
Milking			
Marketing			
Others (mention)			

21. Do you use hired labour for any livestock related activity? Yes / No----------

22 If yes, mention the activity and cost of labour per day. Activity--------- Cost per day----------

23 Has the workload in your household increased since the introduction of dairy cattle?
Yes / No---------- If yes, whose workload? Women / men / all? -----

24. Give the quantities and prices of the following inputs / tools purchased for dairy cattle:

Input / tool	Quantity (indicate units)	Price per unit
Fodder (mention)		
Concentrates		
Minerals		
Veterinary drugs / vaccines		
Tools and equipment Others (mention)		

25. Give the following details for dairy cows:

	COW1	COW2	COW3	COW4
Age at first calving				
Calves born up to now				
Calves dead within 12 months				
Last calving date				
Previous calving date				
Weaning age of calf				
Average milk yield				
Health record of cow				
Other trait				

26 (a) Indicate cattle deaths in 1997 and 1998

Cattle category Calve	1997	1998
Heifers		
Steers		
Adult cows		
Bulls		

(b) What were the major cattle diseases in 1997 and 1998

Disease	Frequency occurrence	Control
ECF		
Foot and Mouth disease		
Abortion		
Worms		
Others (mention)		

27. Indicate the number and price of the following animals sold during the last 12 months:

Animal type	Number sold	Price per animal
Culled cows		
Bulls		
Heifers		
Steers		
Calves		
Goats		
Sheep		
Pigs		
Chickens		
Others (mention)		

28. How do you dispose fresh milk?

Use	Quantity in litres	Price per litre
Calf feeding		
Consumed at home Sold to neighbors		
Sold to vendors at farm		
Sent to local market		
Fermented		
Others (mention)		

29 Are you able to sell all milk produced everyday? Yes / No----------

30 If not what do you do with the unsold milk? ----------

31 If you ferment milk, do you ferment for home use or for sale? ----------

32 If for sale, where do you sell? ---------- Price per litre ----

33 Please estimate the amount of animal dung (manure) produced in your farm ----------
---

34 How do you dispose the animal dung (manure) (i) Use in own farm (ii) sell to neighbors (iii) Give it away free of charge (iv) Both (i) and (ii) ----------

35 If you have a bull, do you allow your neighbors to use it? Yes / No.----------

36 If yes, at what fee per mating? ----------

D TRAINING AND EXTENSION

37 Have you attended any training? Yes / No ----------

38 If yes, what type of training did you attend? (a) short term training (b) Seminar / workshop (c) study tour (d) Meeting organized by Project (e) Other (mention)

39 Where was the training conducted? ---------- 40 For how long? ---

41 Did the training address your perceived needs? Yes / No ----------

42 Mention the aspects on which you were trained ----------

---

43 Has the training enabled you to easily follow recommended husbandry practices? Yes / No ---------- If yes, indicate how ----------
---

44 Who met the training costs? ----------

45 If all the training costs were covered by the Project, would you be willing to contribute to the cost of your training in future? Yes / No ---------- If no, give reasons ----------
---

46 Do you know your village extension officer? Yes / No ----------

47 How many times has he visited you last year? ----------

48 If you have been visited, on what aspects have you been advised? ----------
---
---

49 Has the advice been useful? Yes / No ----------

50 Who pays for the services provided by the VEO and / or Veterinary officer? ----------
---

51 If they are paid by the Project / Government, would you be willing to pay for those costs in future? Yes / No ----------

52 If no, give reasons ----------

Appendix 4 Estimated Milk Supply in Ulanga District - Assuming 45% Traditional Cattle herd is Milked

