ASSESSMENT OF FACTORS AFFECTING PERFORMANCE OF DAIRY CATTLE KEPT IN SMALLHOLDER FARMS IN PERI-URBAN AREAS OF TEMEKE MUNICIPALITY

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ABSTRACT

There was a lack of detailed information of factors affecting the performance of dairy cattle kept in smallholder farms in Temeke municipal. Two approaches were employed to identify factors that affect the productivity and reproductive performance of dairy cattle kept in the study area. The first approach used structured questionnaire which were administered to 84 dairy farmers using a cross sectional survey technique to collect data from 12 villages. The second approach was a longitudinal monitoring where 16 lactating dairy cattle from four streets owned by dairy farmers that filled the questionnaire were monitored for thirty days where feed intakes and milk yield were measured and recorded. Feed samples were collected for quality evaluation. The daily milk yield of lactating cows under cross sectional survey and longitudinal monitoring was 8 litres with range of 4- 13 litres and 9 litres with range of 5-13 litres per cow per day, respectively. The major limitations to improved production identified by farmers were diseases and erratic extension services. The overall percentage of crude protein (CP), calcium (Ca), Phosphorus (P), *In vitro* dry matter digestibility (IVDMD) and Metabolisable energy (ME) contents of mixed forages fed to the animals were 6.38, 0.2, 0.17, 44.77 and 7.14, respectively. IVDMD and ME contents of mixed forages fed to cattle in Mbutu village were significantly ($P<0.05$) higher than those from Kizani, Kidagaa and Kwachale villages. The overall daily nutrient intakes of ME, CP, Ca and P for a cow weighing 420kgs in the study area were 87.5, 758g, 22.9g, and 18.5g per cow per day, respectively which did not meet the requirement for the production of 12 litres of milk per day. According to NRC (2001) a cow weighing 420kg requires 108 ME, 1357gCP, 46.2gCa and 34gP. Therefore supplementary ration of 20.5ME, 599gCP,

23.3g Ca, and 15.5gP per day will be required to cover the shortfall of 3 litres of milk per day.

DECLARATION

I, KARUME SEMFUKO CHAUSSA, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

……. ……

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The above declaration is confirmed

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Professor Mtenga L. A **Date**

(2nd Supervisor)

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DEDICATION

I dedicate this study to my late father George Semfuko Chaussa, my mother Kidawa Chaussa, my wife Fadhiluna, my sisters (Rehema and Riziki), my children (Shabani, Abdul, Khabil, and Khaulat) and the rest of Chaussa family. I want to say this dissertation does not only belong to me but it also belongs to you all. This is a result of your motivation, assistance and your prayer messages. I wish to leave you with a message stating that with God everything is possible. To those who are still scholars in Chaussa family I want to say I have set the pace. Your responsibility is to raise the standard. Finally, education is a weapon you can use to fight enemies irrespective of how dangerous they are and from which part of the world they are coming from.

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LIST OF ABBREVIATIONS

AFC	Age at first calving
AFS	Age at first service
AI	Artificial Insemination
^{o}C	Degree Celcius
Ca	Calcium
CI	Calving Interval
CP	Crude Protein
DM	Dry Matter
DO	Days Open
DMI	Dry Matter Intake
DOMD	Digestible Organic Matter in Dry Matter
ECF	East Coast Fever
FMD	Foot and Mouth Disease
g	Gram
Ha	Hectare
HF	Holstein Friesian
HH	Household
HPI	Heifer Project International
IVDMD	In vitro Dry Matter Digestibility
Kg	Kilogram
L	Litre
LMUs	Livestock Multiplication Units
MALDO	Municipal Agriculture and Livestock Development Office

ME	Metabisable Energy
MJ	Mega Joules
MY	Milk Yield
n	Number
NSC	Number of Services per Conception
%	Percent
P	Phosphorus
STD	Standard
RP	Reproductive Performance
SCC	Somatic Cell Count
SEM	Standard Error of the difference of the means
SPSS	Statistical Package for Social Science
SUA	Sokoine University of Agriculture
Tsh	Tanzanian Shillings
TSHZ	Tanzania Short Horn Zebu
USA	United States of America
VIF	Variable Inflation Factor
WB	World Bank

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The dairy industry in most parts of the world started with small-scale traditional cattle rearing in rural areas with the objective of producing milk to feed the family and neighbours. The dairy industry is among the important components of the livestock sector, source of animal protein, income and employment (Njombe *et al.*, 2012). The sector has a great potential for improving the living standards of the people and contributing towards reduction of poverty. The ability of the dairy enterprise to generate regular income and to contribute to the household diet on a regular basis throughout the year is an advantage over other agribusiness enterprises (Jan *et al*., 2011).

The livestock sector grows at the rate of 3.4% and contributes 3.8% to the Gross Domestic Product (GDP) in Tanzania; of this, 40% comes from beef, 30% from dairy and 30% from other stock (Njombe *et al.*, 2012). Efforts to develop the dairy industry in Tanzania started immediately after independence. The government efforts aimed at increasing the population of improved dairy cattle in order to produce adequate amount of milk to meet the increased demand for dairy products within the country. Between 1960s and 1970s the government's aim was to establish large scale dairy farms through direct importation of exotic dairy breeds, principally from temperate countries (Kurwijila, 2002). To this effect during 1975 and 1993, a total of 1,039 heifers were imported with assistance of the World Bank (WB) and Heifer Project International (HPI). Another batch of 890 heifers were donated by Heifer Project International (HPI) and sent to Kitulo Dairy Farm. These animals

were sourced from USA, New Zealand, Kenya and Zimbabwe (Njombe *et al.*, 2012). The aim was to stock large scale farms with dairy cattle where they could multiply and thereafter surplus heifers be distributed to smallholder farmers. However, due to poor reproductive performance and high mortality rates, no appreciable surplus heifers were produced from the parastatal farms. The direct use of exotic breeds for production was faced with problems of lack of fitness, adaptability and resistance to various diseases and parasites, and hence little success (Mpiri, 1990).

After realizing that the use of pure exotic breeds was a failure, efforts were shifted to crossing dairy breeds with the Tanzania Shorthorn zebu (TSHZ) with the intention of upgrading TSHZ. The crossbreeding of the local cattle to temperate dairy breeds has been pursued as a means of increasing milk production in the country since mid 1960s to date. However, the performance of crossbred dairy cattle in large-scale parastatal farms was disappointing due to management problems, and hence, the envisaged dairy industry development was not achieved (Kurwijila, 2002). The poor performance of the large-scale parastatal dairy farms prompted the government to change the development strategy of the dairy industry towards small-scale production system (Mpiri, 1990). By mid 1980s, small-scale production was encouraged and promoted by initiation of small-scale dairy development programmes in various parts of the country not only as a means of achieving national self-sufficiency in milk and milk products, but also for poverty alleviation in rural areas (Kurwijila, 2002). To increase the supply of F_1 dairy cattle heifers to smallholder farmers, Livestock Multiplication Units (LMUs) were established

(Chenyambuga and Msekelo, 2009). These LMUs were stocked with TSHZ or Boran cows for crossbreeding with sires of exotic breeds, mainly Friesian and Aryshire. The F_1 heifers produced in the LMUs were usually sold to smallholder livestock keepers or to Non-governmental Organizations (NGOs)/Community Based Organizations (CBOs), which in turn, distributed them, to smallholder farmers. The small-scale dairy enterprise is comprised of individual farmers holding a few dairy cattle, normally between one and ten animals (Swai *et al.*, 2007).

It is estimated that in Tanzania there are about 23 million cattle, out of which there are about 720 000 dairy cattle consisting of Friesian, Jersey, Aryshire and their crosses with the East African Zebu (Njombe *et al.*, 2012). Crossbreeding of the local cattle to *Bos taurus* dairy breeds has been pursued as a means of increasing domestic milk production in the country since independence in 1961 to date. According to Njombe *et al*. (2012) various strategies have been employed including use of Bull centers, livestock multiplication farms and use of AI.

Milk produced from cattle under smallholder production systems have been reported to be ranging from 6.3 to 7.5 litres a day along the coastal belts of Tanzania (Epaphras *et al*., 2004) and 5.0 -18.5 litres in Rungwe in the Southern Highlands (Gimbi, 2006). Factors that have contributed to this low production have included low genetic potential, harsh climate, poor feeding and diseases (Johnson *et al.*, 2002).

Temeke is one of the three administrative municipal of Dar es Salaam city in the Eastern part of Tanzania. From 1990s dairy farming has become a prime activity

particularly to resource poor households. Small scale dairying has gained popularity in peri-urban of the municipality where Heifer Project International (HPI) assisted poor families by introducing heifer in-trust scheme (MALDO, 2011).

1.2 Problem Statement and Justification of the Study

Small-scale dairying is an important source of income and has attracted a lot of peri-urban families in Temeke Municipal however it has not been able to improve the livelihood of these farmers because of their poor performance (MALDO 2011; HPI 2010). There is lack of detailed documentation of factors affecting dairy cattle performances in Temeke but studies in Kibaha district (Nkenwa, 2009) have shown that poor feeding contribute to poor performance of dairy cattle owned by small-scale farmers. Poor management, poor nutrition, lack of good breeds, infertility, reproduction disorders, animal diseases and the poor marketing system are among the major constraints in Tanzania (Swai *et al.,* 2005 b).

