THE IMPACT OF A DAIRY CATTLE PROJECT ON HOUSEHOLDS' LIVELIHOODS IN KASULU DISTRICT, TANZANIA

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN RURAL DEVELOPMENT OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

This study was conducted in Kasulu district with the aim of assessing the impact of a dairy cattle project on the households' livelihoods. Muzye and Mnanila wards were surveyed. Purposive, stratified and simple random sampling techniques were employed to obtain the desired sample. Data were collected through a cross sectional survey from a sample of 120 respondents, 60 of whom had received dairy cattle and 60 without dairy cattle. Questionnaires for respondents with and without dairy cattle were used to collect data. Data were analysed using the Statistical Package for Social Sciences (SPSS) version 16 computer program. Descriptive statistics, multiple linear regression and t-test techniques were used to analyse the data. A t-test showed a significant difference ($t=2.978$, $df=59$, $p<0.05$) between households' incomes before and after the project intervention. The mean annual incomes for dairy cattle owners increased from 471 266.67 to 1 012 400.00 TAS after the project intervention. In addition, farmers with dairy cattle had higher mean annual incomes (1 012 400.00 TAS) than those without dairy cattle animals (523 596.67 TAS). Integration of dairy and crop enterprises increased crop yields due to the application of cattle manure. Farmers with dairy cattle (93.3%) reduced application of industrial fertilizers after dairying compared to 51.7% of households without dairy animals. The observed overall mean cow performance in terms of daily milk yield, lactation length and dry period were 7.25kg, 9.08 and 2.65 months, respectively. It was concluded that small scale dairy cattle enterprise had contributed significantly in improving households' livelihoods as regards to food security and increased purchasing power of goods and services. It is therefore recommended that guaranteed milk market, quality extension services and access to quality dairy animals will sustain the project. This calls for development partners to support farmers through small scale dairy schemes.

DECLARATION

I, **Kenneth Muganyizi Tefurukwa**, do hereby declare to the Senate of Sokoine University of Agriculture that this work is my own original work and that it has neither been submitted nor being concurrently submitted for a degree award in any other Institution.

_____ _____

Kenneth Muganyizi Tefurukwa **Date**

(M.A Rural Development Candidate)

The above declaration is confirmed by

_____ _____

Prof. Kifaro G.C. **Date**

(Supervisor)

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DEDICATION

This work is dedicated to my parents, Augustine Tefurukwa and Meltha Kyombakiza, my beloved wife, Jesca Rwiza, sons Prosper and Jasper and my daughter Catherine for their constant prayers and patience during my stay away from home while I was pursuing the M.A (Rural Development) programme.

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LIST OF ABBREVIATIONS

AFC	-	Age at First Calving
CHF	-	Community Health Fund
CI	-	Calving Interval
DALDO	-	District Agriculture and Livestock Officer
DWT	-	Diocese of Western Tanganyika
DP	-	Dry Period
ECF	-	East Coast Fever
FFS	-	Farmer Field School
GDP	-	Gross Domestic Product
HBS	-	Household Budget Survey
HIT	-	Heifer -In-Trust
K	-	Potassium
LL	-	Lactation Length
MDG	-	Millennium Development Goals
MLD	-	Ministry of Livestock Development
MoWLD	-	Ministry of Water and Livestock Development
NSGRP	-	National Strategy for Growth and Reduction of Poverty
P	-	Phosphorus
SPSS	-	Statistical Package for Social Sciences
TAS	-	Tanzanian Shillings
URT	-	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Agriculture is the back bone of the Tanzanian economy, presently accounting for about a half of the national income, three quarters of merchandise export, and is a source of livelihood for about 80% of Tanzanians. The relatively large size of the sector makes the overall growth performance in the economy and therefore improvement in the living standards of the people highly depends on what happens in agriculture. The progress in poverty reduction likewise is highly dependent on the growth of this sector due to the fact that the incidence and severity of poverty is twice as high in rural areas as in the urban areas (Kashuliza *et al.*, 2002). In 2006 the livestock industry sub sector in Tanzania ccounted for 5.9% of Gross Domestic Product (GDP) of which beef, dairy and other stock provided 40%, 30% and 30% respectively. Livestock also play other roles such as contribution to national food supply (Njombe *et al.*, 2008). For example, total milk production in 2009 was estimated at 1.6 billion litres (URT, 2009).

Most (70%) of litres of milk were produced by indigenous cattle raised for multipurpose objectives and only 560 000 litres were from improved dairy cattle consisting of Friesian, Jersey, Ayrshire breeds and their crosses with East African Zebu. The low productivity of indigenous stock has necessitated pursuance of ways and means of increasing the number of improved dairy cattle with the intension of raising milk production. With the assistance of bilateral donor agencies, Tanzania has supported a number of smallholder dairy development programs. This is due to the contribution played by the dairy industry to improve rural livelihood. However, Kivaria (2006) pointed out that increased and sustainable smallholder dairy production has generally been constrained by several factors

including poor management, inadequate feed resources (both in quality and quantity), unimproved genotypes, reproductive wastage, lack of dairying skills and problems related to marketing.

From 2002 to 2006, in collaboration with Austrian Government, Kasulu District council implemented a dairy cattle development project in 16 villages from 3 divisions namely Manyovu, Heru Chini and Buyonga. A total of 149 heifers were distributed to farmers as foundation stock (F1, Friesian x Boran) and these have multiplied making the scheme to expand and more farmers have benefited through the Heifer-In-Trust (HIT) model (DALDO Kasulu, 2006). Objectives of the project were to improve nutritional status and income of poor households in selected villages through sales of milk and integrating dairy cattle and crop production. Integration focused on vegetable production in lowland, coffee and banana production in highland. However, it is not very clear to what extent the project has enhanced farmers' livelihoods.

1.2 Problem Statement and Justification

The Tanzania Development Vision 2025 (URT, 2000) and National Strategy for Growth and Reduction of Poverty (NSGRP) among other things, put more emphasis on high quality livelihoods through undertaking various economic activities (URT, 2005). Studies done in Arumeru (Kisusu, 2003), Temeke (Mbapila, 2006), Ilala (Macha, 2008), and Igunga (Mngofi, 2009), show that dairy cattle farming contribute significantly to improved food security, access to education, health care and household income. Therefore significance of small scale dairying can be realized through regular incomes obtained by those households engaged in dairy related activities including producers, processors and traders of various dairy products (Mutabazi, 2002). Farmers use net profits from dairy cattle products to invest in other income generating activities and this ultimately improves

farmers' livelihoods. In order to assist the resource poor farmers, Kasulu district Council spent substantial amount of funds to provide dairy cattle in kind as an alternative means of credit.

Despite potential contribution of dairy cattle towards improved household livelihoods, yet little information was available as to what extent the dairy cattle project has contributed to household livelihoods. Therefore, lack of empirical information on the actual impact of a dairy cattle project on households' livelihoods was a primary constraint to better understanding of dairy farming in the study area. Though various studies have been done on the impact of dairy cattle on farmers' livelihood, but the impact vary from one place to another depending on how farmers were motivated to adopt the innovation, performance of the introduced animals and how supporting sectors like extension services, market and marketing are functioning. This study intended to provide better understanding on the extent dairy cattle contributed to farmers' livelihoods. Results from the study might be useful in identifying the challenges, opportunities, lessons learnt and achievements and provide an important input in other similar projects. Furthermore, the study results add up information to the little existing one, on which dairy development plans may be based for effective poverty reduction in Kasulu district.

Therefore, the general objective of the study was to assess the impact of a dairy cattle project on the households' livelihood in Kasulu district. There were three specific objectives which were to establish the contribution of the dairy cattle enterprise to the household's livelihoods, assess the integration between dairy cattle enterprise and crop production and determine the effects of geographical location on dairy cattle performance.

1.3 Conceptual Framework

A conceptual framework was developed for the sake of getting information needed by the study objectives and to identify the measurable variables (Fig. 1). The dependent variable which is household livelihood included the following indicators: improved food security, increased income, health, education, housing and household facilities/assets owned by the household members. The dependent variable was considered to be influenced by two groups of variables namely the background (demographic, socio-economic factors and supporting sectors) and independent variables (Dairy cattle farming, crop production and non farm activities). Dairy farming, crop production and non- farm activities are livelihood strategies which significantly determine the household livelihood outcomes. These outcomes include improved food security, increased household income, access to health and education , improved housing and household facilities or assets owned. Concepts and operational definitions for the conceptual framework are given in Appendix 1.

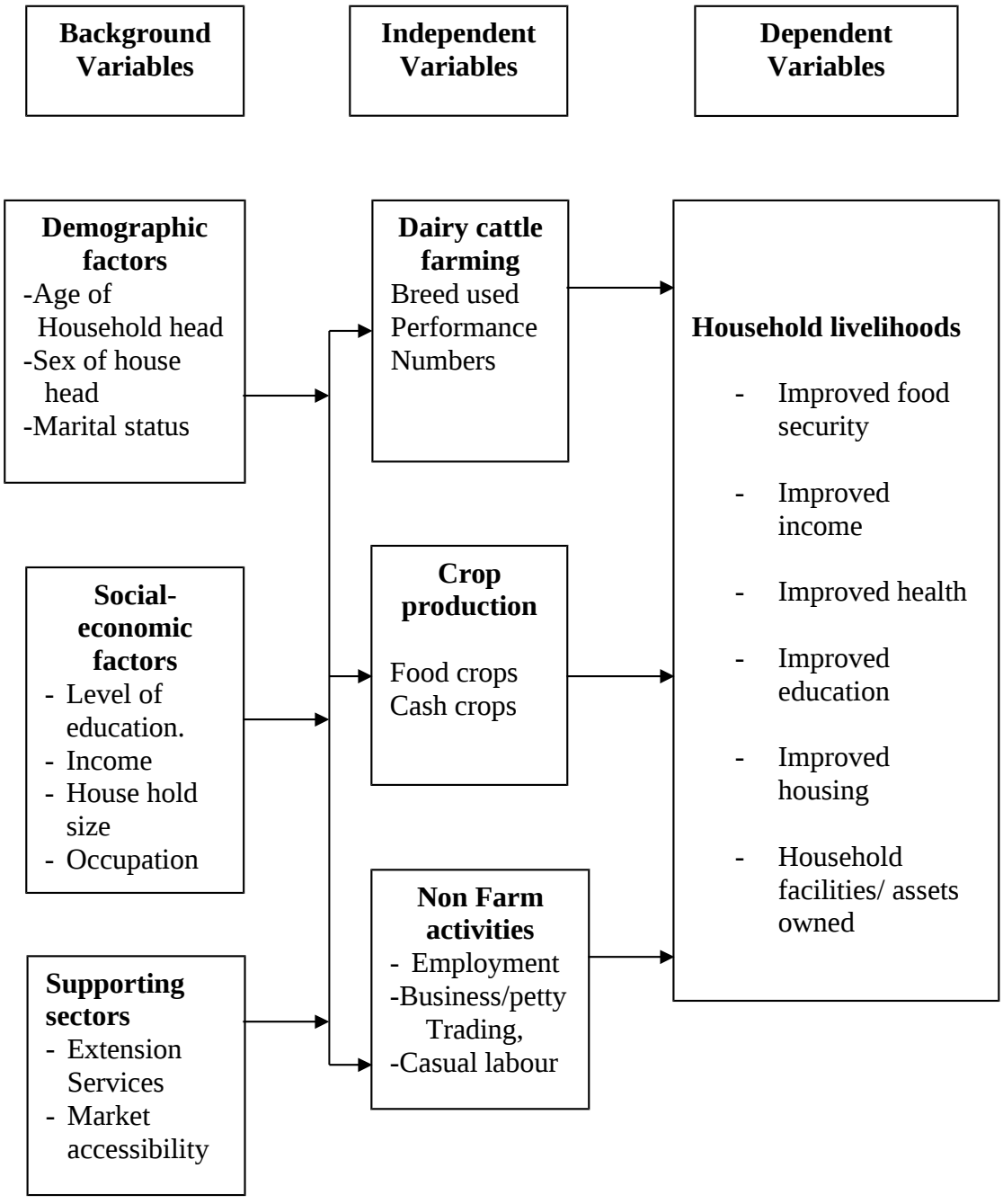

Figure 1: Conceptual framework for the impact of dairy cattle on the household livelihood

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Policy Review on Livestock Development

The National Livestock Policy categorizes the livestock production systems into two categories namely extensive and intensive. The intensive system, though limited in size, has been receiving more emphasis in investment and improvement because of its contribution to the market oriented economy. On the other hand, the extensive system, which is based on mostly agro-pastoralism and pastoralism, is a production system based on seasonal availability of forages and water resulting into uncontrolled mobility (URT, 2006a). The livestock policy aims at stimulating development in the livestock industry in order to increase rural and national income, improve food security and environmental conservation. More specifically this policy endeavors to increase national well-being of all stakeholders involved in the livestock industry, in this case small scale dairy farming. An objective towards dairy farming is to utilize available resources for commercialization and market oriented dairying in order to raise income of dairy stockholders and improve their livelihoods (URT, 2006a).