DIVISION	Supply Variable	1994	1999	2004	2009	2014	2019
VIGOI							
	Traditional herd	224	247	273	301	333	368
	Dairy herd		56	75	100	134	180
	Traditional herd production	20160	22230	24570	27090	29970	33120
	Dairy herd production		78086.4	104580	139440	186849.6	250992
	Total production	20160	100316.4	129150	166530	216819.6	284112
LUPIRO							
	Traditional herd	9650	10654	11763	12988	14339	15832
	Dairy herd		-	-	-	-	-
	Traditional herd production	868500	958860	1058670	1168920	1290510	1424880
	Dairy herd production		0	0	0	0	0
	Total production	868500	958860	1058670	1168920	1290510	1424880
MWAYA							
	Traditional herd	3004	3317	3662	4043	4464	4928
	Dairy herd		10	13	15	24	32
	Traditional herd production	270360	298530	329580	363870	401760	443520
	Dairy herd production		13944	18127.2	20916	33465.6	44620.8
	Total production	270360	312474	347707.2	384786	435225.6	488140.8
MALINYI							
	Traditional herd	30956	34178	37735	41662	45999	50787
	Dairy herd		17	23	30	41	55
	Traditional herd production	2786040	3076020	3396150	3749580	4139910	4570830
	Dairy herd production		23704.8	32071.2	41832	57170.4	76692
	Total production	2786040	3099724.8	3428221.2	3791412	4197080.4	4647522

MTIMBIRA							
	Traditional herd	22345	24671	27238	30073	33203	36659
	Dairy herd		15	20	27	36	48
	Traditional herd production	2011050	2220390	2451420	2706570	2988270	3299310
	Dairy herd production		20916	27888	37648.8	50198.4	66931.2
	Total production	2011050	2241306	2479308	2744218.8	3038468.4	3366241.2
ULANGA							
	Traditional herd	66179	73067	80671	89067	98338	108574
	Dairy herd		98	131	172	235	315
	Traditional herd production	5956110	6576030	7260390	8016030	8850420	9771660
	Dairy herd production		136651.2	182666.4	239836.8	327684	439236
	Total production	5956110	6712681.2	7443056.4	8255866.8	9178104	10210896

Appendix 5 Projected Demand for Milk in Ulanga District

DIVISION	Demand Variable	1988	1994	1999	2004	2009	2014	2019
VIGOI								
SCEN. 1:	Population	23982	27975	31806	36161	41113	46743	53144
0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	623532	727350	826956	940186	1068938	1215318	1381744
	Production Gap		-707190	-726639.6	-811036	-902408	-998498.4	-1097632
SCEN. 2	Population	23982	27975	31806	36161	41113	46743	53144
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	623532	729532.44	829297.56	947768.64	1072475.04	1228358.04	1402947
	Production Gap		-709372.44	-728981.16	-818618.64	-905945.04	-1011538.44	-1118835
SCEN. 3	Population	23982	27975	31806	36161	41113	46743	53144

1% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	623532	735767.76	835532.88	954003.96	1091181	1247064	1427888.28
	Production Gap		-715607.76	-735216.48	-824853.96	-924651	-1030244.4	-1143776.28
LUPIRO								
SCEN. 1:	Population	21630	25231	28686	32615	37081	42159	47932
0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	562380	656006	745836	847990	964106	1096134	1246232
	Production Gap		212494	213024	210680	204814	194376	178648
SCEN. 2	Population	21630	25231	28686	32615	37081	42159	47932
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	562380	657984.6	747965.4	854817.6	967293.6	1107888.6	1265355
	Production Gap		210515.4	210894.6	203852.4	201626.4	182621.4	159525
SCEN. 3	Population	21630	25231	28686	32615	37081	42159	47932
1% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	562380	663608.4	753589.2	860441.4	984165	1124760	1287850.2
	Production Gap		204891.6	205270.8	198228.6	184755	165750	137029.8
MWAYA								
SCEN. 1:	Population	40583	47340	53823	61193	69573	79100	89932
0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	1055158	1230840	1399398	1591018	1808898	2056600	2338232
	Production Gap		-960480	-1086924	-1243310.8	-1424112	-1621374.4	-1850091.2
SCEN. 2	Population	40583	47340	53823	61193	69573	79100	89932