There is, therefore, a need to evaluate the performance of dairy cattle of different breeds kept under the small-scale farmer's management practices. The findings from this study will assist smallholder farmers in making appropriate decisions concerning the improvement in dairy cattle performance and hence improving their standard of living. Thus the main objective of the study was to assess factors affecting performance of dairy cattle kept in smallholder farms in peri-urban areas of Temeke municipality.

Specifically the study aimed at evaluating productivity and reproductive performance of dairy cattle kept by smallholder farmers. The study also aimed at identifying factors that affect the productive and reproductive performance of dairy cattle in peri-urban areas of Temeke municipal.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

Peri- Urban livestock keeping fits different livelihood strategies and contributes to food security, income and employment generation, saving and insurance (Azage *et al,* 2006). However, increased and sustainable production has generally been constrained by several factors including poor management, inadequate feed resources both in quality and quantity, unimproved breeds, reproductive wastage and inadequate animal health care. Genetic improvement remains a tool in livestock research and development, but greater emphasis should be placed on the improvement of the management systems of the existing animal resources for an achievement of an optimum balance between the breeds, the climate and feeding (Tesfay, 2012). This section attempts to review literature on productive and reproductive performances of dairy cattle kept in Tanzania.

2.1.1 Productive performance

The most valuable part as far as economics of dairy cattle rearing is concerned is the production performance. Milk yield is the most important economic trait of dairy cattle enterprise among smallholder farmers since it has direct impact on their socio-economic needs. Milk yield and milk related traits are influenced by a number of factors including effects of feeds quality and quantity, effect of season on milk yield, effect of breeds on milk production, effect of the age of the dam on milk yield, effect of milking intervals and milking frequency on milk yield and diseases as components of an economic production function.

2.1.1.1 Effects of feeds quality and quantity on milk production

Feeding is a fundamental aspect in dairy cattle production. In order to improve milk production levels, energy inputs such as concentrate feeds have to be considered essential for any dairy enterprise, since reduced intake of energy by animals consuming low quality forages is the principal cause of low milk production (Urassa, 1999). Dairy cows compared to other farm animals produce large amount of milk, hence require sufficient quantity and quality feeds with all necessary nutrients, including energy, protein, minerals and vitamins.

Good quality roughage is the basis of a high milk production. Examples of good quality roughages are pasture grass, hay which has been harvested at an early stage of growth (before seed setting), various legumes, and elephant grass with dark green colour and harvested at the length of 90 cm (MOA, 1999). Roughages of poor quality are mature hay, cereal straw, maize stover and overgrown Napier grass. On a good quality pasture a dairy cattle weighing 400kg is able to eat 40-60 kg grass per day, which is enough for a milk yield of about 7-8 kg (MOA, 1999). If the milk yield is higher, concentrate must be added to maintain the maximal production. If the pasture is poor (dry season, overgrazed), additional feed is required even at lower milk production levels (MOA, 1999).

Concentrates rich in energy are feedstuffs such as grain, bran and maize germ meal. Concentrates rich in protein include sunflower seed cake, cottonseed cake and brewers grains. How much energy and protein a concentrate mixture should contain will depend on the quality of the basal roughage and the level of production. As a

rule of thumb; 1 kg good concentrate will increase milk production by 1.5 litres (MOA, 1999)

Minerals (calcium, phosphorus, magnesium, copper and salt) are very important for a dairy cow. Lack of certain minerals can result in poor fertility that includes poor heat signs, poor conception which is usually associated with lack of calcium and phosphorus. Also low milk production is usually associated with lack of phosphorus salt while deformed skeleton in young animals is usually associated with a lack of calcium, phosphorus or inadequate ratio (MOA, 1999).

High performance of dairy cattle under small scale sector has not been realized due to several factors, one of them is the inability to provide sufficient quantity and quality feeds to their livestock on a consistent basis (Hall *et al.*, 2008; Urassa, 1999). Most of the feeds supplied to dairy cows by smallholder farmers are forage based with or without concentrate supplements. Generally, dairy cattle which do not access adequate feeds necessary to meet their nutritional requirements for maintenance, production, and reproduction; results into, delayed age at calving and long calving intervals and low milk yield (Urassa, 1999). Supplementation with concentrates especially to lactating cows has an additive effect on milk yield and milk persistence (Church and Ponda, 1995). For a normal dairy cow, dry matter consumed within 24 hours should be 2.5-3% of its body weight. For a cow weighing 600kg require 15.4kg dry matter when grazing for 8 hours (Mc Donald *et al.,* 1995).

Although fodder shrubs have multiple benefits for milk production, animal health and soil conservation, ICRAF research in East Africa was motivated mainly by demand for quality dairy feed to increase milk production in the smallholder dairy farming systems of the region. Roothaert and Paterson (1997) compared the nutritive value of several common fodder tree species such as *Leucaena leucocephala, Calliandra calothyrsus, and Sesbania sesban*. Among the three, *Sesbania sesban* had the highest dry matter digestibility, low acid detergent fibre levels and average crude protein content, which gave it high nutritive value overall. Anti-nutritive properties in *calliandra* caused by polyphenolic compounds, commonly known as tannins, have been reported by many authors (Dzowela *et al*., 1997). These compounds also have positive effects in animal feeds, as they protect proteins from microbial degradation in the rumen and enable direct absorption in the intestines. For highly productive dairy cows, this can be of advantage for milk production.

According to Paterson *et al*. (1998) one kg of dried *Calliandra* (24% crude protein and digestibility of 60% when fed fresh) has about the same amount of digestible protein as 1 kg dairy meal (16% crude protein and 80% digestibility); each increases milk production by about 0.75 kg under farm conditions, but the response is variable, depending on such factors as the health of the cow and the quantity and quality of the basal feed (Paterson *et al*., 1998). Koech (2005) found that a sample of 20 farmers in the Embu area, Kenya, reported an average response of 0.8 kg milk from feeding one kilogram (dry weight) of calliandra. According to Sarwatt *et al.* (2004) *Moringa olifera* improved the milk yield due to a positive effect on the rumen environment, leading to increased rumen microbial output, and that the

protein in *Moringa* also has good rumen bypass characteristics. *Moringa oleifera* fed at 2 kg or 3 kg DM per day can significantly improve dry matter intake, nutrient digestibility and milk yields of dairy cattle fed a basal diet of *Bracharia brizantha* hay in the dry tropics without affecting milk composition (fat, crude protein and total solids) or organoleptic characteristics of milk (smell, taste and colour), and has thus a great potential to contribute protein rich forage, particularly in dual purpose production systems during the dry season. There was a linear relationship between the amounts of *Leucaena* leaf meal the cows were fed and their milk yield (Place *et al*., 2008); the more *Leucaena* leaf meal provided, the higher the milk yield. A level of 2.6 kg of *Leucaena* leaf meal with 1.8 kg of cottonseed husks gave similar milk yields as a manufactured 1.8 kg cotton seed cake.

2.1.1.2 Effect of season on milk yield in the tropics

Season of calving has an important impact on productive and reproductive traits, as the high temperature increases respiratory rate and severely depresses feed intake and milk production (Amasaib *et al*., 2011). Hot climate contributes significantly to reduced milk production indirectly and directly through its effect on feed intake (West, 2003). High temperature found in Kibaha was one of the factors that contributed to low milk yield of dairy cattle (Nkenwa, 2009). High milk yield observed to be higher during rainy season due to higher levels of energy, protein and minerals available to the lactating animals during such period (Gimbi, 2006). Milk efficiency was the highest in cows born and calving in the winter and the lowest in cows born and calving in the summer. It may be wise to decrease the number of heifers and cows calving during summer by regulating breeding programme (Broucek *et al*., 2005).

2.1.1.3 Effects of Breed on milk production in the tropics

Milk production is affected by the breed of the dairy animals. The increase in blood of *Bos taurus* has been shown to be associated with increase in milk production. Milk production increased as the level of *Bos taurus* increased from 50%, 75% and 87.5 % for 5.3 kg, 6.2 kg and 7.3 kg, respectively (Agyemang and Nkhonjera, 1986). Msanga *et al*, (2000) found that, 62% *Bos taurus* inheritance were producing more milk than 50% *Bos taurus*. However as the level of exotic inheritance increased towards 100%, the problem of high mortality and reduced fertility increased. With respect to effect of breed, it has been found that crossbreeding has improved the age at first calving and oestrous manifestation of crossbred cows, compared with the local ones, kept under equal and satisfactory feeding, management, and health-control regimes (Swensson *et al*., 1981). Moreover, Albero (1983) showed that in 14 small dairy farm cooperatives located in the central highlands of Ethiopia, F1 heifers performed significantly better than the zebu (Calving Intervals of 371 versus 421 days and total milk yield per lactation of 2013 versus 429 kg, respectively). However, a decline in both the productive and reproductive performance with increasing fractions of *Bos taurus* above the F1 crosses was reported in medium to low-input production systems (Madalena *et al*., 1990).

2.1.1.4 Effects of age of the dam on milk production

The amount of milk produced increases with advancing lactations (age), since an increase in body weight is associated with enlargement of the digestive system and the mammary gland (Ruiz-Sanchez *et al.*, 2007). Recurring pregnancies can increase milk production from first to the fifth lactation by 30% (McDonald *et al.*, 1995).