2.2 Impact Assessment Concept

Different authors interpret the term impact assessment differently. In this context, impact assessment is a measure of the direct out-put on the ultimate beneficiaries; it provides a measure of contribution of a project in a broader development goal referred to as a goal of the project (Mkenda, 1997; Makungu, 2004). It is also referred to the analysis or evaluation of the potential result of a particular program; which provides an approximate order of magnitude to be used by stakeholders. It is important to note that impact begins to occur when there is behavioural change. For instance, if farmers start using crop and

livestock production techniques as a result of the intensive training on improved production techniques, then the introduced technology will have led to an impact (Makungu, 2004).

Impact assessment can be carried out before project inception (Ex-ante) or after a project work has been completed (Ex-post). Ex-ante impact assessment is meant for planning, studying likely impact, and setting framework for ex-post impact assessment. The ex- post is meant to provide feedback to implementers, planners, policy makers and other stakeholders (Kisusu, 2003). The impact can be assessed by using the following procedures for comparison, these are “before and after”, “with and without” and the target versus achievement realized.

2.3 Approaches in Impact Assessment

2.3.1 Conventional approach

This approach focuses on assessing whether a project has met its stated objectives and contributed to the achievement of the overall project goal. It assesses criteria of project relevance, efficiency, effectiveness, impact and sustainability and looks at both intended and unintended impact (Ashley and Hussein, 2000).

2.3.2 Participatory approach

This approach is used as an alternative to conventional approach. It makes use of a range of techniques, tools and approaches to assess the impact of a development activity. It involves local people, development agencies and policy makers in deciding together how progress is to be measured, allowing the beneficiaries to contribute to the definition of project success (Ashley and Hussein, 2000).

2.3.3 Livelihood approach

A livelihood comprises the capabilities, assets (stores, resources, and access) and activities required for a means of living. Specifically it consists of a range of on-farm and off-farm activities. However, Barrett and Reardon (2000) noted that the core of livelihood models focus on the relationship between assets (capitals), livelihood strategies composed of various activities (livestock production, off-farm employment, informal sector and exchange activities etc.) and to livelihood outcomes (improved income, food security, sustainable use of natural resources, better functioning of social networks and groups and reduced vulnerability) within a mediating environment (DFID, 2001). Furthermore, livelihood outcomes strengthen the five livelihood assets (physical, financial, natural, social and human capitals). Researchers can adopt a simple framework to assess the impact of agricultural technologies on rural livelihoods. For example, livelihood outcomes associated with income changes represent changes in financial capital and if this has been mediated through a new agricultural technology, then it represents the impact of the technology on the financial capital of rural people.

Ashley and Hussein (2000) suggest that, when it comes to impact assessment, it means that changes should be measurable (such as cash and yield) and must be assessed not in their own right but in terms of the contribution they make to livelihoods. Thinking in terms of livelihoods is a very useful way of examining and documenting the many different ways through which people make a living (Ellis, 2000). The livelihood perspective is perceived as playing useful role in the process of current international development targets (MDGs) which include the aim of halving acute poverty globally by 2015. Livelihoods approach is used because it is people centred and takes the problems of people, and particularly the poorest, as starting point for analysis and development planning (Ashley and Hussein, 2000).

This study employed livelihood approach in assessing the livelihood status before and after the dairy project intervention in the surveyed villages. For comparison 'with and without' project and 'before and after' project intervention procedures were employed in the current study.

2.4 The Contribution of Smallholder Dairying to Households' Livelihoods

2.4.1 Increased purchasing power

The small scale industry contributes significantly to poverty reduction particularly in rural and peri-urban areas. In Tanzania, farmers consider this industry as one of their main source of income (Bayer *et al.,* 2006). Resource poor farmers derive their income from livestock and use them to purchase agricultural inputs such as fertilizer, herbicides and pesticides. Mdoe *et al.* (1998) reported that livestock keeping as a banking strategy and that it plays the role of capital (wealth) accumulation. Abdulai and Deldago (1999) argued that dairy cattle do not only offer capital accumulation which may enable producers to gradually shift to more intensive non-farm activities, but also has spin-off effects from net increase in incomes and spending on assets and services like education and health. In a prvious study, Bayer *et al.* (2006) reported that in Mbeya, Tanzania, income (financial capital) from milk sales helped the smallholder farmers to acquire additional land, improve their houses including cattle sheds (physical capital), finance small scale business, send children to secondary schools (human capital) and expanded the dairy enterprises.

2.4.2 The role of smallholder dairying on food security

Livestock play a dominant role in the diet, contributing more than 50 % of dietary needs for energy and protein. Animal source foods are particularly appropriate for combating malnutrition and a range of nutritional deficiencies which have severe consequences

(Brown, 2005). However, milk consumption in Tanzania is estimated at 40 litres per capita per year, below international recommendation of 200 litres (MLD, 2006). In developed countries, 60% of dietary protein supply is derived from animal products compared to 22% in developing countries (Mtenga *et al*., 1998). These foods also provide high quality protein, micro-nutrients and better nutrition for pregnant and breastfeeding women. Vaughan *et al.* (1989) reportet that the addition of milk to the diet of children after weaning can increase linear growth and reduce stunting growth in population with low milk intake. In urban Nicaragua, non-breastfeeding children between the age of 2.5 and 5 years who drank milk found to be less than half as likely to be stunted as non-breastfeeding children of the same age who did not drink milk (Seireg *et al.*, 1992).

In Kenya, Odhiambo *et al.* (2004) examined the impact of dairy cattle on the nutritional status of preschool children aged between 24 – 59 months. The study reveals that 44.7% of the preschool children were stunted. Stunting were more prevalent (37.2%) among children from households whose main enterprise was sugarcane farming compared to those from households kept dairy cattle and farmed sugarcane. Mdoe and Temu (1994) found out that smallholder dairy sector contributes significantly to poverty and malnutrition reduction particularly in rural and peri- urban areas in Tanzania. Alternatively, money from milk can be used as savings that can be invested to meet emergency cash need. Further, income from milk sales can increase the purchasing power of the households that can enable them to buy cereals during grain scarcity period. In addition, cattle manure application increase crop yields for example in coffee and banana growing areas (Nicholson *et al.*, 1999).

Therefore, World Bank (1996) cited by Minja (2007) states that basically small scale dairy production is important in achieving food security in three ways:

a) Directly through increased food production that adds directly to household nutrition,

b) Indirectly through increased cash income that can be used to purchase foods of plant origin, as well as other household items,

c) Through generation of employment.

2.5 Other Sources of Household Income

2.5.1 Agriculture

Agricultural development offers an opportunity to develop poor people's livelihoods. Therefore, it cannot be focused as a development by single sector but as the development of sustainable livelihoods (Stephen and Jabara, 1988). According to the 1991/1992 Household Budget Survey (HBS) in Tanzania as indicated by URT (2001), about 50% of Tanzanians are defined as poor, meaning that they have a per capita income of less than one US$ per day. Also the study indicated that over 80% of the poor are in rural areas depending on agriculture for their livelihood. This implies that firstly, improvement in incomes of the majority is a precondition for poverty reduction. Secondly, food insecurity is a manifestation of poverty. It is estimated that about 42% of the households regularly have inadequate food (URT, 2001). And thirdly, the agricultural sector accounts for about half (46.2%) of GDP, about 50% of exports and sale of agricultural products, but also accounts for about 70% of rural household income (URT, 2006a). Therefore agricultural development is the key to the country's overall economic development now and in future.

2.5.2 Non - farm activities

Very few people collect all their income from any one source or hold all their wealth in the form of any single asset, or use their assets in just one activity. Multiple motives prompt households and individuals to diversify assets, incomes and activities. Despite the persistent image of Africa as a continent of "subsistence farmers," non-farm sources may already account for as much as 40-45% of average household income and seem to be growing in importance (Little *et al.,* 2001). Reardon's (1997) review of the available data in Africa found a strong positive relation between non-farm income share and total household income, and therefore even more pronounced relationship between the level of non-farm income and total income. In this view, non farm activities play a principle role in two ways: directly, by contributing considerably to rural households' income and indirectly, by influencing agricultural activities with potential implications for sustainability.

In Tanzania, farming remains the most important livelihood activity among rural households but about 42% of households have at least one member involved in non-farm income generating activities (URT, 2007). According to Mngofi (2009), income from farming activities was not sufficient to cover up all the requirements of farm households in Igunga district. About 51% of farmers, apart from agricultural activities they were also engaged in non farm activies.

Therefore, non-farm activities are one of the opportunities to earn some cash and hence an important route out of povert (Lanjouw *et al.,* 2001); taking into consideration that the majority of the rural people practice subsistence farming. Non-farm activities include the following: employment in public and non public sectors in temporary or permanent terms. The deployment of household labour (casual labouring during crop season), handcart to

transport crops and vegetables, selling firewood and charcoal, carpentry, and masonry are also activities performed for income earnings which have received increased attention due to increase in economic constraints (Chambers, 1986, cited by Mngofi, 2009).

2.6 Supporting Sectors to Dairy Cattle Enterprise

2.6.1 Input supply and access to milk marketing

Marketing includes those agencies and services involved in the storage, transport, processing and sale of farm inputs and outputs. Input supply and access to potential market are fundamental for adoption of innovation. A major constraint to smallholder dairy development in developing countries is the inadequacy of feed resoucers available to meet the year around nutrient requirements for dairy animals. Significant quantities of concentrates are not readly available, but also even if they are available cash shortages limit their use by smallholders (Reynolds *et al.*,1993). Furthermore there is insufficient supply of appropriate inputs such as drugs, vaccines, acaricide, pasture seeds and fodder planting materials, equipments and inproved dairy stock to support development of dairy industry in Tanzania (URT, 1997).

Factors which contribute to problems related to marketing include the nature of the agricultural commodities and the way in which small-scale producers are distributed (Upton *et al.,* 2005). Also agricultural production is done poorly in developing rural areas in terms of infrastructure. This leads to wastage of milk on transit because milk requires special containers and refrigeration to ensure that quality is maintained (CMMYT, 1993). MoWLD (2004) pointed out that post harvest milk losses in Tanzania in the entire value chain was 16% during the dry season and 25% or more in the wet season. Mostly, the main markets for milk and other dairy products are the urban centres and cities Due to remoteness of small scale dairy farmers, they face problems to access the market. Farmers suffer from lack of milk collection and cooling facilities and poor feeder roads for milk

transportation. It has been noted that when farmers have ready milk for the market, the major constraint is when, where and how to sell these products. The rural poor can only get out of poverty if there are functional markets that add value to their produce (Mngofi, 2009).

2.6.2 Extension service delivery

The role of extension service delivery in agricultural and livestock development involves improvement in the performance of those involved in the primary production. Dissemination is essentially the process by which knowledge, ideas and skills are introduced to farmers in order to bring about change in crop, livestock and other production practices and thus improve farmers' livelihoods. Training is the basic method used to ensure that new innovations are introduced to the farming communities. Inefficient extension services have been attributed to problems related to management, planning and lack of effective extension- research linkage (Mngulwi *et al.,* 2004).

2.7 Integration of Dairy Cattle and Crop Production

Most of highlands of Tanzania are characterized by high population density, hence a high demand for food, which has led to continuous and intensive land cultivation. Therefore, soil fertility has been observed to decline in a number of areas presenting a serious threat to food security. In this view, many Tanzanians are increasingly integrating livestock and crop production so as to solve the problem of declining productivity. The linkage of livestock (dairy cattle) with crop production allows for efficient nutrient recycling (Kyomo, 1997, cited by Minja, 2007). Livestock manure have been an asset to crop production since the beginning of organized agriculture. These excretions from cattle contain several essential plant nutrients and they contribute to increased crop yields when properly applied to soils. According to Schleich (1986), one animal unit (1LU=500kg) live mass weight which comsumes 15kg DM/day can produce about 7 tones of recoverable

fresh manure per year when stabled all day. Thus, dairy cattle keepers can use manure as a valuable source of fertilizer nutrients for crops production. Nevertheless, method of storage and application determine the quantity of nutrients available to the plants (Haynes and Williams, 1993). Additionally, crops are the source of livestock feed for example milling by-products, oil seeds and crop residues. Similarly, livestock support crop production through manure supply and net profit from sales of milk, live animals and other products which is used to purchase farming inputs such as seeds and herbicides.

2.8 Dairy Cattle Performance

Performance of dairy cattle determines the level of impact and sustainability of small scale dairy projects. Therefore it is important to be assessed. Among the indicators of cow performance related to small scale dairying include daily milk yield (MY), age at first calving (AFC), lactation length (LL), Dry period (DP) and calving interval (CI). Age at first calving (AFC) is defined as the period in days or months from birth date to first calving (Kasonta and Rushalaza, 1993). Early AFC is an important economic character of dairy cows as it increases the margin of profit by increasing life time production and reducing the generation interval.

Calving interval (CI) is defined as the period between consecutive calvings, and can be expressed in days or months. Calving interval is important parameter because it is used to measure the reproductive performance of cows. Udo (1993) reported significant differences in CI among crossbred cows in central Tanzania. Period or year of calving have been reported to influence the lengh of calving interval. Mulangila (1997) observed longer CI (493 $\pm$ 4 days) for cows that calved in 1992 than those cows calved in 1993 (439 $\pm$ 9 days) in Tanga region. In Kagera region, a longest CI of 473 $\pm$ 3.8 days for cows that calved in 1991 to 1995 was observed compared to CI of 459.9 $\pm$ 4.7 days for cows that calved between 1986 to 1990.