0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	1055158	1234534.86	1403360.14	1603840.16	1814871.76	2078661.26	2374105.5
	Production Gap		-964174.86	-1090886.14	-1256132.96	-1430085.76	-1643435.66	-1885964.7
SCEN. 3	Population	40583	47340	53823	61193	69573	79100	89932
1% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	1055158	1245086.44	1413911.72	1614391.74	1846526.5	2110316	2416311.82
	Production Gap		-974726.44	-1101437.72	-1266684.54	-1461740.5	-1675090.4	-1928171.02
MALINYI								
SCEN. 1:	Population	26450	30854	35079	39883	45344	51553	58613
0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	687700	802204	912054	1036958	1178944	1340378	1523938
	Production Gap	1983836	2187670.8	2391263.2	2612468	2856702.4	3123584	0
SCEN. 2	Population	26450	30854	35079	39883	45344	51553	58613
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	687700	804609	914641	1045304	1182844	1354769	1547325
	Production Gap		1981431	2185083.8	2382917.2	2608568	2842311.4	3100197
SCEN. 3	Population	26450	30854	35079	39883	45344	51553	58613
1% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	687700	811486	921518	1052181	1203475	1375400	1574833
	Production Gap		1974554	2178206.8	2376040.2	2587937	2821680.4	3072689
MTIMBIRA								
SCEN. 1:	Population	25963	30286	34433	39148	44509	50604	57534

0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	675038	787436	895258	1017848	1157234	1315704	1495884
	Production Gap		1223614	1346048	1461460	1586984.8	1722764.4	1870357.2
SCEN. 2	Population	25963	30286	34433	39148	44509	50604	57534
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	675038	789794.46	897800.54	1026057.76	1161065.36	1329824.86	1518835.5
	Production Gap		1221255.54	1343505.46	1453250.24	1583153.44	1708643.54	1847405.7
SCEN. 3	Population	25963	30286	34433	39148	44509	50604	57534
1% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	675038	796544.84	904550.92	1032808.14	1181316.5	1350076	1545837.02
	Production Gap		1214505.16	1336755.08	1446499.86	1562902.3	1688392.4	1820404.18
ULANGA								
SCEN. 1:	Population	138658	161744	183893	209075	237706	270257	307265
0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	3605108	4205344	4781218	5435950	6180356	7026682	7988890
	Production Gap	1750766	1931463.2	2007106.4	2075510.8	2151422	2222006	0
SCEN. 2	Population	138658	161744	183893	209075	237706	270257	307265
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	3605108	4217976.36	4794793.64	5479764.16	6200785.76	7102062.76	8111493
	Production Gap		1738133.64	1917887.56	1963292.24	2055081.04	2076041.24	2099403
SCEN. 3	Population	138658	161744	183893	209075	237706	270257	307265
1% GDP	Population growth	2.6	2.6	2.6	2.6	2.6	2.6	2.6

	rate							
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	3605108	4254027.44	4830844.72	5515815.24	6308939	7210216	8255697.32
	Production Gap		1702082.56	1881836.48	1927241.16	1946927.8	1967888	1955198.68

Estimated Milk Supply in Ulanga District – Assuming 30% of the Traditional Cattle Herd is Milked

DIVISION	Supply Variable	1994	1999	2004	2009	2014	2019
	Traditional herd	224	247	273	301	333	368
	Dairy herd		56	75	100	134	180
VIGOI	Traditional herd production	13440	14820	16380	18060	19980	22080
	Dairy herd production		78086.4	104580	139440	186849.6	250992
	Total production	**13440**	**92906.4**	**120960**	**157500**	**206829.6**	**273072**
	Traditional herd	9650	10654	11763	12988	14339	15832
	Dairy herd		-	-	-	-	-
LUPIRO	Traditional herd production	579000	639240	705780	779280	860340	949920
	Dairy herd production		0	0	0	0	0
	Total production	**579000**	**639240**	**705780**	**779280**	**860340**	**949920**
	Traditional herd	3004	3317	3662	4043	4464	4928
	Dairy herd		10	13	15	24	32
MWAYA	Traditional herd production	180240	199020	219720	242580	267840	295680
	Dairy herd production		13944	18127.2	20916	33465.6	44620.8
	Total production	**180240**	**212964**	**237847.2**	**263496**	**301305.6**	**340300.8**
	Traditional herd	30956	34178	37735	41662	45999	50787
	Dairy herd		17	23	30	41	55
MALINYI	Traditional herd production	1857360	2050680	2264100	2499720	2759940	3047220
	Dairy herd production		23704.8	32071.2	41832	57170.4	76692