This is in agreement with the observation made by Migose *et al.* (2006) that milk yield in dairy cows increases with age as a result of a combination of increased body weight and full development of secretory tissues. According to Migose *et al.* (2006) the peak lactation yield in Aryshire crosses is observed in the fourth lactation. The older age may contribute to reduced milk production through turnover of secretory cells, with higher numbers dying compared to the newly produced active secretory cells (Migose *et al.,* 2006). The shape of the lactation curve is determined by the number of mammary epithelial cells and their secretory activity such that the increase in the number accounts for increased milk yield to peak lactation and vice versa (Capuco *et al.,* 2003).

2.1.1.5 Effect of Milking intervals and frequency on milk yield

Commercial farmers milk twice and even three times per day. Cows that are milked twice per day produce more milk than cows milked only once per day (Stelwagen *et al*., 2007). Cows milked at unequal intervals produce less milk than those milked at equal intervals (Stelwagen *et al*., 2007). The cow and its mammary glands can respond to more frequent milking has been reported since the late 1800's (reviewed by Wall and McFadden, 2008). More frequent milking is profitable when the value of the extra milk produced exceeds the costs associated with the extra milking (Thomas, 2010). Hale *et al.* (2003) reported that frequent milking for just the first 3 wk of lactation was sufficient to elicit a carryover effect on milk production that continued into late lactation, and this result was subsequently confirmed in a field study by Dahl *et al.* (2004). Incomplete milking for several consecutive days is one of the factors that reduces milk yield and can permanently reduce the cow's milk

yield for the entire lactation (Stelwagen, 2001). Cows that suckled their calves yielded significantly more milk (9.8 ± 0.33 litres/d) in comparison to cows where calves were bucket reared (7.1 ± 1.32 litres/d) as reported by Msangi *et al.* (1999).

2.1.2 Reproductive performances

Reproductive performance is one of the major factors influencing the efficiency of milk production, the number of calves produced per cow and life time milk production (Esselmont, 1992). The productivity of dairy cattle breeds depends mainly on their reproductive performance and efficiency of service per conception. Among reproductive performance traits: age at first service, age at first calving, number of service per-conception, calving interval, and calf mortality are the bases of profitable production for dairy farm (Mukasa, 1989).

2.1.2.1 Age at first service

According to Gidey (2001), age at first service (AFS) is the age at which heifers attain body condition and sexual maturity for accepting service for the first time. The least square means for the period from birth to when a heifer calved for the first time ranged from 37.0 ± 1.7 to 39.6 ± 0.9 months, with a coefficient of variation of 12.2% (Chenyambuga and Mseleko, 2009). Misostov *et al. (*1996) reported age at first service of heifers controlled in intensive dietary system was 12-14 months while Reddy *et al.* (1995) reported that age at first service of non-descript cows was 3.7 years. A substantial delay in the attainment of sexual maturity may mean a serious economic loss, due to an additional, non-lactating, unproductive period of the cow over several months (Mukasa, 1989).

2.1.2.2. Number of services per conception (NSC)

The number of services per conception (NSC) is the number of services (natural or artificial) required for successful conception. Number of service per conception depends largely on the breeding system used. The number of inseminations required to produce a live calf is one of the most useful parameters of reproductive efficiency which mainly depends on the breeding system used (Young, 2002). The number of service per conception was 1.52 in Asella town Ethiopia (Hunduma, 2012) which is closely to 1.62 reported by Shiferaw *et al*. (2003), 1.67 reported by Yifat *et al*. (2009) and 1.61 reported by Haile-mariam *et al.* (1993).

The study done by Osei *et al.* (2001) on conception performance of 39 Holstein Friesian crossbreds in Ghana found that 74.3% were pregnant after two services and almost 92% after three services. The NSC of 2.2 and 2.3 were reported for crossbred dairy cattle kept under smallholder farms (Mureda and Mekuriaw, 2007) and at a research station (Haile *et al.,* 2009), respectively. The overall mean NSC of 2.0 reported in Holstein Friesian dairy cattle (Ngodigha *et al*; 2009) and 2.11 for HF in Pakistan (Niazi and Aleem, 2003). The mean number of services per conception were 2.5, 2.7 and 2.7 for the first, second and third lactations (Amasaib, 2011) with no seasonal or parity effect. Similar findings were reported by Mureda and Mekuriaw (2007) and Yoseph *et al.* (2003) for crossbred cows.

2.1.2.3 Age at first calving

Age at first calving (AFC) is the number of months from birth date to first calving date. The observation by Asimwe and Kifaro (2007) reported that AFC is influenced

by the seasons in which the heifers are born. This is associated with seasonal fluctuation of feed availability and quality. The animals born in the dry season were weaned in the wet season in which there is abundant and good quality pastures, hence, the weaned calves got better nutrition and grew faster than those born in the wet season and weaned in the dry season which is characterized by inadequate and poor quality pastures (Chenyambuga and Msekelo, 2009). Ages at first calving reported by different researchers are shown in Table 1.

Table 1: Age at first calving

Months	**Source**
26.1 to 42.2	Abu *et al*. (2004)
36.7 to 40.1	Agyemang and Nkhonjera (1990)
29.3	Ajili *et al.* (2007)
32.7	Haile-mariam *et al*. (1993)
34.8	Hunduma (2012)
28.5 to 38.9	Kishinhi (1999)
36.8 to 58.3	Masama *et al.* (2003)
32	Mulangila (1997)
44	Musa *et al.* (2005)
28.5 to 29.2	Negussie *et al*. (1998)
27.2	Niazi and Aleem (2003)
32.7	Sattar *et al.* (2005)
40.6	Shiferaw *et al.* (2003)
31.9	Yifat *et al*. (2009)

The prolonged AFC of cows could be attributed to factors such as poor nutrition and management practices including poor heat detection at the time of mating the heifers. With good nutrition it is expected that heifers would exhibit fast growth and attain higher weights at relatively younger ages. The optimal AFC for cows reared under tropical conditions is between 24-36 months, as these had the highest first lactation yield, highest estimated life time production and had the highest proportion of total life spent in active milk production (Wathes *et al*, 2008).

2.1.2.4. Calving interval

Calving interval (CI) refers to the period between two consecutive calving expressed in days or months (Gidey, 2001). It is probably the best indicator of a cow's reproductive efficiency and expresses the economic importance of reproduction. Twelve months calving interval is generally considered the most economically desirable period for dairy cows. However, such a standard lactation length might not work for smallholder dairy cows in which the lactation length is extended considerably in most cases (Msangi *et al.*, 2005).

The overall mean calving interval was 402.6 ± 3.0 days in Mufindi with a coefficient of variation of 13.1% (Chenyambuga and Msekelo, 2009) while calving interval of 454 – 479 days was observed in Aryshire crosses (50, 62.5 and 75%) by Mulangila (1997) and 476 days observed in various crosses of dairy cattle by Swai *et al.* (2007) in Tanga region. Arguments against short CIs show that dairy cattle get pregnant sooner after calving have high average milk yield per day of lactation period and per year. This is because shorter CIs reduce the prolonged periods of lower daily milk yield with delayed conception (Little, 2004)

A cross-sectional study of reproductive performance of small-holder dairy cows in Tanzania by Swai *et al*. (2005) revealed that poor nutrition, mineral deficiency, high levels of dystocia and retained placenta might interact as management causes of long calving intervals. Lanyasunya *et al*. (2006) also reported animals with low body weight had low conception rate and long calving intervals. The authors concluded that poor nutrition contributed to the poor reproductive performance of dairy cows on smallholder farms.

The longer calving interval predicts reduced reproductive efficiency, which may also be due to diseases, poor nutrition and poor management factors such as failure of heat detection and absence of record (Swai *et al*., 2007). Long calving interval (LCI) is considered to occur if the CI is beyond the standard recommended of 430 days under tropical condition (Mujuni, 1991). Yearly calving interval is desired for economical milk production and provides replacement animals in future.

2.1.2.5 Calf mortality

Calf mortality is a serious indication of productivity levels in dairy cattle. Dystocia and perinatal mortality to a lesser extent are found to be more frequent in heifers than in cows **(**NERPO, 2007). Perinatal mortality is common in calves that were born with very low birth weight that is lower than 20 kg. Gastrointestinal parasites are associated with calf mortality (Ganaba *et al.,* 2002) by causing calf diarrhoea. Some of the calves die as a result of infection by *Babesia bigemina* which is caused by *Cowdria ruminantum* (Ganaba *et al.,* 2002; Marufu *et al.,* 2010). The newly born calf is very weak and susceptible to diseases. Few studies on calf mortality on smallholder farms in Tanzania show mortality that range from 9% to 45% (Chenyambuga and Msekelo, 2009). The authors found overall calf mortality rate in Mufindi was 18.2% which is comparable to the calf death rate of 22% reported by Wudu *et al.* (2008) in smallholder farms in Ethiopia. In the Limpopo Province of South Africa, estimates of calf mortality rates are as high as 60% per annum and these rates increase significantly during multi-year droughts (Moyo, 2003). During drought in Kenya, Ethiopia and Zimbabwe, stock losses were between 30 and 98%. The mortality rate of male calves (21.5%) was greater than that of female calves

(14.5%). This is a reflection of preferential treatment given to female calves compared to male calves (Chenyambuga and Msekelo, 2009).

Furthermore in many countries, the type of dairy farming, generally poorly resourced smallholder production systems (Moran, 2009), and the lack of awareness of the long term implications of poorly reared young stock (Moran and McLean, 2001), does not encourage farmers to pay close attention to their calf rearing systems.