Lactation length (LL) is the period during which the cow actively produces milk and is defined as the period of time in days from calving to dry off. The LL varies between cows, breeds and level of milk production. Mwatawala (2006) noted that the amount of milk produced in a lactation period of 305 days is the unit measurement employed in developed countries for judging the milk production potential of dairy cow. In Kagera region, Msuya (2002) reported the mean LL of 350 days. Parity and period of calving were highly significant sources of variation for LL. Furthermore, she indicated that LL progressively increased with time. For example, cows that calved in 1996 to 2000 lactated 43 days longer than those from 1980 to 1985. In Igunga district, the mean LL of 11 months (330 days) was observed by Mngofi (2009).

Milk production varies with the breed type, age, stage of lactation, nutritional status in late pregnancy and water availability (McDonald *et al.*, 2002). High milk yield of satisfactory composition is the most important aspect in ensuring high economic returns in the dairy industry. Haile *et al*. (2002) found out that cross bred cows in Ethiopian Boran with Holtein Friesian had milk potential of not exceeding 10 litres per cow per day. Msuya (2002) reported a mean daily milk production of 6 litres per cow in Kagera region. Other studies done by Mchau (1991) and Mwatawala (2006) reported means of 9.0 and 9.5 litres of milk produced per cow per day, respectively.

Dry periods (DP) refers to the interval between dry off date and the following calving and is normally measured in days. This period enables the animals to build reserves prior to the next lactation. The length is reported to vary within animals, breed type, herd, year and season of calving (Msuya, 2002). Kifaro (1995) reported that year effects contributed 1 to 4% of the variation in dry periods. Another study done by Mulangila (1997) among

smallholder farms in Tanga region, Tanzania indicated that the average ranged between 121 ± 14 days and 180 ± 30 days in cows that calved from 1983 to 1989.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the Study Area

Kasulu District is one of the three districts of Kigoma region (Fig. 2). It boarders Kigoma rural district in the Southern and Eastern part, in the North and North-East, it borders Kibondo district and Republic of Burundi in the West. Kasulu district is located between latitudes 30^0 45' and 30^0 55' South of the Equator and longitudes 29^0 45' and 30^0 45' East of Greenwich. The district has ample fertile and productive soil with reliable rains. The district covers a total land area of 9324 square kilometres. However, out of 6060 km^2 (65%) of arable land only 28% is utilised. The population census of 2002 recorded a population number of 626 742, and annual population growth rate is 4.8% compared to a national growth of 2.9%. There are about 52 000 head of indigenous cattle, 2400 dairy cattle, 67 250 goats, 8100 sheep, 2850 pigs, 8600 ducks and 247 000 chickens. The study was carried out in two divisions namely Manyovu and Buyonga in Kasulu district. These divisions are found in two different agro-ecological zones and consequently have different farming systems (DALDO Kasulu, 2006).

Figure 2: Map of Kigoma region, showing location of Kasulu district

Source: Adopted from URT (2006b).

3.2 Background of the Project

From 1988 the Anglican Church, Diocese of Western Tanganyika (DWT) supported farmers to improve their livelihoods through a Heifer-In-Trust (HIT) scheme which operated under “take a heifer and give a first female offspring to another farmer” philosophy. The coverage of the project was limited to few farmers around Kasulu town because of financial constraints. From 2002 to 2006, in collaboration with Austrian Government, Kasulu District council implemented a dairy cattle development project in 16 villages from 3 divisions including Manyovu, Heru Chini and Buyonga. Over 149 in-calf heifers were distributed to farmers as foundation stock and these heifers have multiplied and making the scheme to expand and hence more farmers are befitting through the HIT model (DALDO Kasulu, 2006). To qualify for a credit animal, a farmer had to meet the following criteria: to have established not less than 0.2 ha of improved fodder, undergo training on basic principles of dairy cattle husbandry for seven days, pay 50 000 TAS in advance as an extension fee and lastly to construct a cow shed. In addition, a farmer had to sign a contract with the project for passing on a first weaned female calf to another farmer within the same village. In each village, farmers formed a committee which was responsible for recruiting new farmers under supervision of the extension worker.

3.3 Research Design

This study was a cross sectional survey, that enabled the researcher to collect data at a single point in time (Bernard, 1994). Six villages from Muzye and Mnanila wards were involved in this study which included: Muzye, Mutala, Bugaga, Mnanila, Mukatanga and Nyakimue. The design was appropriate because it was cost effective, less time consuming and more information could be obtained (Babbie, 1990; Bailey, 1994 cited by Omolo, 2002). Data collected were used for simple statistical description, interpretation and also to determine relationship between different variables focused at the time of survey using

interview schedules. The study was also supplemented by observations on farmers' activities and discussions with three officials in District Agricultural, Cooperatives and Livestock Development department.

3.4 Sampling Procedures and Sample Size

To obtain the desired representative sample, a stratified sampling procedure was employed since the study used both "with and without" and "before and after" impact assessment procedures. Purposive selection of two (Buyonga and Manyovu) out of seven divisions based on the availability of farmers involved in dairy cattle farming and differences in agro-ecological locations was performed. Furthermore, Muzye ward from Buyonga division was purposively selected. Also purposive sampling of three villages from Muzye ward was done since only three villages received dairy cattle from the project.

In Manyovu division, Mnanila ward was selected purposively and simple random sampling of 3 out of 6 villages was performed. Lastly simple random sampling was employed to get twenty (20) households from each selected village, ten with dairy cattle and ten without dairy cattle. Therefore, from the six villages, a total of 120 households were interviewed. The sample was considered big enough based on Bailey's (1994) argument that 30 cases is the bare minimum for a study in which statistical data analysis is to be done.

3.5 Data Collection

Both primary and secondary data were collected. Primary data was collected at households' level using interview schedules. Data on dairy cattle performance were gathered from cow cards being kept by farmers and from farmers based on recall. Structured interview schedule with both open and closed-ended questions and tabular

questions was designed. Two categories of questionnaires, one for respondents with dairy cattle and the other for those without dairy cattle were prepared (Appendices 2 and 3).

Secondary data relevant on the impact of small scale dairying in the study area were obtained from various sources like project reports and extension agents. Pre-testing was an important step to be done so as to test the accuracy, validity of questions and make necessary modifications to the interview schedule before actual data collection. Pre-testing of the interview schedules was carried out in Nyansha village involving 10 household heads.

3.6 Data Processing and Analysis

3.6.1 Data processing

Data collected was edited, coded and summarized using the computer soft ware, Statistical Package for Social Sciences (SPSS, 2006).

3.6.2 Data analysis

The computer program SPSS (2006) was used to generate descriptive statistics such as frequencies, percentages, means, and standard deviations and cross tabulations. Results were used to summarize the information on the impacts of individual factors on the household livelihoods for both dairy and non-dairy cattle farmers. A t-test was employed to determine significance of differences of variables between the means of the two strata (farmers with dairy cattle and those without). Further, a t-test was used to determine differences between the mean income before and after the intervention of dairy cattle project. Multiple linear regression was used to determine the influence of independent variables: dairy cattle farming, crop production and non-farm activities on total household income.

Multiple linear regression analysis:

$Y = A + B_1X_1 + B_2X_2 + B_3X_3 + E$……(1)

Where;

Y = Predicted value of dependent variable (Total annual household income)

A = Y- intercept, the value of Y when all X_1, X_2, X_3 are zero (constant term)

X_1 = Income from dairy cattle farming

X_2 = Income from crop production

X_3 = Income from non- farm activity

B_1, B_2, B_4, = Regression coefficients for the various independent variables

E = An error term

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Demographic and Socio- economic Characteristics of Respondents

4.1.1 Age distribution in the surveyed villages

Respondents' age distribution varied considerably (Fig. 3). Age within the active group (35- 44 years) was 35% and 33.3% for dairy and non dairy cattle owners, respectively. This shows that most of respondents were in the economically active group carrying main responsibilities for households' livelihoods. The study revealed that respondents aged above 64 years were 5.0% and 8.3% for dairy and non dairy cattle owners, respectively. This implies that few farmers above 64 years were engaged in dairy activities. This is similar to the argument put forward by Rutasitara (2002) that old people are not physically strong to generate wealth and consequently likely to be poor if they have not accumulated savings over the years during their life time. However, Mandara (1998) stated that in Tanzania the economically productive class ranges between 15 and 64 years.

The age of an individual has an influence on productivity as well as food consumption. Age is a factor that can explain the level of production and efficiency (Basnayake and Guranatne, 2002). Performance of economic activities can be influenced by age of a person. Children and the old tend to be less active in economic activities than those in the middle age (Rutasitara, 2002). At middle age, people are very active, aggressive and motivated by needs of their families. Therefore, age composition of respondents was considered to be important in this study.

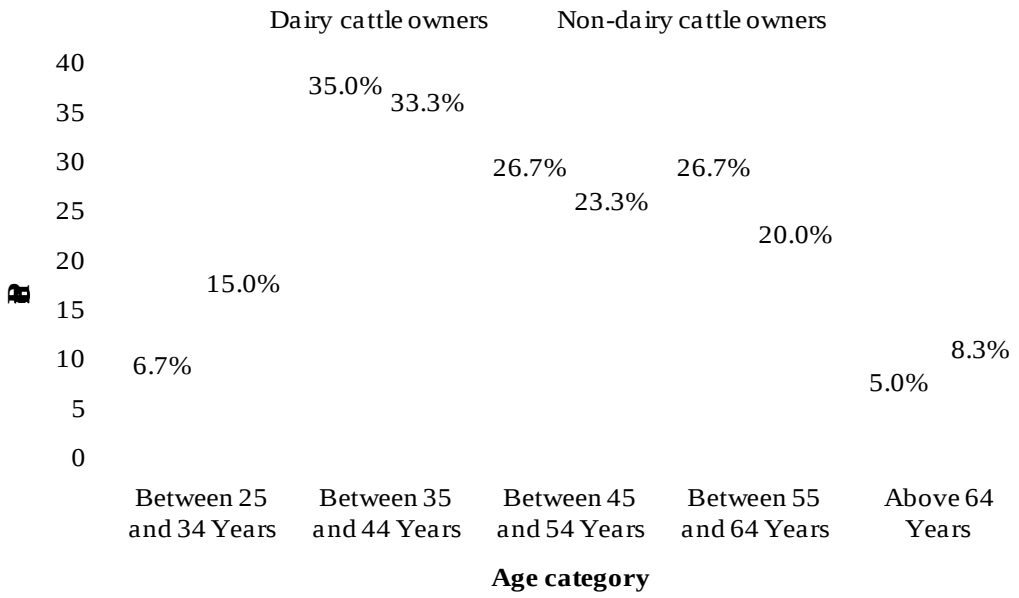

Figure 3: Distribution of respondents by age

4.1.2 Household size

Results summarized in Table 1 show that household size was relatively high with the means of 7.2 and 8.3 of household members for dairy and non dairy cattle keepers, respectively. These results are higher compared to 4.9 which is the National average household size. The larger household sizes could be influenced by extended families, which is a common phenomenon in rural areas. According to URT (2002), the size of the household can be an impoverishing force particularly when it indicates a significantly skewed dependency ratio. The number of household members influences income stability of households. Large household size reflects demand for funds to meet family financial obligations. However, larger household sizes sometimes hinder the expansion of business because income generated by the business is used at home to sustain family needs. This reduces the capacity of a household to invest in other income generating activities. On the other hand, Rodgers (1989) stated that rich households have more members than poor ones.

Table 1: Household size, marital status, education level and economic activities

Variable	Dairy cattle owners (n=60)		Non dairy cattle owners (n=60)	
	Frequency	**Percent**	**Frequency**	**Percent**
Marital status				
Married	59	98.3	60	100.0
Divorced	1	1.7		
Total	**60**	**100.0**	**60**	**100.0**
Level of education				
No formal education	3	5.0	3	5.0
Primary education	50	83.3	55	91.7
Secondary education	7	11.7	2	3.3
Total	**60**	**100.0**	**60**	**100.0**
Main economic activities				
Farming	55	91.7	57	95.0
Wage employment	2	3.2	0	0.0
Self employment	1	1.7	2	3.3
Business	1	1.7	1	1.7
Others	1	1.7	0	0.0
Total	**60**	**100.0**	**60**	**100.0**
Household size				
Minimum	2		3	
Maximum	14		17	
Mean	7.2		8.3	
Std. Deviation	2.05		3.17	

4.1.3 Marital status of the respondents

During the study, respondents were asked to indicate their marital status. The implication of marital status to this study is that it is an institutional factor that has great influence on family matters. It was revealed that 98.3% and 1.7% were married and divorced for the dairy cattle owners respectively, while all of non dairy cattle owners were married as indicated in Table 1. Married couples are likely to be more productive compared to single people due to labour supply and hence can share farm duties in crop and dairy production or in non farm activities. These results agree with that observed by Mtama (1997) who found that marriage has an effect on the production process as it increases labour availability in the household.