	Total production	**1857360**	**2074384.8**	**2296171.2**	**2541552**	**2817110.4**	**3123912**
	Traditional herd	22345	24671	27238	30073	33203	36659
	Dairy herd		15	20	27	36	48
MTIMBIRA	Traditional herd production	1340700	1480260	1634280	1804380	1992180	2199540
	Dairy herd production		20916	27888	37648.8	50198.4	66931.2
	Total production	**1340700**	**1501176**	**1662168**	**1842028.8**	**2042378.4**	**2266471.2**
	Traditional herd	66179	73067	80671	89067	98338	108574
	Dairy herd		98	131	172	235	315
ULANGA	Traditional herd production	3970740	4384020	4840260	5344020	5900280	6514440
	Dairy herd production		136651.2	182666.4	239836.8	327684	439236
	Total production	**3970740**	**4520671.2**	**5022926.4**	**5583856.8**	**6227964**	**6953676**

Projected Demand for Milk in Ulanga District

VIGOI	Demand Variable	1988	1994	1999	2004	2009	2014	2019
SCEN. 1:	Population	23982	27975	31806	36161	41113	46743	53144
0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	623532	727350	826956	940186	1068938	1215318	1381744
	Production Gap		**-713910**	**-734049.6**	**-819226**	**-911438**	**-1008488.4**	**-1108672**
SCEN. 2	Population	23982	27975	31806	36161	41113	46743	53144
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	623532	729532.44	829297.56	947768.64	1072475.04	1228358.04	1402947
	Production Gap		**-716092.44**	**-736391.16**	**-826808.64**	**-914975.04**	**-1021528.44**	**-1129875**
SCEN. 3	Population	23982	27975	31806	36161	41113	46743	53144
1% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26

	Demand	623532	735767.76	835532.88	954003.96	1091181	1247064	1427888.28
	Production Gap		**-722327.76**	**-742626.48**	**-833043.96**	**-933681**	**-1040234.4**	**-1154816.28**
LUPIRO								
SCEN. 1:	Population	21630	25231	28686	32615	37081	42159	47932
0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	562380	656006	745836	847990	964106	1096134	1246232
	Production Gap		**-77006**	**-106596**	**-142210**	**-184826**	**-235794**	**-296312**
SCEN. 2	Population	21630	25231	28686	32615	37081	42159	47932
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	562380	657984.6	747965.4	854817.6	967293.6	1107888.6	1265355
	Production Gap		**-78984.6**	**-108725.4**	**-149037.6**	**-188013.6**	**-247548.6**	**-315435**
SCEN. 3	Population	21630	25231	28686	32615	37081	42159	47932
1% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	562380	663608.4	753589.2	860441.4	984165	1124760	1287850.2
	Production Gap		**-84608.4**	**-114349.2**	**-154661.4**	**-204885**	**-264420**	**-337930.2**
MWAYA								
SCEN. 1:	Population	40583	47340	53823	61193	69573	79100	89932
0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	1055158	1230840	1399398	1591018	1808898	2056600	2338232
	Production Gap		**-1050600**	**-1186434**	**-1353170.8**	**-1545402**	**-1755294.4**	**-1997931.2**
SCEN. 2	Population	40583	47340	53823	61193	69573	79100	89932
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita	26	26	26	26	26	26	26