2.1.3 Diseases

A major challenge for dairy producers is to maintain healthy dairy cows. Dairy cows are most likely to become ill during the transition period around calving (3 week before to 3 week after calving). Climatic condition, poor nutritional status and low level of management contribute to a high incidence of cattle diseases, especially in the crossbred cattle (Berhanu, 2002). In Ethiopia, the aggregate annual economic losses from animal diseases through direct mortality and reduced productive and reproductive performance were estimated at US$ 150 million (Berhanu, 2002).

These illnesses include metabolic diseases such as hypocalcaemia and ketosis, infectious diseases such as mastitis and metritis, and diseases in the hoof and leg that cause lameness. Diseases are costly to the producer and cause poor welfare for the afflicted cow; thus they are of high relevance to the dairy industry (von Keyserlingk *et al.*, 2009). Disease causes loss of production and product loss set aside the additional costs for extra labour, veterinary intervention, and product withdrawal

time. In developing countries dairy production and cattle diseases are moreover related to geographical conditions, politics and socio-economic issues (Makuze and Wollny, 2005). In the tropics, diseases have been recognized to be one of the major constraints in livestock production (Swai *et al.*, 2009; Kivaria and Noordhuizen, 2009). A major drawback in improving animal health status on smallholder farms is the lack of veterinary infrastructure. The local availability and accessibility of veterinary livestock technicians are very often a limitation to offering proper veterinary services, while on the other hand the veterinarians are too expensive, too far away or too few in numbers to provide such services (Woods, 2001). Also, exotic cattle breeds do often not very well adapt to local climatic conditions, feedstuffs, pathogens or management. Some of the diseases of importance to dairy industry include mastitis and tick born diseases (anaplasmosis, babesiosis, East Coast Fever).

2.1.3.1 Mastitis

Mastitis is an inflammatory reaction of the mammary gland caused by bacterial infection or tissue trauma and is the most common and economically costly disease in dairy farming (Nielsen, 2009). It is a multifactorial disease, affected by management practices, exposure to pathogens and efficiency of the udder defense mechanisms and presence of environmental risk factors, as well as interaction between these factors (Oviedo-Boyso *et al.*, 2007). Both clinical and subclinical mastitis forms are associated with increased Somatic Cell Count (SCC) (Pandey *et al.*, 2005). Subclinical mastitis, on the other hand, exhibits no clinically visible signs and often remains undetected unless laboratory methods measuring milk SCC and bacteriological examination are used and usually this is the most prevalent form on smallholder dairy farms (Edmondson and Bramley, 2004).

Dirty bedding constitutes a hygiene risk to udder health (Barberg *et al.,* 2007), and it was also reported that suckling improves udder health in suckled compared to non-suckled cows, probably due to improved udder emptying (Fröberg *et al.,* 2008). However, residual calf suckling has the advantage of reducing contamination, the feeding of cold milk to the calf and incidence of mastitis in the dam (Mdegela *et al.*, 2004).

2.1.3.2 Tick born diseases

Ticks cause substantial losses in cattle production, in terms of diseases, reduced productivity and fertility and often death, and are economically the most important ecto-parasites of cattle (Rajput *et al.*, 2006). Furthermore, they reduce body weight gains and milk yield, in addition to creating sites for secondary invasion by pathogenic organisms (Kaufman *et al.*, 2006). Ticks transmit a greater variety of pathogenic micro-organisms from infected cattle to healthy ones than any other arthropod vector group, and are among the most important vectors of diseases affecting dairy cattle (Jongejan, 2007). The overall mortality rates were estimated to be 8.5 and 14.2 per 100 cattle years risk for Tanga and Iringa regions, respectively; 57.7% of the reported deaths were of young stock less than 12 months old; 45% of reported young stock deaths or = 12 months old) were due to tick-borne diseases, mainly East Coast Fever (ECF) and anaplasmosis (Swai *et al.*, 2010).

Tick born diseases are the most important problems in introducing exotic animals into Africa (Girma and Sumption, 2000). In the tropics, the disease has been recognized to be one of the major constraints in livestock production (Swai *et al*., 2009, Kivaria and Noordhuizen, 2009).

The total annual national loss due Tick Born Disease (TBD) was estimated to be 364 million USD, including an estimated mortality of 1.3 million cattle. *Theileriosis* accounted for 68% of the total loss, while *anaplasmosis* and *babesiosis* each accounted for 13% and *cowdriosis* accounted for 6% of the total loss (Kivaria and Noordhuizen, 2009). Costs associated with mortality, chemotherapy and acaricide application accounted for 49%, 21% and 14% of the total estimated annual TBD losses, respectively. Infection and treatment method milk loss and weight loss accounted for 1%, 6% and 9% of the total annual loss, respectively.

Tick-borne diseases, namely, a*naplasmosis*, *babesiosis*, and *theileriosis*, constrain cattle production and improvement in Tanzania, leading to considerable economic losses (Kivaria and Noordhuizen, 2009).

a) Babesiosis

Babesia bovis and *Babesia bigemina* are the main causal agents of bovine babesiosis (Coetzer *et al.*, 1994). The symptoms of the acute form of the disease include anaemia, fever, haemoglobinuria, ataxia, high parasitaemia, and sometimes death (Bock *et al.*, 2004). Animals that recover from primary infection become carriers; in these animals, parasitaemia is virtually undetectable on microscopy. Subclinical infections may endure for long periods (Brown *et al.*, 2006) with infected animals acting as reservoirs. Babesiosis tends to be more important in non-resistant exotic animals, although *B. bovis* infections are very severe and even local breeds of cattle can be greatly affected by *B. bigemina* under conditions of poor health or nutrition (Minjauw and McLeod, 2004).

a) Anaplasmosis

Anaplasma marginale (Rickettsiales: Anaplasmataceae) is the causative agent of bovine anaplasmosis worldwide (Kocan *et al.*, 2004). The clinical symptoms of bovine anaplasmosis may include fever, weight loss, abortion, lethargy, icterus, and often death in animals older than two years (de Waals, 2000). Cattle that survive acute infection develop persistent infections characterized by cyclic low-level rickettsaemia (French *et al.*, 1999). Persistently infected or "carrier" cattle have lifelong immunity and are resistant to clinical disease on challenge exposure. *Bos taurus* breeds (Holstein, Brown Swiss, or Hereford) are more likely to develop acute anaplasmosis than Zebu cattle and their crossbreds. Serological tests have been developed for the evaluation of anaplasmosis and these are useful in the development of preventive measures (Barros *et al.*, 2005).

a) East Coast Fever (ECF)

In Tanzania it is estimated that annual *theileriosis* costs to be US$ 205.40 per head, whereas the introduction of immunisation reduced this by 40-68% depending on the post immunisation dipping strategy adopted (Kivaria and Noordhuizen, 2009).

In Sudan, Siddig *et al.* (2003) reported the total losses due to an outbreak of tropical *theilerioisis* in a dairy farm in Khartoum State to be about US$ 62,000. However, Latif (1994) estimated the losses due to *Theileria annulata* in Khartoum to reach 4-6 million dollars annually. Furthermore, tropical *theileriosis* was shown to cause substantial economic losses to dairy farms in the Northern State (Gamal and ElHussein, 2003). In Juba endemic area of East Coast fever, Marcellino (2004) estimated cost of treatment to range between 20 US$ per calf and US$ 40 per cow

when using Butalex and from US$ 15 per calf and US$ 30 per cow when using parvexon to treat the disease. The losses due to ECF can be lowered by intensive spraying, or dipping, using an effective acaricide (Mugisha *et al*., 2005).

CHAPTER THREE

3.0 METHODOLOGY

Two approaches were used to collect information from the dairy farmers. The first one was the use of structured questionnaires and the second approach was monitoring that was conducted for one month.

3.1 Baseline Survey Using Structured Questionnaires

3.1.1 Description of the Study Area

The study was conducted in Temeke municipal in Dar es Salaam Region. Temeke municipal is in the southernmost of Dar es Salaam, Tanzania. To the East is the Indian Ocean and to the South is Mkuranga district. To the North is Ilala municipal and to the West is the Pwani region of Tanzania. The 2002 Tanzania National Census reports that the population of Temeke District was 768,451. The area is 786.5 km². The area lies between latitude 6°52′08″ and 6°86′9″ southwards, and longitude between 39°15′40″ and 39°26′1″ Easting (MALDO, 2010).

The municipal has 3 divisions including Mbagala, Kigamboni and Chang'ombe. Also the municipal has 24 wards namely Azimio, Chamazi, Charanbe, Makangarawe, Yombo Vituka, Mbagala Kuu, Mbagala, Sandali and Mburani in Mbagala division. Others are Keko, Chang'ombe, Kurasini, Mtoni, Tandika and Temeke in Chang'ombe division and Kigamboni, Mjimwema, Pemba Mnazi, Somangira, Toangoma, Vijibweni, Kisarawe, Kimbiji and Kibada found in Kigamboni division. These wards are comprised of 72 villages/streets with 1179 dairy cattle farmers and 7072 dairy cattle.

The soil types in the study area consist of sand, clay, and loam properties. The main forages available in the study area were *Panicum maximum, Chloris gayana, Hyperrhenia rufa, Cynodon doctylon* and *Brancharia brizantha.* Fodder trees which were used as supplementary feeds were *Moringa oleifera and Leucaena leucocephala.* Other forages which available in the study area are crop residues which are rice straws, maize stovers and sweet potato leaves.