4.1.4 Education level of the respondents

Results in Table 1 show a very high literacy level in the surveyed area. It was observed that 83.3% of respondents with dairy cattle completed primary education followed by 11.7% who had secondary education, and about 5% had never attained formal education. On the other hand, non-dairy cattle keepers had high literacy level and the majority (91.7%) had completed primary education whereas 3.3% had secondary education. Literacy level is very useful for a small-scale farmer to learn, use and adopt new appropriate agricultural technologies introduced, since most of technologies can be offered using Swahili language. Furthermore, education is perceived as one of the factors that influence an individual's perception of intervention before deciding to take part. It also imparts the desire of an individual to learn more, to attend training and seek information regarding agriculture and non-farm activities (Luhosi, 1998).

4.2 Main Economic Activities of Respondents

Table 1 presents main economic activities of respondents in the study area which is based on farming activities. It has been observed that 91.6% and 95% of dairy and non dairy cattle keepers respectively, depended on farming as their major source of income. The major crops grown in the study area were maize, beans, bananas and coffee. Apart from farming, respondents seemed to be engaged in other non-farm activities whereby 8.4% and 5.0 % were undertaking non-farm activities as sources of income for dairy and non dairy cattle owners, respectively. Non-farm activities included self employment, small business, carpentry, masonry and tailoring. These results present a typical Tanzanian rural area since over 90% of the interviewed respondents were engaged in farming.

4.3 Dairy Cattle Activities in the Surveyed Villages

4.3.1 Herd structure and size

Table 2 shows that the herd size and different classes owned by farmers. The majority of households (73.3%) owned 1 to 2 animals while 25% owned 3 to 4 animals. Only one farmer owned above four dairy cattle. These results imply that farmers still had small herd sizes. This might be attributed to several reasons including mortalities, sales of bull calves, passing on heifers and probably long calving intervals. The observation that the majority of farmers were rearing between 1 and 2 dairy animals per household is lower than 2 to 3 heads of cattle per household as reported by Kurwijila and Boki (2003) for small holder farms in Tanzania. From the results, the majority of respondents (86.7%) owned one cow, 25% owned young heifers and 23.3% kept one female calf. It was observed that there were few female calves which resulted into few new farmers to join the scheme, or few cows were being replaced by the heifers.

Table 2: Categories and herd size of dairy cattle owned

Category	Frequency	Percent
Herd size		
1- 2 dairy cattle	44	73.3
3 - 4 dairy cattle	15	25.0
Above 4 dairy cattle	1	1.7

Total	**60**	**100.0**
Cows		
1	52	86.7
2	7	11.7
3	1	1.6
Total	**60**	**100.0**
Bulls		
0	52	86.7
1	8	13.3
Total	**60**	**100.0**
Young heifers		
0	45	75.0
1	15	25.0
Total	**60**	**100.0**
Female calves		
0	46	76.7
1	14	23.3
Total	**60**	**100.0**

4.4 The Role of Small Scale Dairying on Households' Livelihoods

4.4.1 Milk production and consumption

The sampled households were asked to provide information on quantities of milk produced. The responses summarized in Fig. 4 show that on average, each household produced 7.6 litres of milk with a maximum and minimum of 15 litres and 2 litres per day per cow respectively, during lactating periods. However, results in Fig. 4 indicate that the majority of milked cows (53.3%) produced 6 to 9 litres, while 28.3% of them produced 2 to 5 litres and only 16.7% produced above 10 litres of milk per day per cow.

It was observed that the average production of milked cows was a bit lower (7.6 litres) compared to other areas e.g 9.0 litres per day per cow (Mbapila, 2006) in Temeke Municipality. Mwatawala (2006) reported an average of 9.5 litres per day per cow in Kagera region and Mchau (1991) observed an average of 9.0 litres per day per cow in Mbeya region. Also, average milk production is higher in the study area compared to average of 6.9 litres reported by Mngofi (2009) in Igunga district, Tanzania.

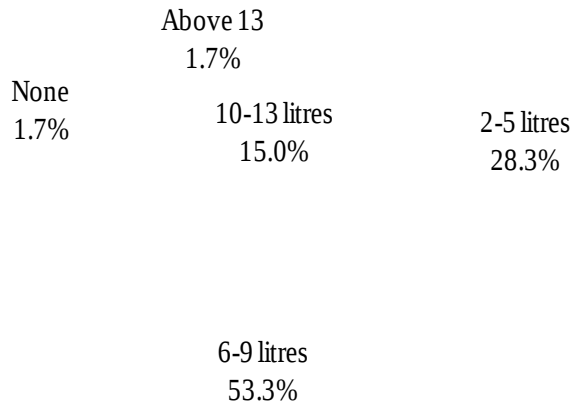

Figure 4: Quantities of milk produced in litres per cow

Before project intervention, 80% of the households could not drink milk while 20% were able to drink milk by purchasing from kiosks or cafes around their localities. Results in Table 3 show that on average after joining dairy farming, the minimum and maximum quantities of milk consumed were 0.5 and 4 litres per household per day, respectively. This indicates that milk consumption had increased by 71.7% after project intervention. Average milk consumption after the project intervention of 1.31 litres per day per household size of 7.2 members translates into a consumption of 181ml per person per day x 365 days = 66065 ml (66 litres) per person per year. This is higher than the average consumption in Tanzania of 40 litres per person per year (MLD, 2006).

The low milk consumption before project intervention is due to lack of improved dairy cattle for milk production. These results suggest that households with dairy cattle in the study area are likely to be more food secured because they obtain milk directly from their dairy cows.

Table 3: Average milk production and consumption per household before and after joining dairy enterprise

Aspect	N	Minimum	Maximum	Mean
Milk produced in litres	60	2	15	7.63
Milk consumed before joining dairying	60	0.0	1.0	0.37
Milk consumed after joining dairying	60	0.5	4.0	1.31

Results in Table 4 show that 68.4% of the interviewed households had children of less than five years old who indicated that the health status of their children had improved compared to the period before joining the dairy cattle enterprise. Two respondents (3.3%) reported to observe no difference between before and after establishing dairy cattle project. The reason behind might be associated with quantities of milk which was provided to the children and frequencies. Another reason could be very low milk production and shorter lactation lengths of their cows.

Table 4: Children's health status before and after keeping dairy cattle

Health status of children under five years old	Frequency	Percent
Number of children under five years	17	28.3
Better than before	41	68.4
Remained the same	2	3.3
Total	**60**	**100.0**

4.4.2 Live animals as source of income

Apart from selling milk, the respondents also sold live animals. Results show that 65% of interviewed farmers sold some live animals and 33.3% did not sell any. Animals sold were those with fertility problems and male calves. Few animals were sold due to the fact that the project was new in the surveyed area and the fertility problems which caused less calf crop and hence few animals were available to be sold to other farmers. Secondly, farmers had to pass on the first female calves to other beneficiaries. A similar reason was also

reported by Mbapila (2006) in Temeke district. Under normal circumstances, where there are no fertility losses, a cow is supposed to calve down every year (Mathewman, 1993). On average farmers who sold live animals earned 350 270 TAS while minimum and maximum values were 30 000 TAS and 1 700 000 TAS, respectively.

4.4.3 Non-dairy cattle owners' awareness on dairy cattle project in the surveyed villages

Respondents without dairy cattle were asked if they were aware of the existence of dairy cattle project in the study area and the majority (98.3%) were aware. Study results show that 41.7% of respondents were not dairy cattle keepers because of various reasons. These included shortage of foundation heifers from the project (38.4%), financial constraints for initial costs (41.7%) and not being aware (20%) during the inception of the project. Also it was observed that 91.7% of interviewed farmers wanted to join the project indicating that small scale dairying improves households' livelihoods. However, 8.3% of respondents rejected the enterprise because of higher initial costs. These results imply that most of the respondents were aware of the dairy cattle project, but their capacity to meet initial costs like building a moderate cow shed that could cost 100 000 TAS and paying in advance 50 000 TAS as extension fee were the main obstacles to resource poor farmers to own heifers.

These conditions are difficult to be met by resource poor farmers (Lyimo *et al.*, 2004 as cited by Mbapila, 2006). It can be concluded that projects of similar structure and objectives could find out ways of reducing entry fee thus allowing more farmers to manage dairy animals before they start producing while maintaining the sustainability of the project as suggested by Christian Aid (2002).

4.4.4 Incomes of households before and after joining dairy cattle project

Data for household income were given by the respondents based on recall. Table 5 shows that before joining dairy cattle project 43.3% of farmers earned annual incomes between 30 000 and 329 000 TAS; 36.7% earned between 330 000 and 629 000 TAS while 17% earned between 630 000 and 929 000 TAS. Annual incomes increased after joining small sacle dairying and about 41.7% of farmers earning between 330 000 and 629 000 TAS. About 20% earned between 30 000 and 329 000 TAS while 21.7% received between 330 000 and 629 000 TAS. Furthermore, the percentage of farmers in the study area earning above 930 000 TAS annually doubled after joining the dairy cattle project. Mean annual incomes were 471 266.67 and 1 012 400 TAS before and after joining dairy cattle project respectively, which is an increment of 53 %.

These results demonstrate that small scale dairying significantly improved rural households' livelihoods using money accrued from sale of milk, live animals and the effects of integrating crop and dairy cattle enterprises. In a previous study in southern highlands of Tanzania, Bayer *et al.* (2006) observed that income from milk sales supported some smallholder families to acquire additional land, improve their houses (and cattle sheds), finance small-scale businesses, send their children to secondary school and expand the dairy business**.**

A t-test performed to compare the two means of household incomes before and after joining dairy cattle project showed a significant difference ($t = 2.978$, $df = 59$, $p < 0.05$) between the two incomes, implying that households' incomes increased after project intervention in the study area.

Table 5: Range of income before and after joining dairy cattle project in '000' Tas

Range of income	HH income before project		HH income after project	
	Frequency	Percent	Frequency	Percent
30 - 329	26	43.3	12	20.0
330 - 629	22	36.7	25	41.7
630 - 929	7	11.7	13	21.7
Above 929	5	8.3	10	16.6
Total	**60**	**100.0**	**60**	**100.0**
Statistics				
Minimum	30		84	
Maximum	5 200		12 000	
Mean	471 .26		1 012 .4	
Std. Deviation	892 .44		1 845 .98	

HH =Household

4.4.5 Incomes of farmers with and without dairy cattle

Table 6 indicates that mean annual incomes of dairy and non dairy cattle owners were 1 012 400.00 and 523 596.67 TAS, respectively. About 46.7% of the interviewed respondents had incomes ranging between 50 000 and 499 000 TAS compared to 66.7% of non dairy cattle keepers who were in the same range of income. This indicates that most of non dairy cattle keepers earned less annually compared to respondents with dairy cattle. Furthermore, the above fact is confirmed from the results that only 23.3% of non dairy cattle keepers earned between 500 000 and 949 000 TAS compared to 40% in the same range of income for farmers who practiced small scale dairying. These results suggest that households with dairy cattle enterprises earned more income and this might be contributed by selling of milk, live animals and application of manure for cash and food crop production.

Table 6: Households incomes for farmers with and without dairy cattle in '000' Tas

Statistics	Dairy cattle keepers n=60	Non -dairy cattle keepers n=60
Minimum	84. 00	65. 80
Maximum	12 000. 00	3 000. 00
Mean	1 012 . 40	523 . 59
Std. Deviation	1 845 . 98	499 . 23

Income category	Frequncy	Percent	Frequncy	Percent
50 - 499	28	46.7	40	66.7
500 - 949	24	40.0	14	23.3
950 - 1 399	5	8.3	5	8.3
Above 1 399	3	5.0	1	1.7
Total	**60**	**100.0**	**60**	**100.0**

4.4.6 Expenditure patterns of revenues from milk and live animal sales

Table 7 shows that the majority of dairy cattle owners (90%) used revenues from milk to fulfill various household requirements. About 10% of them used revenues for other purposes. Results indicate that 60%, 5% and 25% of farmers spent revenues accrued from milk for purchasing agricultural inputs, implements and acquiring new land plots, respectively. These results imply that dairy enterprise as a major component in agriculture, enabled farmers to invest in crop production. On the other hand, the investment by most of them (63.3%) was below 199 000 TAS in 2009/2010. Improving performance in small scale dairying could increase revenues and hence more investments in crop production in villages keeping dairy cattle.