	Consumption							
	Demand	1055158	1234534.86	1403360.14	1603840.16	1814871.76	2078661.26	2374105.5
	Production Gap		**-1054294.86**	**-1190396.14**	**-1365992.96**	**-1551375.76**	**-1777355.66**	**-2033804.7**
SCEN. 3	Population	40583	47340	53823	61193	69573	79100	89932
1% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	1055158	1245086.44	1413911.72	1614391.74	1846526.5	2110316	2416311.82
	Production Gap		**-1064846.44**	**-1200947.72**	**-1376544.54**	**-1583030.5**	**-1809010.4**	**-2076011.02**
MALINYI								
SCEN. 1:	Population	26450	30854	35079	39883	45344	51553	58613
0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	687700	802204	912054	1036958	1178944	1340378	1523938
	Production Gap	**-687700**	**1055156**	**1162330.8**	**1259213.2**	**1362608**	**1476732.4**	**1599974**
SCEN. 2	Population	26450	30854	35079	39883	45344	51553	58613
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	687700	804609	914641	1045304	1182844	1354769	1547325
	Production Gap		**1052751**	**1159743.8**	**1250867.2**	**1358708**	**1462341.4**	**1576587**
SCEN. 3	Population	26450	30854	35079	39883	45344	51553	58613
1% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	687700	811486	921518	1052181	1203475	1375400	1574833
	Production Gap		**1045874**	**1152866.8**	**1243990.2**	**1338077**	**1441710.4**	**1549079**
MTIMBIRA								
SCEN. 1:	Population	25963	30286	34433	39148	44509	50604	57534

0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	675038	787436	895258	1017848	1157234	1315704	1495884
	Production Gap		**553264**	**605918**	**644320**	**684794.8**	**726674.4**	**770587.2**
SCEN. 2	Population	25963	30286	34433	39148	44509	50604	57534
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	675038	789794.46	897800.54	1026057.76	1161065.36	1329824.86	1518835.5
	Production Gap		**550905.54**	**603375.46**	**636110.24**	**680963.44**	**712553.54**	**747635.7**
SCEN. 3	Population	25963	30286	34433	39148	44509	50604	57534
1% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	675038	796544.84	904550.92	1032808.14	1181316.5	1350076	1545837.02
	Production Gap		**544155.16**	**596625.08**	**629359.86**	**660712.3**	**692302.4**	**720634.18**
ULANGA								
SCEN. 1:	Population	138658	161744	183893	209075	237706	270257	307265
0%GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	3605108	4205344	4781218	5435950	6180356	7026682	7988890
	Production Gap	**-3605108**	**-234604**	**-260546.8**	**-413023.6**	**-596499.2**	**-798718**	**-1035214**
SCEN. 2	Population	138658	161744	183893	209075	237706	270257	307265
0.5% GDP	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Growth	Per capita Consumption	26	26	26	26	26	26	26
	Demand	3605108	4217976.36	4794793.64	5479764.16	6200785.76	7102062.76	8111493
	Production Gap		**-247236.36**	**-274122.44**	**-456837.76**	**-616928.96**	**-874098.76**	**-1157817**

SCEN. 3	Population	138658	161744	183893	209075	237706	270257	307265
1% GDP Growth	Population growth rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6
	Per capita Consumption	26	26	26	26	26	26	26
	Demand	3605108	4254027.44	4830844.72	5515815.24	6308939	7210216	8255697.32
	Production Gap		**-283287.44**	**-310173.52**	**-492888.84**	**-725082.2**	**-982252**	**-1302021.32**

Appendix 6: Livestock Numbers in Ulanga District (Based on 1994 Vaccination Census)

Division	Cattle	Goats	Sheep	Pigs	Chickens
Vigoi	224	416	130	1,243	16,513
Mwaya	3,004	510	312	90	32,732
Lupiro	9,650	618	300	11	17,800
Mtimbira	22,345	558	958	112	27,255
Malinyi	30,956	2,214	1,752	9	18,570
Total	66,179	4,316	3,452	1,465	112,870