Each dairy farm belonging to a small scale household in the peri-urban study area considered as a farm system that comprises three main components including the household, crops (rice, maize, cassava, sweet potatoes, and cultivated grass) and livestock (MALDO, 2011).

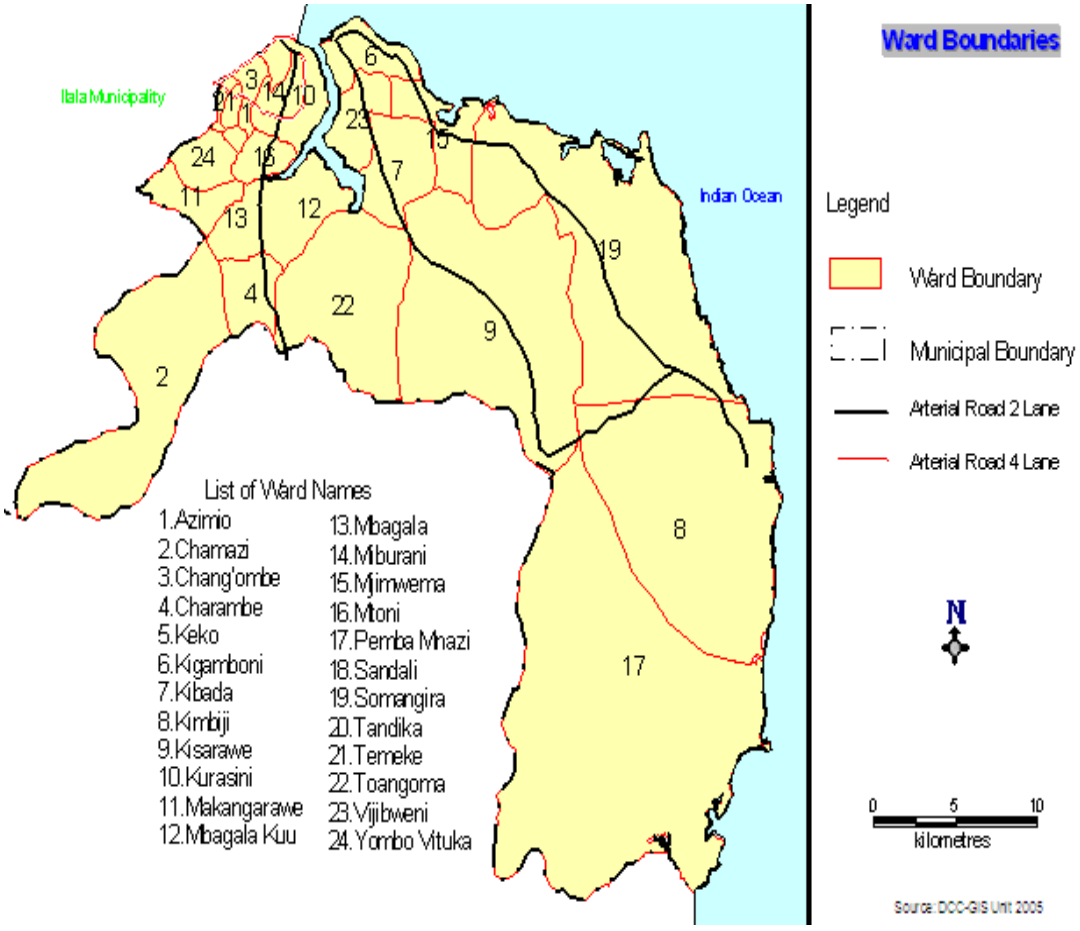

Figure 1: A Map of Temeke Municipal (Source, MALDO, 2011)

3.1.2 Sampling procedures and design

All 3 Division of Temeke District were involved in the study depending on the availability of dairy cattle keepers and accessibility to the locations. Two wards were purposively chosen from each division and two villages/streets were randomly selected from each of the chosen wards. The wards chosen from Mbagala Division were Yombo Vituka and Charambe. The wards chosen from Kigamboni Division were Somangira and Kimbiji and the wards chosen from Chang'ombe Division were Keko and Chang'ombe. Two villages/streets chosen from Charambe, Yombo Vituka, Somangira, Kimbiji, Keko, and Chang'ombe ward were Majimatitu B,

Kimbangulile, Machimbo, Makangarawe, Mbutu, Kizani, Kidagaa, Kwachale, Magurumbasi, Keko Toroli, Bora and Chang'ombe B respectively.

The sample size from each selected village/street was chosen according to the equation: $n = \frac{N}{1 + N(e^2)}$ (Yamane, 1967).

Where

n= Sample size

N= Population

e= Precision level (error term).

Seven dairy farmers were chosen from each village/street. The sample size comprised a total of 84 small-scale dairy cattle farmers in the municipal.

A structured questionnaire was prepared in accordance to the objectives of the study and pre-tested on 8 farmers in Gezaulole Street, and modified before the main survey where it was administered to 84 selected farmers. The questionnaires were administered to 84 respondents using a single visit formal survey technique to collect required data. Some information collected through interview was supported by observation.

3.1.3 Primary data Collection

The questionnaire was administered between December 2011 and March 2012 at the farmers' homesteads. Data on household characteristics included; socio-demographic characteristics, dairy herd characteristics, breeding practices, feeding and health management and constraints faced by smallholder dairy farmers. Data on productive performance were; milk yield, types of breeds kept, feed quantity and

quality, frequency of milking and age of lactating cow. Data on reproductive performance were; methods of breeding, age at first service, age at first calving, calving interval, number of services per conception and calf mortality. Collected data on dairy constraints included diseases, feed availability and availability of extension services. Data on socio-economic contribution of dairy enterprise included the amount of milk sold per day, total income from milk sales, ability to buy goods and services, and ability to pay school fees for children.

3.1.4 Secondary data collection

Secondary data like climate, disease control measures, feeding drawbacks methods of breeding and extension services were collected using reports from the ward executive offices, Livestock Municipal Office and Heifer Project International (HPI). Data obtained enhanced the understanding of the factors that affect the performances of dairy cattle kept by small-scale farmers.

3.1.5 Data analysis

The data was subjected to statistical analysis using Statistical Package for Social Sciences (SPSS) software, version 16.0 (SPSS). Descriptive statistics such as means, frequency distribution and percentages were used for data on productive and reproductive performance and data on socio economic contribution of dairy cattle to smallholder farmers. Also chi-square was employed to find out whether the observed differences were statistically and significantly different or not.

Data on the factors that affect the performance of dairy cattle were performed by Multiple linear regression model; that is Y= f (independent variables). Two models

were employed in this study. The first model was used to measure factors that affect productive performance that is $Y=a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+e$

Where Y=Milk yield

X_1=level of education (STD VII)n/HH

X_2=land owned (Ha)

X_3=breed kept (Types)/HH

X_4=land used for grazing (Ha)

X_5=age of the dam (Years)

a=intercept

e=error term

b=constant

The second model was used to measure factors that affect the reproductive performance that is $Y=a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+e$

Where, Y=Number of calves (calf crop)

X_1=Age at first calving (yrs)

X_2=Number of services per conception (n)

X_3=Calving interval (yrs)

X_4=Calf mortality (n/herd)

a=intercept

e=error term

b=constant

3.2 Monitoring

3.2.1 Monitored animals and their management

The second approach was a monitoring study where 16 lactating dairy cattle from 16 farmers that filled the questionnaire were monitored for thirty days. Two wards that are Somangira and Kimbiji were chosen and four lactating cows in each of the 4 selected villages/streets (Kizani, Mbutu, Kidagaa and Kwachale) were monitored milk yield/cow/day, weight of the animal (kg), amount of feed offered (kg), type of feeds and amount of water offered per day. Feed samples were collected for chemical analysis and calculated to see whether the animals were getting enough nutrients for milk production.

Used animals for monitoring study were lactating cows of Friesian cross and Aryshire cross. Those monitored animals were under zero grazing and depended mainly on natural pastures cut and carried from the communal land as their basal diet. Also those monitored lactating cows selected had between two to four lactations, one to six months after calving and the age of 3.5 to 6.5 years. As well monitored cows were those which were supplied with concentrates and minerals.

3.2.2 Sampling of mixed forage

Forage samples for estimating nutrient contents of feeds fed to the lactating cows were collected from each farmer’s feed bundle two times within a month; in the end of February and the end of March. A total of 16 representative samples weighing 0.25kg each were collected and pre-dried in the sun before being taken for laboratory analysis.

3.2.3 Collection of concentrate samples

Concentrate samples were collected once for the whole experimental period, from each farmer who provided concentrate to his/her dairy cattle. About 0.25kg of concentrate from each farmer was taken for analysis. A total of 16 samples were collected.

3.2.4 Measurement of feed intake and estimation of nutrient intake.

Feed offered to lactating cows was monitored for thirty days and measured in kilograms by using spring balance. No intervention was introduced in the livestock husbandry practice. Literate farmers were encouraged to do the recording on their own while those who could neither read nor write were advised to identify one household member that could do recording. A one day training session on record keeping format was conducted before the commencement of the monitoring study. Recording sheets were written in Swahili language and local extension officers facilitated the exercise.

3.2.5 Measurement of body weights

Body weights of monitored dairy cattle were estimated by measuring the length of heart girth using weighing band tape that give corresponding body weight. This was done in order to establish relationship between body weight and feed intake.