Table 7: Expenditure of revenues from milk and live animal sales in '000' Tas

Variable	Frequency n = 60	Percent
Whether revenue from milk was used for fulfilling household requirements		
Yes	60	100.0
Total	**60**	**100.0**
Buying agricultural inputs	36	60.0
Buying agricultural implements	3	5.0
Buying land	15	25.0
Others	6	10.0
Total	**60**	**100.0**
Expenditure by categories		

None		7	11.7
Below	199	38	63.3
200 –	399	7	11.7
400 –	599	6	10.0
Above	599	2	3.3
Total		**60**	**100.0**

4.4.7 Economic status of farmers as reflected by their possessions

Dairy cattle owners were asked to compare their economic status before and after the project intervention. The majority (95%) indicated that their economic status had improved and was reflected through possessions and ability to purchase various goods and services. About 3.3% and 1.7% showed that economic status after project intervntion remained the same or decreased, respectively. Assets owned by the respondents included modern and traditional houses, radios, furniture, house wares, bicycles, mattresses, television sets and agricultural tools. Table 8 indicates that most of dairy cattle owners (68.3%) had assets with value less than 500 000 TAS compared to 60% of non dairy farmers. Also, 21.7% of farmers with dairy cattle owned assets with value between 500 000 and 999 000 TAS compared to 33% of farmers without dairy enterprise in the same category of revenues. This implies that farmers without dairy cattle seemed to have more wealth compared to those with dairy cattle. Reason might be the decision of most dairy cattle owners to invest their money in education, acquiring new land and expanding dairy cattle enterprises. These results are different from previous study done by Mngofi (2007) in Igunga District, where farmers with dairy cattle owned assets with high values compared to those without dairy cattle enterprise. However, respondents with dairy cattle in the study area had better housing in terms of burnt brick walls (98.3%), cemented floors (35.0%) and 96.7% of them possessed houses roofed by corrugated iron sheets.

Table 8: Value of physical assets in '000' Tas and nature of housing

Variable	Dairy cattle keepers n= 60		Non dairy cattle keepers n = 60	
	Frequency	**Percent**	**Frequency**	**Percent**
Total value of physical assets owned				
None	1	1.7	0	0.0
Below 500	41	68.3	36	60.0
500 - 999	13	21.7	20	33.3
1,000 - 1499	2	3.3	2	3.3
1500 - 1,999	1	1.7	1	1.7
Above 2,499	2	3.3	1	1.7
Total	**60**	**100.0**	**60**	**100.0**
Nature of house walls				
Un-burnt bricks	1	1.7	0	0.0
Burnt bricks	59	98.3	59	98.3
Mud and trees	0	0	1	1.7
Total	**60**	**100.0**	**60**	**100.0**
House floor				
Earth/dung/sand	39	65.0	53	88.3
Cement	21	35.0	7	11.7
Total	**60**	**100.0**	**60**	**100.0**
House roof				
Thatched grass	2	3.3	12	20.0
Iron sheets	58	96.7	48	80.0
Total	**60**	**100.0**	**60**	**100.0**

4.4.8 Income spent for health services and education

Results in Table 9 show that all (100%) interviewed farmers were accessing health services. However, it was established that some respondents were not members of Community Health Fund (CHF), which provides medical services after paying in advance 5000 TAS. Also, results show that 55% and 43.3% of dairy and non dairy keepers were members of CHF respectively, while 45% of dairy cattle keepers and 56.7% of non dairy cattle keepers were not members of CHF. These results suggest that dairy cattle owners were capable of paying some money for CHF and health services on cash basis since they were assured of weekly or monthly income from milk sales. Similarly, dairy cattle keepers spent on average 63 178.60 TAS compared to average of 44 363.60 TAS spent by non dairy cattle keepers. In addition, households with and those without dairy cattle were capable of paying on average about 274 321.40 and 153 291.60 TAS for education for

their children per year, respectively. This implies that households with dairy cattle were more capable in parchasing power than their counterparts.

Table 9: Income spent for health services and education in '000' Tas

Variable	Dairy cattle keepers (n =60)		Non -dairy cattle keepers (n =60)	
	Frequency	**Percent**	**Frequency**	**Percent**
Accessibility to health services	60	100.0	60	100.0
CHF Membership				
Member	33	55.0	26	43.3
Not member	27	45.0	34	56.7
Total	**60**	**100.0**	**60**	**100.0**
Money spent for health services per year				
Minimum	20		12	
Maximum	360		400	
Mean	63. 18		44 .36	
Having children attending school	**Frequncy**	**Percent**	**Frequncy**	**Percent**
None	1	1.7		
Attending school	57	95.0	54	90.0
Not attending school	2	3.3	6	10.0
Total	**60**	**100.0**	**60**	**100.0**
Money spent for school fees per year				
Minimum	4		5	
Maximum	3 000		1 500	
Mean	274.32		153. 29	

4.4.9 The influence of other sources of income on total households' income

In the study area dairying is regarded as an important component to complement other livelihood strategies, including crop production and non-farm activities. Crop production was the major means of livelihood supporting all sampled respondents.

4.4.9.1 Non-farm activities

In Africa, there is a strong positive relationship between non-farm income share and total household income, and therefore a more prominent relationship between the level of non-

farm income and total income (Reardon, 1997). Based on the observation from the current study (Table 10) which indicate that less than a half (about 42%) of respondents with dairy cattle were engaged in non-farm activities while about 62% of farmers without dairy cattle were undertaking non-farm activities. This trend could be due to the tendency of farmers with dairy cattle, not to spread their capitals over numerous non-farm activities but rather concentrate on dairy cattle enterprises. Management of dairy animals is a labour intensive activity and needs closer supervision which hinders one to look after other activities, especially when a household has limited labour power. Although, a few (42%) respondents with dairy cattle were engaged in non-farm activities, they earned higher income with the mean of 859 000 TAS compared to 235 428 TAS earned by non dairy cattle keepers**.** The reason for this big difference in incomes could be the fact that dairy cattle keepers had invested more in profitable non-farm income generating activities than non dairy cattle keepers hence more income is realised. Further, they had guaranteed source of income (sales of milk) compared to those farmers without dairy animals. Similar trend of results were also reported by Macha (2008) when studying on contribution of small scale dairy cattle to household income. He observed a significant number of households (28.3%) to be engaged in non-farm activities and 15% of respondents earned between 30 000 and 150 000 TAS in the year 2006/2007. Also a study conducted in Igunga by Mngofi (2007) indicate that off- farm activities helped farmers to increase their income. Further, he observed that with the exception of employment, the income from non- farm activities (780 793 TAS) was higher than other sources of income and that is the reason non farm activities ranked second in contributing total household income. A study done by Kamugisha (2004) in Kagera region, also foudout that off-farm activities helped famers to increase their income.

Table 10: Distribution of households by income from non farm activities in '000' Tas

Variable	Dairy cattle owners n= 60		Non -dairy cattle owners n= 60	
	Frequency	**Percent**	**Frequncy**	**Percent**
Non farm activities				
Not engaged in non- farm activities	35	58.3	23	38.3
Salary employment	3	5.0	1	1.7
Wage labour	3	5.0	15	25.0
Carpentry	4	6.7	5	8.3
Charcoal making	1	1.7	2	3.3
Small business	9	15.0	10	16.7
Masonry	3	5.0	4	6.7
Tailoring	2	3.3	0	0.0
Total	**60**	**100.0**	**60**	**100.0**
Income from Non- farm activities				
Minimum	60		120	
Maximum	5 200		2 400	
Mean	859		235 .42	

4.4.9.2 Income from crop production

Small scale dairying in all surveyed villages was carried out jointly with other income generating activities, including non farm activities and crop production. Results indicate that minimum and maximum incomes were found to be 30 000 and 3 000 000 TAS respectively, while the annual mean income was 430 517 TAS. This implies that income from dairy cattle production complemented incomes from other sources in fulfilling household cash needs.

4.4.9.3 Income from other livestock species

Sampled households kept different species of livestock. Apart from keeping dairy cattle, they owned other species like goats, pigs, poultry and sheep. Both farmers with and without dairy cattle kept these species as a source of household income and for solving social and cultural problems. Results in Table 11 show that 35% and 25% of dairy cattle

owners and non owners earned between 51 000 and 150 000 TAS per year, respectively. Furthermore, 28.3% and 40% of dairy and non dairy cattle owners respectively did not keep any other species of livestock. These results suggest that households with dairy cattle also kept other species of livestock compared to those without dairy animals and therefore contributing more to the household food security and income. Livestock helped to alleviate seasonal food insecurity. In addition, farmers with dairy cattle kept other species of livestock since they have basic knowledge in livestock husbandry, but also might be due to purchasing power and being risk takers compared to their counterparts. Similar trend of results were also reported by Minja (2007) in Kilombero District, Tanzania when studying the contribution of smallholder dairy cattle to the household food security. He found out that on average households with dairy cattle kept 4.7 birds, 2.6 goats, and 3.7 pigs compared to households without dairy cattle, which kept 3.6 birds, 1.4 goats, and 2.7 pigs.

Table 11: Income from other livestock species in '000' Tas

Variable	Dairy cattle owners n= 60		Non - dairy cattle owners n= 60	
	Frequency	**Percent**	**Frequency**	**Percent**
Income from other livestock species				
Below 50	12	20.0	10	16.7
Between 51 - 150	21	35.0	15	25.0
Between 151 -250	3	5.0	3	5.0
Between 251 -350	7	11.7	5	8.3
Above 350	0	0.0	3	5.0
Do not keep others species	17	28.3	24	40.0

Total	**60**	**100.0**	**60**	**100.0**

4.5 The Effects of Geographical Location on Dairy Cattle Performance

Dairy cattle performance is influenced by genetic, environmental and the interaction between genetic and environmental factors.Therefore, variations in agro-ecological zones are associated with variations in feed and water availability and hence animal nutritional status, which ultimately affect performance of dairy cows**.** Performances in terms of lactation milk yield, lactation length and dry period were analysed.

4.5.1 Daily milk yield

Respondents from two the wards, Mnanila (highland) and Muzye (lowland) were asked to comment on the performance of their cows and the results are summarized in Table 12. The mean daily milk yields were 7.80 and 7.89 litres in Mnanila and Muzye wards, respectively. The minimum and maximum daily milk yields were 4 and 12 litres in highland while they were 4.5 and 15.7 litres in the lowland. This shows that, cows in lowlands (Muzye ward) were performing better than animals from highlands (Mnanila ward). Reasons could be the availability of feed supplements and other feed stuffs as lowland farmers are good producers of cereal crops and are closer to Kasulu town where there is good markert and high milk price which is an incentive to sell more milk. These results resemble those reported by Macha (2008) in Ilala district indicating that minimum and maximum productions per cow per day were 3 and 14 litres, respectively. On the other hand, he reported a slightly higher mean production (8.5 litres per cow per day) compared to the present results. Mchau (1991) and Mwatawala (2006) reported higher means of 9.0 and 9.5 litres of milk produced per cow per day, respectively. Milk production varies with the breed type, age, stage of lactation, nutritional status in late pregnancy and water availability (McDonald *et al.*, 2002).

4.5.2 Lactation length

The minimum and maximum lactation lengths (LL) in the study area were 4.5 and 11.75 months for highland respectively, while corresponding figures for lowland were 7 and 12.25 months. This indicates that animals in highlands had shorter lactation periods by 1 month leading to less milk being produced per cow per lactation (Table 12). The mean lactation lengths were 8.41 months (256.5 days) and 9.44 months (287.92 days) months in high and lowlands, respectively. The observed maximum lactation length in highland is similar to that reported by Mngofi (2009) in Igunga, Tanzania of 11 months. Also he reported a higher (6 months) minimum lactation length compared to that of 4.5 months observed in the current study. Overall mean LL of 9.08 months (272.4 days) in the study area is longer than what was reported by Mngofi (2009) of 7.4 months (226 days). Macha (2008) reported a higher mean LL of 8.7 months (261 days) for Ilala district, which was shorter, compared to 9.44 months that was observed in highlands (Mnanila ward) in the current study.

The difference in LL between low and highlands might be attributed to variations in management and feeding levels. Adequate feeding is done in lowland due to ample cereal by-products (maize stovers, bean straws and maize bran) compared to highland which is highly populated and based on banana and coffee production**.** Extension services are vital for improving dairy cattle husbandry in terms of feeding, disease control and managing reproductive disorders. Therefore, shortage of extension officers could be a reason for farmers not accessing regular services on good dairy cattle husbandry. Lactation period of 10 months (305 days) is a standard measure employed by developed countries for judging milk production potential of a dairy cow. Therefore, the major advantage of 10 months

lactation length is that, it corresponds very closely to a LL of a cow that is calving each year (Mwatawala, 2006).

4.5.3 Dry period

With regards to dry periods (DP), Table 12 shows that the overall minimum and maximum dry period lengths were 1.9 months (57 days) and 4.25 months (128 days), respectively. The overall mean DP was 2.65 months (80 days). However, the DP means in both locations and the overall mean (2.65 months) are shorter than what was reported by Mulangila (1997) of 4.7 months (142 days). On the other hand, Mngofi (2008) reported a longer mean DP of 7.4 months (222 days) and shorter maximum DP of five months (150 days) in Igunga district. Dry periods are essential for cows' mammary gland system to regenerate and put up new secretory cells. The recommended DP is 2 months (60 days) and therefore the observed longer DP in this study indicate that farmers were feeding un-productive animals. However variations in DP might be attributed to year of calving, breed type, location and length of calving interval.

Table 12: Reported cow performance in two different wards

	Daily milk yield (litre) n = 52		Lactation lengths (months) n = 51		Dry period (months) n = 49	
	High land	**Low land**	**High land**	**Low land**	**High land**	**Low land**
Statistics						
Range	8	11.2	7.2	5.2	2.3	2.4
Minimum	4	4.5	4.5	7	2	1.8
Maximum	12	15.7	11.7	12.2	4.3	4.2

Mean	7.80	7.89	8.41	9.4	2.7	2.6
Std. Deviation	2.15	2.14	2.01	1.47	1.50	1.58
Overall cow performance						
Range	11.27		8		2.35	
Minimum	3.73		4.5		1.9	
Maximum	15.00		12.50		4.25	
Mean	7.25		9.08		2.65	
Std. Deviation	2.20		1.78		1.66	

Highland=Munanila ward Lowland= Muzye ward

4.6 The 'Pass on' Philosophy

As in other areas of Tanzania, the philosophy of 'pass on' is the appropriate approach whereby a farmer receiving a dairy animal is supposed to pass on a heifer calf to another farmer. Through this approach, each farmer becomes a donor and with good management, the project investment expands and becomes sustainable. About 43% of farmers passed on weaned female calves to 44 new farmers within their villages and 17% had not yet paid back, probably because they had recently received weaned calves, or their animals were still heifers. However, about 20% of the calves died due to various reasons out of which 11.7% died of East Coast Fever (ECF). This implies that even if there are reliable sources of funds for dairy cattle schemes, management of calves is very crucial in terms of disease control and feeding by the farmers.

Also the observed low 'pass on' rates (43%) among the respondents might be partly due to deaths of calves from ECF and other reasons, like the ratio of female: male calves born within the study area. Female-male calf ratio determines the number of farmers to benefit (expansion of scheme) from the scheme since only a female calf is passed on to a new farmer.

In addressing the problems of lack of capital by smallholder farmers, the government of Tanzania is encouraging farmers to establish saving and credit cooperative societies (SACCOS), encouraging financial institutions to offer micro-credits to farmers under less tough conditions, as well as encouraging the Heifer-In-Trust (HIT) credit schemes to support farmers. Previous studies show that the HIT has assisted many resource poor farmers who did not have capital to buy dairy cattle (Mwankemwa, 2004; Kyomo *et al.*, 2006; Ssendi and Anderson, 2009). Similar advantages of HIT have been observed in the current study.

4.7 Integration Between Dairy Cattle and Crop Enterprises

Results from Table 7 indicate that 60% of respondents used revenue from milk and sales of live animals to purchase agricultural inputs, while 25% spent money for acquiring new land. Inputs purchased using money accrued from milk sales included fertilizer, improved seeds in production of maize, beans and coffee.

4.7.1 Influence of cattle manure on crop production and changes realized in yields

Table 13 shows that 95% and 63.3% of dairy and non dairy cattle owners respectively applied cattle manure in their fields and have observed and increase in crop yields. About 5% and 36.7% of dairy and non dairy cattle keepers did not apply manure, respectively. The probable reasons for dairy cattle keepers not applying manure could be that they had just started keeping dairy animals during the previous crop season. However, 41.7% of households without dairy cattle did not apply manure because they did not own other species of livestock and were incapable of purchasing manure. The majority of households (95%) with dairy cattle who applied cattle manure obtained them from their farms whereas 25.5% of non dairy cattle keepers purchased manure from their neighbours.

About 93.3% and 51.7% of households with and without dairy cattle respectively, indicated that applying cattle manure reduced the use of industrial fertilizers. These results confirm that, besides increasing crop yields, cattle manure application reduced costs of producing crops since industrial fertilizers are expensive. Also, farmers were asked to recall on production levels in 2009/2010 season, for the three main crops (beans, maize and coffee). Their responses showed that in all crops, the use of cattle manure significantly increased yields.

Dairy cattle return significant quantities of nutrients to crops through dung and urine. Up to 65% of the phosphorus (P) eaten in the animal diet is returned in faeces, while approximately 11% and 79% of the consumed potassium (K) is returned in dung and urine respectively (Haynes and Williams, 1993). Farmers in the study area were practicing intercropping. In Mnanila ward mainly coffee, banana, beans and maize are grown in one field. Similarly in lowland (Muzye ward), maize and beans are intercropped. In this kind of farming system, small scale dairy farming has a potential influence in improving households' livelihoods. It can be concluded that integration of crop and dairy cattle enterprises improves crop production because of using improved seeds, manure and expansion of their farm fields and ultimately increased income per household. The significance of dairy cattle in increasing field crops also was reported by Iiyama *et al*. (2007) in Rift Valley of Kenya. They found out that households that kept dairy cattle and grew fruits earned more income. Also, Stotz (1979) noted that one of the main objectives of adopting zero grazing was for production of manure for coffee production in Kenya, Tanzania and Malawi.

Table 13: Cattle manure application and reduction of industrial fertilizer

	Dairy cattle keepers n=60	**Non - dairy cattle keepers n= 60**

	Frequency	Percent	Frequency	Percent
Use of manure				
Applied cattle manure	57	95.0	38	63.3
Did not apply cattle manure	3	5.0	22	36.7
Total	**60**	**100.0**	**60**	**100.0**
Source of manure				
From own farm	57	95.0	22	36.7
None	3	5.0	23	38.0
Purchased	0	0.0	15	25.3
Total	**60**	**100.0**	**60**	**100.0**
Fertilizer reduction because of applying cattle manure				
Did not apply cattle manure	3	5.0	25	41.6
Reduction in fertlizer	56	93.3	31	51.7
No reduction observed	1	1.7	4	6.7
Total	**60**	**100.0**	**60**	**100.0**

4.7.2 Use of crop residues as livestock feed

About 96.7% of dairy farmers used crop residues to feed their animals while 3.3% of them did not. Sources of crop residues were mainly from their own farms (56.7%) whereas 5% of respondents obtained them through exchange with other items or got them freely (15%). However, about 23.3% of dairy cattle farmers purchased crop residues. The majority of farmers (76.7%) did not purchase crop residues whereby those who purchased them, paid a minimum and maximum of 20 000 and 245 000 TAS per year (with an average of 143 571 TAS), respectively**.** A similar observation was also reported by Mngofi (2009) in Igunga district, Tanzania whereby 94.1% of interviewed farmers were feeding their animals with crop residues. Furthermore, farmers with dairy cattle in the study area were able to recycle nutrients by feeding animals crop residues (maize stovers, banana leaves and bean straws) collected from their farms and then later nutrients are brought back to the farm as cattle manure. Nutrient recycling is a major factor in sustainability of various farming systems in rural areas. Apart from nutrient recycling,

crop residues are used as fodder bank during dry season when there is scarcity of feeds for livestock.

4.7.3 Small scale dairying and household food security

Results in Table 14 indicate that 65 % of respondents with dairy cattle produced sufficient food for their household and the rest (35%) produced insufficient food. About 26.7% of households without dairy cattle had sufficient food while 73.3% could not produce sufficient food. These results demonstrate that households with dairy cattle were more food secured than those without dairy cattle. Minja (2007) reported higher food sufficiency of 70% and 60% for households with and without dairy cattle in Kilombero district, respectively. These findings in th current study suggest that small scale dairying supports households with dairy cattle to be more food secured throughout the year compared to households without dairy cattle.

Table 14: Status of food sufficiency

Food sufficiency thoughout the year	**Dairy cattle keepers n=60**		**Non -dairy cattle keepers n=60**	
	Frequency	**Percent**	**Frequency**	**Percent**
Yes	39	65	16	26.7
No	21	35	44	73.3
Total	**60**	**100.0**	**60**	**100.0**

Furthermore, households which were not able to feed themselves throughout the year faced critical food shortage particularly between December and February. Results in Fig. 5 indicate that during this period, 21.7% and 25% of households with and without dairy cattle respectively, faced critical food shortage of 1 to 3 months. A half (50%) of households without dairy cattle faced critical food shortage of above 4 months. A similar

trend of critical food shortage was also reported by Minja (2007) in Kilombero district, Tanzania where 13% of farmers had critical food shortage between January and March. He further reported that about 65% of respondents had no food shortage. The period between November and January is preceded by a long dry season and farmers are planting and weeding crop fields. This might be the reason for being critical months of food shortage in the surveyed area.

Results in Table 15 show that 16.7% and 36.7% of households with and without dairy cattle used income from sales of crops to purchase food items during critical food shortage, respectively. Furthermore, households without dairy cattle used incomes from non-farm activities (25%), labour sales (15%) and other sources (21.7%) for the same purpose. This shows that households without dairy cattle had more sources of income to combat critical food shortage though they were likely to be food insecure. Additional and reliable income from sales of milk increased purchasing power of households involved in dairy roduction. The earned income from milk enabled purchaseof cereal grains (Kisusu *et al.,* 2002*)*

Table 15: Sources of money to buy food items during critical food shortage

	Dairy cattle keepers n=60		**Non-dairy cattle n=60**	
	Frequency	**Percent**	**Frequency**	**Percent**
Source of money				
Did not face critical food shortage	35	58.3	1	1.7
Sales of milk	13	21.7	0	0.0
Sales of various crops	10	16.7	22	36.7
Others	2	3.3	13	21.7
Off farm income	0	0.0	15	25.0
Labour sale	0	0.0	9	15.0
Total	**60**	**100.0**	**60**	**100.0**

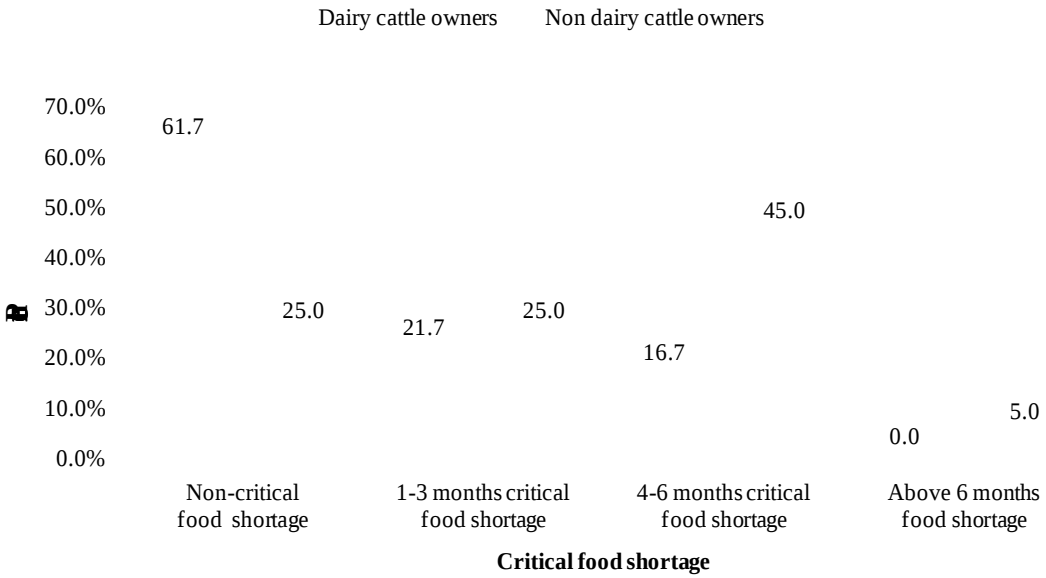

Figure 5: Distribution of households by critical food shortages

4.8 Supporting Sectors in Dairy Cattle Enterprise

4.8.1 Milk marketing

In terms of distances from production to consumption points, it was observed that most of the respondents (85%) were selling milk within their villages and 15% sold milk outside their villages. Minimum and maximum distances travelled to consumption points were 0.5 and 6 km respectively, with an average of 1.34 km. About a half (51.7%) of respondents were selling milk to food vendors. Others were selling to neighbours (33.3%) and to kiosks (15%), (Table 16). Findings from this study resemble those reported by Ashimogo and Kurwijila (1992) as cited by Luoga (2005) who observed that most dairy products were marketed through inter-household sales within farmers' location. However, Mwatawala (2006) indicated that milk in Kagera region was mainly sold as fresh milk to milk vendors probably because of low milk production and lack of milk markets.

The average price of milk was 485 TAS and ranged between 300 and 800 TAS. About 48.4% and 43.3% of farmers reached the market access by bicycles and on foot,

respectively. Only 8.3% of farmers reported that their buyers collected milk themselves from homesteads (Table 16). Additionally, respondents were asked to comment on the current market price of milk. Their responses were that 13.4%, 46.7% and 40% considered their prices to be good, fair and unfair, respectively. Market opportunities for milk are mainly in urban areas where people have high purchasing power, although efforts can be done to stimulate milk demand in rural areas. These stimulants may include milk drinking campaigns in primary and secondary schools and encourage rural communities to have milk drinking habit.

Table 16: Milk markets, transport means, distance from homestead and prices

Aspect	Frequency	Percentage
Milk market		
Within the village	50	85.0
Outside the village	9	15.0
Total	**59**	**100.0**
Point of selling milk		
Within the village	50	85.0
Outside the village	9	15.0
Total	**59**	**100.0**
Main Costumers/consumers		
Neighbours	20	33.3
Food vendors	31	51.7
Kiosk owners	9	15.0
Total	**60**	**100.0**
Means of milk transport		
By bicycle	28	48.4
On foot	26	43.3
Buyers collect themselves	5	8.3
Total	**59**	**100.0**
Milk prices in TAS		
300	2	3.4
400	16	26.7
500	32	53.3
600	8	13.3
800	2	3.3
Total	**60**	**100.0**
Comments on milk prices		
Good	8	13.3
Fair	28	46.7
Unfair	24	40.0
Total	**60**	**100.0**

4.8.2 Modes of payment for milk sales

Fig. 6: shows that for the majority (61.0%) of respondents received their payment on daily basis followed by payments done on weekly intervals (28.8%). Only 6 out of 59 respondents were being paid on monthly basis. Results from this study suggest that firstly, farmers preferred daily payments in order to meet daily household cash requirements. Secondly, to avoid consumers' delay in paying if one is to pay on monthly basis. These results are divergent to what was reported by Mngofi (2009) in

Igunga, Tanzania where 47.9% of farmers conceived that monthly payments were preferred since it facilitated income accumulation in the household. He further noted that fluctuations in daily milk yield led to changes in revenue which according to farmers they distorted their development plans.