3.2.6 Determination of milk yield during monitoring

Lactating cows from the four villages were milked by farmers daily at 0600h and 1500h. The milk obtained from each cow was measured by farmers using milk

measuring jars and buckets. Milk yield was recorded daily by farmers in the recording sheet. Recording activities were made for thirty days. The researcher visited farmers regularly during milking and recording time to monitor the activities. Determination of milk yield in the study area formed the relationship between milk yield and feeding levels of dairy cattle kept by smallholder farmers.

3.2.7 Determination of in- vitro dry matter digestibility and Metabolisable energy

In vitro dry matter digestibility (IVDMD) of both feed forages and concentrates offered was determined in the laboratory using two stage *in vitro* techniques according to Tilley and Terry (1963). Metabolisable Energy (ME) contents of the feed samples were computed according to MAFF (1975) standards as ME (MJ/kgDM) = 0.16 DOMD. Where DOMD = Digestible organic matter in dry matter = 0.92*IVOMD.

3.2.8 Chemical analysis of feed samples

All representative forage and concentrate samples were analysed for dry matter (DM), crude protein (CP), Calcium (Ca) and Phosphorus (P) according to A.O.A.C (1990) techniques. DM was determined using proximate analysis by oven drying method at 105 ^{o}C. Crude Protein was analysed using kjeldahl method No 988.05. Ca was analysed using atomic absorption spectrophotometric method No 968.08. P was analysed using photometric method No 965.17.

3.2.9 Data analysis

Data on milk yield of lactating cows and the amount of nutrients intakes were analysed using General Linear Model (GLM) procedures of statistical Analysis System (SAS, 2000). The following statistical model was used;

$Yij = \mu + Vj + Eij$, where

Yij = Milk yield or nutrient intakes as affected by i^{th} villages

μ = Overall mean

Vj = Effects of villages

Eij = Random error

CHAPER FOUR

4.0 RESULTS

4.1 Results from Survey Questionnaires

4.1.1 Characterizations of respondents

Table 2 shows characteristics of respondents in the study area. These include age, sex, marital status, education level and type of employment. The age of people involved in dairy cattle production ranged from 30 to 60 years old. Whereby the most involved were those aged between 45-60 years which formed the larger group of dairy cattle keepers in the study area followed by those aged between 31-45years old and those above 60 years old as shown in the Table 2. Many youths (less than 30 years of age) were not engaged in dairy farming, since this age group constituted the minority (1.2%) in the study area. The study revealed that majorities (66.6%) of the respondents were males and one third were females who were mostly involved in dairy cattle enterprise. Majority (84.5%) of the respondents were married couples while 4.8% were widower and 6% were single. In the present study 41.7% of the respondents had attained Primary School education while 39.3% had attained Ordinary Secondary School education.

Majority of the respondents (36.9%) relied on dairy production as their main source of income while others combined dairy with employment (23.8%) and dairy with other business 11.9%. Other activities that were combined with dairy cattle included well drilling, pastor ship and fishing.

Table 2: Socio-economic and demographic characters of respondents (N=84)

Characterization of respondents			
Parameter	**(n=84)**	**Percent (%)**	**P-value**
Age			
<30	1	1.2	
30-45	19	22.6	
46-60	45	53.6	
>60	19	22.6	
Total	**84**	**100.0**	
			0.14 (ns)
Sex	**n=84**	**Percent**	
Male	56	66.7	
Female	28	33.3	
Total	**84**	**100.0**	0.58(ns)
Marital status	**N=84**	**Percent**	
Married	71	84.5	
Single	5	6.0	
Divorced	4	4.8	
Widowed	4	4.8	
Total	**84**	**100.0**	0.66 (ns)
Level of education	**n=84**	**Percent**	
No formal education	8	9.5	
Primary School education	35	41.7	
Ordinary Secondary School education	33	39.3	
Advanced Secondary School education	5	6.0	
Technical college	1	1.2	
Graduates	2	2.4	
Total	**84**	**100.0**	0.003**
Employment status	**n=84**	**Percent**	
Crop farming	9	10.7	
Livestock keeping	31	36.9	
Salary/wage	20	23.8	
Business	10	11.9	
Crop and livestock keeping	10	11.9	
Well drilling	1	1.2	
Pastor	1	1.2	
Fisherman	1	1.2	
Total	**84**	**100.0**	0.000***

* = P<0.05; **=P value<0.001; ns = Not significantly different (P>0.05)

4.1.2 Herd size and structure

In the study area the average herd size of dairy cattle that owned by smallholder farmers were three cows, two heifers, and two calves for each farmer. The average number of bulls in the study area was three bulls for every village/street. During the rainy season most of the smallholder dairy cattle farmers particularly Somangila, Kimbiji and Yombo Vituka ward graze the animals in groups to avoid crop damage

and to save labour cost. In a group the number of animals grazed together ranges from 12-16 animals. Most farmers in the other wards in the study area practices *cut and carry* system.

4.1.3 Performances of dairy cattle

4.1.3.1 Milk yield

The reported mean milk yield in the study area was 8.1 litres with range of 4-13 litres of milk per cow per day. Majority of respondents (25%) indicated that they milk 8 litres per cow per day while 20.2% of the respondents get 6 litres per cow per day.12% of the respondents get 12 litres per cow per day. Other respondents (3.6%) indicated that their cows produced 13 litres per cow per day which was the highest yield in the study area. Also 3.6% and 1.2% of the respondents indicated that their cows produce 4 and 5 litres, respectively which were the lowest production in the study area.

Table 3: Amount of milk (litres) produced per cow per day.

Milk yield/cow/day			**P-value**
Litres	**n=84**	**Percent**	
4	3	3.6	
5	1	1.2	
6	17	20.2	
7	11	13.1	
8	21	25.0	
9	9	10.7	
10	7	8.3	
11	2	2.4	
12	10	11.9	
13	3	3.6	
Total	**84**	**100.0**	0.8 (ns)

* = P<0.05; **P value<0.001; ns = Not significantly different (P>0.05)

4.1.3.2 Age at first service

The average age at first service in the study area was 24 months as reported by majority (97.6%) of the respondents while 1.2% of the respondents indicated that their cattle are mated for the first time when they are 18 and 36 months old (Table 4).

4.1.3.3 Average number of services per conception

Majority of cows were mated once per conception as reported by 56.0% of the respondents followed by two times per conception as indicated by 33.3% of respondents while few respondents (8.3%) indicated that their cows were mated thrice before they conceived (Table 4).

4.1.3.4 Age at first calving

In the study area the majority of the respondents (91.7%) indicated that their cows calve for the first time when they were three years of age whereas 4.8% their cows calve for the first time when they attain four years of age and 3.6% of the respondents indicated that their cows calve for the first time when they are over five years.

4.1.3.5 Calving interval

Table 4 shows that the calving interval of the cows in the study area was 24 months as reported by 45.7% of the respondents while other respondents (41.0%) indicated that the calving interval for their cows was 12 months and other respondents (13.3%) the calving interval for their cows were 36 months.

4.1.3.6 Calf mortality

Calf mortality in the study area was low as reported by 15.5% of the respondents. Other respondents (84.5%) reported that there were no calves' deaths under six months (Table 4).

4.1.3.7 Breeding methods

Results in Table 4 show that majorities (79.8%) of the interviewed dairy cattle farmers apply natural breeding (bull) to their cows and 16.6% of the respondents use artificial insemination (AI) for their cows. Few respondents (3.6%) use both bull and AI. Tables 4 also show that 47.7% of the respondents borrow bulls from their neighbours for breeding while 17.1% respondents rent bulls from their neighbours. Others (35.7%) use their own bulls and 1.4% of the respondents rent from bull service centre owned by HPI. Table 4 shows that source of AI for 76.2% was from Government recruited technicians and other 4.8% respondents get AI service from private sector.

Table 4: Reproductive performance of dairy cattle

Reproductive performances			P-value
Age at first service			
Months	**n=84**	**Percent**	
18 months	1	1.2	
24 months	82	97.6	
36 months	1	1.2	
Total	**84**	**100.0**	0.44 (ns)
Average number of services per conception			
Number of Services	**n=84**	**Percent**	
once	47	56.0	
twice	28	33.3	
Thrice	7	8.3	
Forth	1	1.2	
fifth	1	1.2	
Total	**84**	**100.0**	0.01*
Age at first calving			
Years	**n=84**	**Percent**	
2years	1	1.2	
3 years	77	91.6	
4 years	4	4.8	
> 5 years	2	2.4	
Total	**84**	**100.0**	0.36 (ns)
Calving interval			
Months	**n=83**	**Percent**	
12 months	34	41.0	
24 months	38	45.8	
36 months	11	13.2	
Total	**83**	**100.0**	0.74 (ns)
Calf mortality			
Deaths in six months ago	**n=84**	**Percent**	
Yes	13	15.5	
No	71	84.5	0.000***
Total	**84**	**100.0**	
Breeding methods preferred by dairy cattle farmers			
Breeding methods	**n=84**	**Percent**	
Natural (bull service)	67	79.8	
Artificial insemination (AI)	14	16.6	
Both	3	3.6	0.01*
Total	**84**	**100.0**	
Source of the bull	**n=70**	**Percentage**	
Borrow from neighbour	32	45.7	
Rent from neighbour	13	18.6	
Own bull for service	25	35.7	
Total	**70**	**100.0**	0.000***
AI services	**n=84**	**Percentage**	-
AI users	17	20.2	
Do not use AI	67	79.8	
Total	**84**	**100**	
Source of AI	**n=17**	**Percentage**	
Government recruited technicians	16	76.2	
Private	1	4.8	
Total	**17**	**100.0**	0.012*

* = P<0.05; **=P value<0.001; ns = Not significantly different (P>0.05)

4.1.3.8 Number of calves (calf crop)

In the study area it was shown that 44.6% of the respondents had one calf each while 25.7% had three calves each and few respondents (6.8%) had four calves each which were born six months before interviewed.