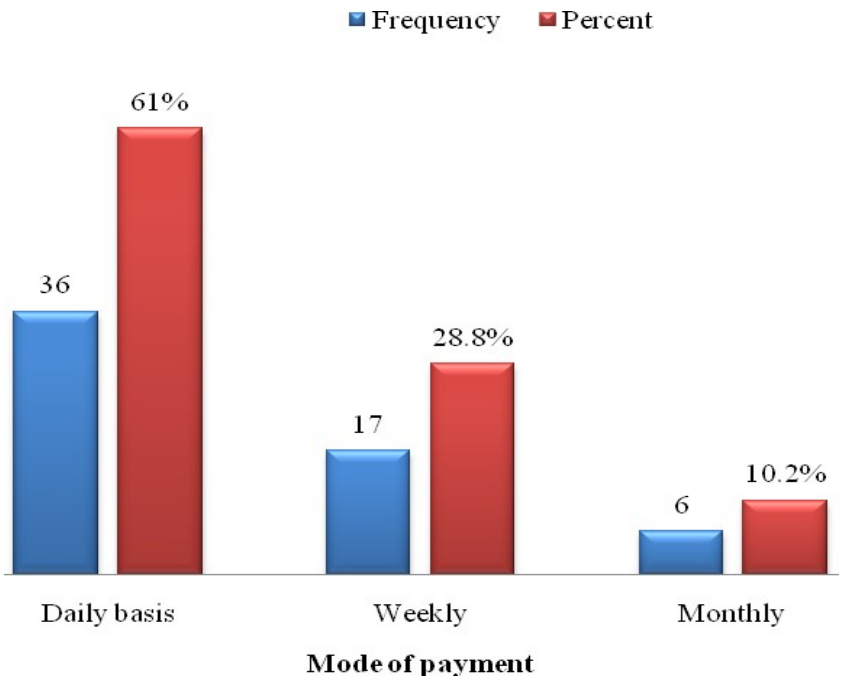

Figure 6: Distribution of households by modes of payments for milk sales

4.8.3 Extension service delivery

Results in Table 17 show that 60% and 51.7% of dairy and non dairy cattle owners indicated that they were not sure whether the extension workers were providing advisory work, respectively. However, 31.7% of dairy cattle owners and 46.7% of non dairy cattle keepers were accessing extension services in the surveyed villages (Table 17).

These results imply that there was a shortage of extension workers in the study area. District officials confirmed that among the six surveyed villages, there were only two extension workers, one in each ward who were supposed to work in more than 6 villages each. Practically, this hindered the efficiency in extension service delivery. Probably, Farmer Field Schools (FFS) approach which has been recently introduced in the study area for crop production may be adopted for dairy cattle production. Under FFS approach, dairy cattle farmers could learn faster about improved dairy husbandry practices like cleanliness, housing, feeding and disease control (Braun *et al.,* 2006*).*

Furthermore, respondents who were accessing extension services were asked on the frequencies of contact with an extension worker. Results indicated that the majority (61.7% and 58.3% of dairy and non dairy cattle owners, respectively), accessed extension services by calling up an extension worker and not based on regular visits. On the other hand, 65% and 30% of dairy cattle owners showed that knowledge and skills offered by extension officers were adequate and inadequate but useful, respectively. Most of non dairy cattle owners (76.7%) showed that skills and knowledge offered by extension officers were inadequate but useful. Based on these results, it can be concluded that there were insufficient contacts between farmers and extension workers though dairy cattle owners considered knowledge and skills offered were adequate. Contact frequencies between farmers and extension workers are determinants for innovation adoption.

Table 17: Status of extension services provided

Variable	Dairy cattle owners (n=60)		Non dairy cattle owners (n=60)	
	Frequncy	**Percent**	**Frequency**	**Percent**
Whether extension worker provided advisory services				
Do not know	36	60.0	31	51.7
Provided	19	31.7	28	46.6
Not provided	5	8.3	1	1.7

Total	**60**	**100.0**	**60**	**100.0**
Frequency of getting extension services				
Don't know	0.0	0.0	12	20.0
Weekly	2	3.3	6	10.0
Monthly	21	35.0	7	11.7
On call	37	61.7	35	58.3
Total	**60**	**100.0**	**60**	**100.0**
Knowledge and skills offered				
Adequate	39	65.0	14	23.3
Inadequate but useful	18	30.0	46	76.7
Neither adequate, nor useful	3.0	5.0	0.0	0.0
Total	**60**	**100.0**	**60**	**100.0**

4.8.4 Constraints faced by the dairy cattle project

In the current study, respondents were asked to mention problems they perceived to constrain them in small scale dairying. All respondents (100%) admitted that the project had a significant impact on their livelihoods and that further funding was welcome so that the project expands. This shows that with the project intervention the households' livelihoods have improved. However, results summarized in Table 18 indicate that 95% of respondents faced various constraints; unreliable market for milk (36.6%), lack of extension services (18.3%) and shortage of quality breeding bulls (16.7%).

Extension services were provided on call rather than on regular visits. About 30% of respondents claimed that knowledge and skills offered by extension officers were inadequate but were useful.

These results are different from the study done by Macha (2008) in Ilala Municipality, Tanzania. He showed that about 58% of respondents faced shortage of pasture during dry seasons, followed by 33.8% who claimed high prices of feed supplements. Other constraints included poor quality of pastures and mineral supplements each was raised by 4.1% of farmers. Also, Mngofi (2009) indicated that in Igunga District, Tanzania about 68.6% and 39.2% of dairy cattle farmers faced scarcity of pastures and disease outbreaks,

respectively. Other problems mentioned by farmers included high prices of drugs (11.7%), incidences of diseases (5%) and lack of heifers (5%). Also a similar trend of constraints was observed by Lwelamira *et al.* (2010) in Kayanga ward, Karagwe district in Tanzania. They reported that, unreliable milk market was perceived as a major constraint and the majority (72%) of respondents ranked it as a first constraint in small scale dairying. Ranking of problems depends on how farmers perceive them and in principle they are supposed to be location specific.

Table 18: Constraints faced by the dairy cattle project

Variable	Frequency	Percent
Unreliable market for milk produced	22	36.6
Absence of extension officers in villages	11	18.3
Shortage of quality breeding bulls	10	16.7
High prices of drugs	7	11.7
Diseases	3	5.0
Lack of heifers from the project	3	5.0
No constraints	3	5.0
Feed shortage during the dry season	1	1.7
Total	**60**	**100.0**

4.9 Regression Model Analysis and Interpretation of Results

4.9.1 Regression model analysis

Apart from small scale dairying and crop production, non-farm activities were also considered to have contributed substantially to the total household income. By using forward multiple linear regression, relative contribution of independent variables on annual household income were`determined. The variables (x_1 to x_3) entered in the regression were incomes from dairy activities, non-farm activities and crop production, respectively. The results thereof are summarized in Table 19.

4.9.2 Interpretation of regression results

Table 19 indicates that the coefficient of determination R square (R^2) of 0.897 was observed when all independent variables were involved, meaning that the model has accounted for 89.7% of the variation in the total household income. The remaining (10.3%) was due to variables not entered into the model and errors. The regression model was: Total annual household income = 164 338 + 0.470 ID + 0.792 IN + 0.386 IC (Table 19).

Furthermore, results indicate that all sources of income had statistically significant ($p<0.01$) contribution to the total household income. It is therefore concluded that, small scale dairying and non farm activities in the current study were found to be more significant in contributing to the total annual household income than crop production. However, farmers in the surveyed villages and others practicing small scale dairying in Kaslu district are advised to intergarte small scale dairying, crop production and non farm income generating activities.

Table 19: Forward multiple regression coefficients results

Y	A	bX	Se	P-value	R^2
Total annual household income	692 277	0.563 ID	0.231	.000	0.305
	278 118	0.586 ID	0.103	.000	
		0.742 IN	0.061	.000	0.863
	164 338	0.470 ID	0.032	.000	
		0.792 IN	0.342	.000	
		0.386 IC	0.020	.000	0.897

ID = Income from dairy enterprise, IN =Income from non-farm activities, IC=Income from crop enterprise.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following conclusions emanate from the major findings of this study:

i) Small scale dairy cattle farming played a big role to improve households' livelihoods in different ways. Farmers' incomes have increased after the project intevention and revenues gained from milk and animal sales and have raised their purchasing power for goods and services. Also it has directly contributed to food security through consumption of own produced milk, which was increased by 71%.

ii) Integration of dairy and crop production has shown positive effects on households' livelihoods. The use of cattle manure has increased crop yields. Households with dairy cattle have reduced use of industrial fertiliser and hence lowering cost of crop production. On the other hand, dairy cattle have been fed crop residues that were reserved as fodder bank.

iii) Variations in cow performance in terms of milk yields, lactation lengths and dry periods were the result of environmental factors such as diseases and inadequate feeding that has been experienced in the study area. However, dairy animals in low land (Muzye ward) performed better since it is closer to Kasulu town where there are reliable feed supplements and high milk prices compared to Mnanila ward. Guaranteed market is an incentive to produce more milk.

iv) Households keeping dairy cattle were capable of investing revenues accrued from dairy production into various profitable non-farm income generating activities.

v) The majority of dairy cattle farmers accessed extension services on calling up extension workers and not based on regular visits. This signifies that there were insufficient contacts between farmers and extension workers, though farmers considered knowledge and skills offered by extension officers were adequate.

5.2 Recommendations

i) It is recommended that provision of guaranteed milk market by the Kasulu District Council, stimulate small scale dairy farmers to increase production. Efforts should be done to stimulate milk demand in rural areas. These stimulants should include milk drinking campaigns in primary and secondary schools and encourage rural communities to have a milk drinking habit. On the other hand, formation of voluntary dairy farmer groups and cooperatives so as to exploit benefits of economies of scale is highly recommended in Kasulu District.

ii) Small scale dairy farming is a profitable venture, although profitability varies among individual farms. This calls for the development partners to support small scale dairy development schemes (Heifer-In-Trust) through which farmers can access quality dairy animals on credit. An integrated approach to such efforts is important and such approach should address increased production as well as marketing accessibility, management and credit issues.

iii) Extension services should be strengthened in the study area since training is the basic method used to ensure that new innovations are introduced to the dairy cattle farmers. Extension services can be effective if there are functional small scale dairy farmers' groups, assisting farmers in acquiring basic knowledge on managing their dairy animals. Further, Kasulu District Council should recruit enough extension personnel for providing quality extension services.

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APPENDICES

Appendix 1: Concepts and operational definitions used in the conceptual frame work

CONCEPT	OPERATIONAL DEFINITION
Age	Number of years since one was born.
Sex	Biological appearance as being a female or male.
Marital status	Having a spouse around or away.
Level of education	Number of years on pursuing formal education; primary, secondary or higher education.
Household size	Number of members within a household.
Occupation	Any activity that is legal and can generate income to an individual or household.
Household income	Money value of goods and services earned by a household
Livelihood	Increase in net household production/house hold position in terms of income and meeting living necessities.
Crop yield	Amount of crop products harvested per ha.
Herd size	Number of animals present on the farm.
Farm size	Size of land (in ha) owned by the farmer.
Land ownership	The right to use piece of land and land available for economic activities.
Extension Services	Getting contact with agriculture extension officers.
Market accessibility	Economic condition that give people buying and selling, price and place.
Improved Health	General good condition of a person in all aspects (physical, mental and social well being).
Household assets	Anything tangible or intangible that is capable of being owned or controlled to produce value and that is held to have positive economic value.

Appendix 2: Questionnaire for dairy cattle owners

Name of respondent……

Village……..

Ward ……

Division ……

Date …….

A. BACKGROUND INFORMATION

Please tick [ ], circle and or fill where applicable

1. What is your age……. (Years)

2. Sex of the respondent? 1. Male 2. Female

3. Marital status. 1). Single. 2). Married 3). Widowed 4). Divorced

4. What is your education level? (1). No formal education. (2). Adult education
(3). Primary education. (4). Secondary education (5). Post secondary education
(5) Family size

Category	**Male**	**Female**
Head of household		
Dependants		
Adults		
Young		
Total		

Socio - economic status

6. By ranking according to the importance, what are the major economic activities and estimated incomes?

SN	Main occupations	Rank	Estimated income per month	Estimated income per year(to be computed)
1	Farming			
2	Wage employment			
3	Self employment			
4	Business			
5	Others (specify)			

B. DAIRY COWS' PERFORMANCE

7. When did you join dairy cattle activities (Year)……

8. How many cattle do you have on your farm now?

Classes (Herd Structure)

1. Cows……. 2.Bulls…….
3. Young bulls…… 4.Young heifers……
5. Male calves…… 6.Female calves……

9. How much milk do you get per day (litres)……..

10. Amount of milk consumed by household per day (Litres)…….

Cow No.	Breed	dateBirth	**date1st calv.**	calfofSex	Lact. Yield (litres)	Length (monthsLact.	Dry Period (months	**dateCalv2nd**	LY	monthsLL	DP	**dateCalv.3rd**

11. How many calves died since you started the dairy enterprise and reasons?
(Mortality and cause of deaths)

SN	Age	Sex	Death reasons
1			
2			

13. What was your monthly income before joining dairy activities ……Year….. (TAS)?

14. What is your total monthly income after joining dairy activities…….Year…..(TAS)?

15. How many female calves have you passed to others so far?

16. Bulls used for mating 1.Owned Bull 2.Hired bull

C. INTEGRATION OF DAIRY CATTLE AND CROP PRODUCTION

17. Do you use cattle manure …? 1. Yes 2.No

18. If cattle manure is used for crop production, have you realised changes in crop yield?

1. Yes 2. No

19. If yes, indicate production before and after using cattle manure

	Crop Produced	**Before applying cattle manure (Production/Ha)**	**After applying cattle manure Production/Ha)**
1	Beans		
2	Maize		
3	Vegetable		
4	Coffee		
5	Banana		

20. Is there any reduction in industrial fertiliser use because of applying cattle manure?

1. Yes 2. No

21. Do you think food produced from your farm is sufficient to feed household till next harvesting period?

1. Yes 2. No

22. If the answer is No how many months does it take…….....?

23. What is the critical food shortage period……From……to…….

24. If you buy food during food shortage, where do you get money?

(1). …… (2). ……(3)..…… (4). ……(5). . …

25**.** Is there any revenue from milk/animals used for crop production?

1. Yes 2.No

26. If Yes, how much …….and for which purposes……..?

SN	Items	TICK if income from dairy cattle contributed on it	Estimated amount (TAS)
1	Buying agriculture inputs (seeds, fertiliser, insecticides)		
2	Buying implements		
3	Buying land		
4	Others (specify)…		

27. Do you use crop residues to feed your animals?

1. Yes 2. No

28. If yes, how do you obtain those residues?

1. Freely. 2. From own farm.
3. Exchange with others items 4. Purchased.

29. Can you estimate how much do you spend per month if crop residues are purchased. [TAS]

D.CONTRIBUTION OF DAIRY CATTLE ON HOUSEHOLDS'S LIVELIHOODS

30. Do you drink milk? 1. Yes 2. No

31. If Yes, what was the amount consumed before joining dairy cattle project per day... (Lts)

32. What is the amount of milk consumed per day after joining dairy cattle project..... (Lts)

33. What are physical assets have you acquired using money from the dairy project?

SN	Item	Tick	Quantity	Estimated value for @ item (TAS)	Total value (TAS)
1a	House (modern)				
2b	House (traditional)				
3	Couch set				
4	Cupboards				
5	Dining tables				
6	Office chairs				
7	Bed				
8	Wardrobe				
91	Mattress				
10	Bicycle				
11	Radio				
12	Television set				
14	Hand hoe/pangas/axes				
15	House ware				
16	Others (specify)				
	Total value TAS				

34. Type of the house owned by the household [TICK]

A.	House walls	1. Thatches/grasses 2. Mud and trees	TICK
		3. Un burnt bricks	
		4. Burnt bricks	
		5. Others (specify)……	
B	Nature of floor	1. Earth/dung/sand	
		2. Cement	
		3. Other (specify)……	
C	Roofing material	1. Thatches/grasses	
		2. Iron sheet	
		4. Others (specify)……	

36. Do you have children who are attending school? 1. Yes 2. No

If the answer is No proceed to question No. 38

37. How much do you spend paying school fees per student per year?..... (TAS)

SN	Level of school/college	No of children	Amount per year (TAS)	How much form the dairy project

38. Do you have any access to health services ……..1.Yes 2. No

39. Are you a member of Community Health Fund (CHF)? 1**.** Yes. 2. No

40. If No, can you estimate how much do you spend on health services per year…...TSH

41. State the estimated income from other species of livestock per year.

SN	Livestock species	Number sold	Income estimates (TAS)
1	Poultry		
2	Goats		
3	Pigs		
4	Sheep		
5	Others (specify		

E. NON – FARM ACTIVITIES

42**.** Which of the following **non- farm** activities did the household member/members engage in 2009/2010?

SN	Source of Income	Tick	Amount/month TAS	Amount /year in TAS
1	Salary employment			
2	Wage labour			
3	Carpentry			
4	Charcoal making			
5	Making bricks			
6	Bicycle repair			
7	Brewing and making local beer			
8	Others (specify)			

F. ACCESS TO MILK MARKET AND MARKETING

43. What is the price of one litre…….?

44. Where do you sell your milk……..?

45. How far is the selling point from the homestead....? (Km)

46. To whom do you sell your milk and at what price……..?

SN	**Milk sold to**	**Tick**	**Price in (TAS) per litre**
1	Neighbours		
2	Food vendors		
3	Kiosk owners		
4	Middle men		
5	Others (specify)		

47. Comment on the price of milk in your case… 1. Good 2. Fair 3. Not good

48. How do you transport your milk? [Tick]

1. By bicycle 2. On foot 3. Buyers collect themselves

49. How much do you pay for the transport of your milk per day ……TAS.

50. How do you receive your payment after selling milk? [Tick]

1. On daily basis. 2. Weekly 3. After two weeks. 4. Monthly

5. Others (specify)……

51. Comment on the number of milk producers compared to the milk demand in your locality…….……

52. Did you sell live animals since you got your first heifer?

1. Yes 2. No

53. How much did you earn (TAS)……..…..?

SN	Animal sold	Sex	Amount earned (TAS)
1st			
2nd			
3rd			

G. EXTENSION SERVICES

54. Is there any extension worker in your village?

1. Yes 2. No

55. If yes, has the extension worker been providing advisory work?

1. Yes 2. No

56. If yes, how the training being conducted?

1. Through workshops 2. Farmer Field Schools
2. Through seminars 3. Learn from others
3. Farmer- extension officer discussion/contacts
4. Other (specify)……

57. What is the frequency of getting extension services?

1. Weekly 2. Monthly 3. Quarterly 5. Once in six months

6. Annually

58. Was the knowledge and skills offered by extension officers on dairy cattle husbandry

Sufficient and useful?

1. Adequate 2. Inadequate but useful 3. Neither adequate, nor useful

4. Do not know

59. I n general, what is your opinion about dairy cattle project?

60. What are the constraints faced the dairy cattle project?

E. BEFORE AND AFTER FARMERS JOINED DAIRY CATTLE FARMING

61. Is there any difference in household income between now and before keeping dairy cattle?

1. Yes 2. No

62. If Yes, has the income 1. Increased. 2 decreased 3. Remained the same

63. Do you have children less than five (5) years in your household?

1. Yes 2. No

64. If yes, is there any difference in children nutrition between now and before keeping dairy Cattle? Explain……

Appendix 3: Questionnaire for non-dairy cattle owners

Name of respondent……

Village……..

Ward ……

Division ……

Date …….

A. BACKGROUND INFORMATION

Please tick [ ], circle and, or fill where appropriate

1. What is your age …… (Years)

2. Gender of the respondent 1. (Male) 2. (Female)

3. Marital status.

1. Single 2. Married

3 Widowed. 4. Divorced

4. What is your education level?

1. No formal education 2. Adult education

3. Primary education 4. Secondary education

5. Post secondary education 6. Others (specify)

5. Family size

Category	**Female**	**Male**
Head of household		
Dependants		
Adults		
Young		
Total		

6. Main occupation of a household head……

SN	**Main occupation**	**Tick**	**Estimated income per month (Tsh)**
1	Crop production		
2	Wage employment		
3	Self employment		
4	Business		
5	Livestock farming		
	Others (specify)		

B. SOCIO –ECONOMIC STATUS OF HOUSEHOLDS.

7. By ranking according to the importance, what are the major economic activities and

Estimated income?

SN	Main activities	Rank	Estimated income per month	Estimated income per year
1	Farming			
2	Wage employment			
3	Self employment			
4	Business			
5	Livestock			
6	Others (specify)			

8. Do you keep livestock? **1. Yes** **2. No**. If No go to question No. 9

Estimated annual income from selling various livestock species and their products

Livestock category	Number of animals sold	Average price per animal (TAS)	Annual income (TAS)
Cattle			
Goats			
Sheep			
Poultry			
Products from animals	**Amount**		
Eggs			
Milk (litres)			
Total			

9. What are physical assets do you own?

SN	Item	Tick	Quantity	Estimated value for @ item (TAS)	Total value (TAS)
1a	House (modern)				
2b	House (traditional)				
3	Couch set				
4	Cupboards				
5	Dining tables				

6	Office chairs				
7	Bed				
8	Wardrobe				
91	Mattress				
10	Bicycle				
11	Radio				
12	Television set				
14	Hand hoe/pangas/axes				
15	House ware				
16	Others (specify)				
	Total value TAS.				

10. Type of house(s) owned by the household

A.	House walls	1. Grasses 2. Mud and trees	
		3. Un burnt bricks	
		4. Burnt bricks	
		5. Others (specify)…….	
B	Nature of floor	1. Earth	
		2. Cement	
		3. Other (specify)……..	
C	Roofing material	1. Grasses	
		2. Earth	
		3. Iron sheets	
		4. Others (specify)……	

11. Do you have children that are attending school?

1. Yes 2.No. If yes, go to Question No 12

12. How much do you spend for paying school fees per year……..?

SN	Level of school	No. of children	Amount spent (TAS) per year
1	Primary education		
2	Secondary education		
3	Tertiary education		
4	Others (specify)		

13. Do you have access to health services? 1. Yes 2. No

14. How much do you spend on health service per year?

(TSH).....

C. DAIRY CATTLE FARMING ACTIVITIES

15. Are you aware of existence of dairy activities in your villages?

1. Yes 2. No

16 If yes, why are you not a member of the project? Mention. ……

17. Would you like to join the project? 1. Yes 2. No

18. If Yes, Why.....

19. If No Why…….....

20. Do you use farm manure in crop production?

1. YES 2. NO

21. If Yes, how do you obtain it……1. Freely 2. Purchased.

22. If obtained through purchase, how much do you pay per cart/lorry……TSH

23. If manure is used for crop production, have you observed changes in crop yield? Yes/No

If yes indicate production for 2009/2010 season.

Crop produced	Before applying cattle manure (Production /Ha)	After use of cattle manure (Production /Ha)
Maize		
Beans		
Banana		
Coffee		
Cabbage		
Tomatoes		
Others (specify)		

24. Is there any reduction in industrial fertiliser use because of applying cattle manure?

1. Yes 2. No

25. Do you think food produced from your farm is sufficient to feed household till next Harvesting period?

1. Yes 2. No

26. If No how many months does it take……?

27. If Yes estimate annual income obtained from selling extra crops……. (TSH

28. What is the critical food shortage period……from……to……

29. What are the sources of food during food shortage?

1. Sales of livestock products 2. Crop income
3. Off- farm income 4. Credit
5. Labour sale

30. If you buy food during food shortage, where do you get money……?

31. Do you use crop residues to feed your animals? 1. Yes 2.No

D. NON – FARM ACTIVITIES

32**.** Which of the following non -farm activities did the household members engage in 2009/2010?

SN	**Source of income**	**Tick**	**Amount/month (TAS)**	**Amount/ year to be computed (TAS)**
1	Salary employment			
2	Wage labour			
3	Carpentry			
4	Charcoal making			
5	Making bricks			
6	Bicycle repair			
7	Others (specify)			

E. EXTENSION SERVICES

33. Is there any extension worker in your village?

1. Yes 2. No

34. If yes, has the extension worker been providing advisory work?

1. Yes 2. No

35. If yes, how the training being conducted?

1. Through workshops 2. Farmer Field Schools
3. Through seminars 4. Learn from others
5. Person-to-person contact 6. Other (specify)…

36. What is the frequency of getting extension services?

1. Weekly 2. Month 3. Quarterly 5. Once in six months 6. Annually

Appendix 4: Check list for district officials

Respondent's name……

Position …….

Date……..

……

1. Age of the respondent (Years)……
2. Sex of the respondent 1. Male 2. Female
3. Highest professional qualification attained……..……
4. Which criteria were used to select members of the project? ……...
5. Did you involve farmers during the project planning?

   1. Yes 2. No

6. Is there any committee that was involved?

   1. Yes 2.No

7. What were the project objectives? …….
8. Did the project objectives address the farmers' requirements and priorities?

   1. Yes 2. No

9. If Yes, which priorities were addressed……..
10. Is there any success of the project?

    1. Yes 2. No

11. If yes, what are the indicators? ……..……
12. What are the constraints met during project implementation?

    1.…….....

    2. ……

13. What are the measures in place to contain the constraints encountered during the project implementation?
14. How do you compare dairy cows' performances in high and low lands areas and reasons? …….……..
15. In general what are your comments on the dairy development activities in this area?

Thank you very much for your cooperation