Table 5: Number of calves (calf crop)

Total number of calves			**P-value**
Number of calves	**n=74**	**Percent**	
1	33	44.6	
2	16	21.6	
3	19	25.7	
4	5	6.8	
5	1	1.4	0.38 (ns)
Total	**74**	**100.0**	

* = P<0.05; **=P value<0.001; ns = Not significantly different (P>0.05)

4.2 Factors Affecting Productive Performance

4.2.1 Farmers who supply minerals and concentrates during milking

Table 6 shows that 81% of the respondents supply mineralick to the lactating cows during milking while 19% of the respondents do not supply mineralick to their lactating cows. Similarly Table 6 shows that 92.9% of the respondents supply concentrates to their lactating cows whereas 7.1% of the respondents do not supply.

Table 6: Number of farmers who supply concentrates and minerals and those who do not supply

Number of farmers who supply and those who do not supply			**P-value**
Parameter			
Mineralick	**n=84**	**Percentage**	
Supply	68	81.0	
Do not supply	16	19.0	
Total	**84**	**100**	0.05*
Concentrates	**n=84**	**Percentage**	
Supply	78	92.9	
Do not supply	6	7.1	
Total	**84**	**100.0**	0.001*

* = P<0.05; **=P value<0.001; ns = Not significantly different (P>0.05)

4.2.2 Feed quality and quantity

Table 7 shows that all respondents supply mineralick to their dairy cattle.

Also Table 7 shows that 34.6% of the respondents fed two kilogram of concentrates per cow per day. Few respondents (4%) fed one kilogram of concentrate per cow per day and 5% of the respondents give four kilogram of concentrate per cow per day. Results shows that 44% of the respondents supply 40 grams of minerals per cow per day while 31.7% of the respondents supply 30 grams of minerals per cow per day and 24.4% of the respondents gave 10 grams of minerals per cow per day.

Table 7 also shows that more than 80% of the surveyed farmers have indicated that high costs of concentrates is a limitation on its use while 13% indicated that poor availability of supplementary feeds as a limitation to its use. Table 7 shows that majority (81%) of small scale dairy cattle farmers own small pieces of land less than one hectare while only 7% of the respondents own more than three hectares.

Table 7: Feed quality and quantity, land owned and feeding practices

Types of feeds and quantity offered			**P-value**
Types of minerals given to lactating cows			
Mineralick	**n=68**	**Percent**	
Super lick powder	34	50.0	
Mineral block	27	39.7	0.000***
Maclick super powder	7	10.3	
Total	**68**	**100.0**	
Amount of minerals given/cow/day			
Grams	**n=41**	**Percent**	
20	10	24.4	
30	13	31.7	0.38 (ns)
40	18	43.9	
Total	**41**	**100.0**	
Amount of concentrate given per lactating cow per day			
Kg	**n-78**	**Percent**	
One	3	3.8	
Two	27	34.6	
Three	15	19.2	
Four	26	33.3	
Five	3	3.8	
Six	4	5.1	
Total	**78**	**100.0**	0.002*
The main problem that limit use of concentrate			
Problem	**n=84**	**Percent**	
Unawareness	1	1.2	
Poor availability	11	13.1	
Costly	70	83.3	
No problem	2	2.4	
Total	**84**	**100.0**	0.000***
Land owned (hectare)	**n=84**	**Percent**	
<0.125	16	19.0	
0.25-0.50	34	40.5	
0.50-1.00	18	21.4	
1.00-1.50	3	3.6	
1.50-2.00	4	4.8	
2.00-2.50	1	1.2	
2,50-3.00	2	2.4	
>3.00	6	7.1	0.000***
Total	**84**	**100.0**	
Feeding practices	**n=84**	**Percentage**	
Grazing	22	26.2	
Zero Grazing (Stall feeding)	55	65.5	
Tethering	6	7.1	
Both 1 and 2	1	1.2	
Total	**84**	**100.0**	0.000***

* = P<0.05; **=P value<0.001; ns = Not significantly different (P>0.05)

4.2.3 Source of feeds during dry and rainy season

Results in Table 8 also shows that 87% of the respondents indicated that their main source of feed/pasture during dry season were dry pastures while 2.4% of the respondents fed established pastures to their cows. About 7% bought pastures during the dry season. During the rainy season 60.7% of the respondents feed their cows green natural pasture while 30% of the respondents practice grazing their dairy cattle to green natural pasture.

Table 8 shows that 3.6% of the respondents offered their lactating cows 15-25kg of the forages plus partial grazing. Other respondents (15.5%) offered their lactating cows 26-35kgs of forages per day. Majority of the respondents (38%) offered their lactating cows 36-45kgs of forages per cow per day. Also table 8 shows that 9.5% of the respondents offered their lactating cows 46-55kgs of forages per cow per day. Other respondents (33.3%) were practicing grazing. Those forages offered to zero grazed cows were measured by using spring balance to get the estimated amount offered per cow per day.

Table 8 shows that few respondents (7%) conserve feed for their cows during the time of feed shortage in a particular dry season. Majority of the respondents (93%) in the study area do not conserve feeds.

Table 8: Source of feeds and amount of feeds offered

Source of feed during dry season			**P-value**
Source	**n=84**	**Percent**	0.01*
Established pastures	2	2.4	
Buying from vendors	6	7.1	
Dried natural pastures	73	86.9	
Collecting/fetching from other places(e.g. along the road)	2	2.4	
Fetching along the river banks	1	1.2	
Total	**84**	**100.0**	
Source of feeds during the rainy season			0.001**
Source	**n=84**	**Percent**	
Established pastures	1	1.2	
Buying from vendors	5	6.0	
Green natural pastures	51	60.7	
Grazing	25	29.8	
Grazing plus cut and carry	2	2.4	
Total	**84**	**100.0**	
Amount of pasture/grasses given per lactating cow per day			0.24 (ns)
Kg	**n=84**	**Percent**	
15-25+ partial grazing	3	3.6	
26-35	13	15.5	
36-45	32	38.1	
46-55	8	9.5	
Grazing	28	33.3	
Total	**84**	**100.0**	
Feed conservation to feed lactating cows in times of feed shortage			0.17 (ns)
Parameter	**n=84**	**Percent**	
Yes	6	7.1	
No	78	92.9	
Total	**84**	**100.0**	

* = P<0.05; **=P<0.001; ns = Not significantly different (P>0.05)

4.2.4 Breeds, effect of age of dam and frequency of milking

The distribution of dairy cattle breeds in Table 9 shows that majority of the respondents (57%) keep Friesian cross bred followed by Aryshire crosses (25%) while a minor groups of dairy cattle keepers in the study area kept pure Friesian

(14.3%) and Aryshire (3.6%) breed. Table 9 also shows that majority of lactating cows kept by farmers in the study area were between 3 to 6 years of age as reported by 85% of the respondents while 6% of the respondents indicated to have cows with an age of 8 years. Results show that majority (95.2%) of the respondents milked their cows two times a day while 3.6% of interviewed farmers milked their lactating cows once a day and only 1.2% of the respondents milked their cows thrice per day.

Table 9: Breeds, effect of age of dam and frequency of milking

Breeds of dairy cattle kept, age of cow and milking frequency			**P-value**
Breed	**n=84**	**Percent**	
Friesian pure	12	14.3	
Friesian crosses	48	57.1	
Aryshire pure	3	3.6	
Aryshire crosses	21	25.0	
Total	**84**	**100.0**	0.33 (ns)
Average age of lactating cow			
Age	**n=84**	**Percent**	
3	22	26.2	
4	18	21.4	
5	15	17.9	
6	17	20.2	
7	7	8.3	
8	5	6.0	
Total	**84**	**100.0**	0.20 (ns)
Frequencies of milking/cow/day			
Frequency	**n=84**	**Percent**	
Once	3	3.6	
Twice	80	95.2	
Thrice	1	1.2	
Total	**84**	**100.0**	0.002*

* = P<0.05; **=P<0.001; ns = Not significantly different (P>0.05)

4.2.5 Diseases

Mastitis was reported by 51.2% of the respondents to be the most prevalent disease in the study area resulting in decreased milk yield, premature culling of cows, milk

discard and high treatment costs. ECF considered as the second prevalent disease by 18% of the respondents and this was associated with high tick infestation.

Table 10: Diseases which affect milk yield of lactating cow(s)

Disease	n=84	Percent	P-value
Mastitis	43	51.2	
ECF	15	17.9	
Lampy skin	7	8.3	
FMD	7	8.3	
Trypanosomosis	7	8.3	
Anaplasmosis	4	4.8	
Helminthiasis	1	1.2	
Total	**84**	**100.0**	0.074 (ns)

* = P<0.05; **=P<0.001; ns = Not significantly different (P>0.05)

4.3 Significance of Factors for Productive and Reproductive Performance

Table 11 shows regression results on factors affecting productive and reproductive performances of dairy cattle kept by small scale farmers. The findings showed that the reproductive performance of dairy cattle was explained by 46% of the considered independent variables which were age at first service, age at first calving, services per conception, calving interval and calf mortality. However only calves mortality contributed significantly to the reproductive performance. Furthermore the findings showed that the productive performance of dairy cattle was explained by 54% of independent variables which were level of education, land owned, breed owned, age of the dam, and land used for grazing. Size of land owned and land used for grazing were the only significant contributors to the productive performance of dairy cattle.

Table 11: Regression table for factors affecting reproductive and productive performance of dairy cattle

	Descriptive statistics				
Factor	**Mean**	**Std deviation**	**R^2**	**Beta coefficient**	**Significance**
Reproductive performance(calf crop)			0.46	0.000	0.000
Age at first calving (yrs)	2.1111	0.40605		0.168	0.170
Services per conception(n)	1.5714	0.79746		0.099	0.353
Calving interval (yrs)	1.0794	0.27248		0.146	0.164
Calf mortality(n/herd)	1.8254	0.38268		0.682	0.000***
Productive performance(milk yield)			0.54		
Level of education(STD VII) n/HH	1.8333	0.70711		-0.047	0.838
Land owned (Ha)/HH	2.8333	2.20294		-0.642	0.013*
Breed kept (types)/HH	2.4444	1.04162		0.068	0.744
Age of the dam (yrs)	5.5000	1.29479		0.308	0.151
Land used for grazing (Ha)/street	2.0278	1.81879		0.517	0.047*

Significance of the model P<0.05, VIF= 1.055 to 1.937, *= P<0.05; **=P<0.001

4.3.1 Level of training

Table 12 shows that majority of the respondents (78.57%) did not get training on dairy cattle husbandry before engaging in the project while 21.43% of the respondents were trained before engaging in the dairy cattle enterprise. The amount of milk yield per cow per day for respondents who were trained was higher (9.05 litres) compared to 7.9 litres for respondents who did not get training before engaging in dairy cattle enterprise. Also Table 12 shows that 61.54% of the calf mortality occurs to untrained respondents compared to 38.46% of calf mortality which occurs to trained respondents.

Table 12: Trained and untrained farmers on dairy cattle husbandry

Trained farmers on dairy cattle husbandry and their impacts				**P-value**
Parameter	**Average milk yield(litres)/day/cow**	**n=84**	**Percent**	
Trained dairy farmers	9.05	18	21.43	
Untrained dairy farmers	7.9	66	78.57	
Total		**84**	**100**	
				0.31 (ns)
	Calf mortality (n)	**n=84**	**Percent**	
Trained dairy farmers	5	18	38.46	
Untrained dairy farmers	8	66	61.54	
Total	**13**	**84**	**100**	0.14 (ns)

* = P<0.05; **=P<0.001; ns = Not significantly different (P>0.05)

4.4 Socio economic Contribution of Dairy Cattle

Results in Table 13 shows that 34.6% of the respondents get milk for their family consumption from their dairy cattle. Also results show that 28% of the respondents engaged in dairy enterprise as a source of income. Table 13 shows that 15.2% of respondents engaged in keeping dairy cattle in case of a sudden problem like a sudden patient at home. Table 13 shows that 9.1% of the respondents kept dairy cattle because farming is/was uncertain. Other respondents (8.2%) engaged in dairy cattle keeping because they were interested; and 3.7% learnt dairy cattle keeping from their neighbours then attracted to keep dairy cattle. Few respondents 1.2% were gifted dairy cattle.

Results in Table 13 show that majority of the respondents (58%) uses the money from milk sales to purchase animal feeds. Table 13 shows that 29% of the respondents pay school fees for their children from milk income. Also results in Table 13 show that 11.8% of the respondents use the money from milk sales to buy goods and services. Table 13 shows that few respondents 4% deposited the money in their bank account,

Table 13: Socio economic contribution of dairy cattle

Multiple responses			
	Responses		
Reason of keeping dairy cattle	**N=84**	**Percent**	**Percent of Cases**
To get milk for home consumption	84	34.6	100.0
To get milk for income generation	68	28.0	81.0
Savings in case of sudden problem	37	15.2	44.0
Farming is/was uncertain	22	9.1	26.2
Because it was just a gift	3	1.2	3.6
Learn from neighbours	9	3.7	10.7
Interest	20	8.2	23.8
Total	**243**	**100.0**	**289.3**
Uses of the money from milk sales			
	Responses		
	N=84	**Percent**	**Percent of Cases**
Purchase animal feeds	142	58.0	169.0
Pay school fees	73	29.8	86.9
Buy goods & services	29	11.8	34.5
Deposit in bank account	1	.4	1.2
Total	**245**	**100.0**	**291.7**

Results in Table 14 shows that majority (38.1%) of the respondents sold the milk at the price of 1200 Tsh per litre while 21.4% and 17.9% sold the milk at the price of 1400 Tsh per litre respectively. Table 14 shows that 23.7% of the respondents sold their milk at the price of 600 Tsh per litre which was the lowest price in the study area.

Majority of the respondents (64.3%) indicated that costs of veterinary drugs were expensive while 34.5% indicated that the cost of drugs was moderate. Table 14 shows that 10.7% of the respondents were visited once after every two weeks. Also 36.9% of the respondents were visited when need arise and 48.8% of the respondents did not get extension services. Also it has been shown that average milk production in the study area was 8 litres per cow per day therefore one cow producing such an amount can earn a profit of 258.38 Tsh per litre per day (Table 14).

Table 14: Profitability of dairy cattle enterprise

Profitability		
The costs of drugs for animal treatment		
Cost	**n=84**	**Percent**
Very expensive	54	64.3
Moderate	29	34.5
Low	1	1.2
Total	**84**	**100.0**
Extension worker visits		
Weekly	2	2.4
Fortnightly	9	10.7
When need arise	31	36.9
None	41	48.8
After three months	1	1.2
Total	**84**	**100**
Milk price (Tsh)		
1400	18	21
1200	32	38.1
800	15	17.9
600	19	23
Total	**84**	**100**
Smallholder dairy production profitability		
Parameter		**Amount/day**
Average milk yield (litres)/30days	240	8L
Concentrates (kg30/days per cow)	90	3kg
Mineral powder (kg/30days)	12	40gms
Costs of concentrates(Tsh)/30days	30000	1000 Tsh
Cost of mineral powder(Tsh)/ 30days	18000	600 Tsh
Drugs, acaricides (Tsh))/30days	30000	1000 Tsh
Labour **(**Tsh**)**/month	40000	1333.33 Tsh
Average milk Price (Tsh) / litre)	1000	8000 Tsh
Total revenue (Tsh)/30 days	**240000**	**8000 Tsh**
Total cost/30days(Tsh)	**178000**	**5933 Tsh**
Profit margin/30days(Tsh)/240L	**62000**	**2067 Tsh**
Profit margin/litre/day(Tsh)		**258.4 Tsh**

4.5 Results from Monitoring

4.5.1 Nutritive values of the feeds in the study area.

The mean value for the chemical composition, in vitro dry matter digestibility (IVDMD) and ME contents of mixed forages offered to dairy cows in the study area are shown in Table 15, either IVDMD was significantly higher ($P< 0.05$) in Mbutu village than Kizani, Kidagaa and Kwachale village. Table 15 shows that ME content of the mixed forages was significantly ($P<0.05$) higher in Mbutu street than Kizani, Kidagaa and Kwachale street.

Table 15: Chemical composition, *in vitro* dry matter digestibility (IVDMD) and Metabolisable Energy (ME) contents of mixed forages

Parameter	Mbutu	Kizani	Kidagaa	Kwachale	SEM	P-value
Forages						
DM (%)	40.3	39.8	41.9	38.2	2.5	0.79
CP %	7.00	6.03	6.1	6.42	0.78	0.81
Ca %	0.24	0.24	0.25	0.24	0.02	0.98
P %	0.18	0.16	0.17	0.18	0.02	0.91
IVDMD (%)	51.4	41.1	44.7	41.9	2.4	0.04*
ME (MJ/KgDM)	8.27	6.34	7.2	6.75	0.38	0.02*

*Significant at P<0.05; **=P<0.001

The mean value for the chemical composition, *in vitro* dry matter digestibility (IVDMD) and ME contents of mixed concentrates offered to dairy cows in the study area are shown in Table 16.

Table 16: Chemical composition, *in vitro* dry matter digestibility (IVDMD) and Metabolisable (ME) contents of mixed concentrates

Parameter	Mbutu	Kizani	Kidagaa	Kwachale	SEM	P-value
Concentrates						
DM (%)	93.39	94.74	95.65	94.5	1.1	0.56
CP %	12.82	13.05	13.68	11.79	0.52	0.13
Ca %	1.14	1.41	1.39	0.71	0.52	0.76
P %	0.61	0.6	0.93	0.85	0.21	0.6
IVDMD (%)	52.97	55.67	55.61	52.07	1.32	0.17
ME (MJ/KgDM)	8.5	8.9	9.0	8.48	0.17	0.78

*= P<0.05, **=P<0.001

4.5.2 Amount of feed offered, milk yield and live weight of animals from monitoring

Results in Table 17 shows that there was no significant difference in live weight and milk yield of lactating cows kept in Mbutu, Kizani, Kidagaa and Kwachale Street. Also results shows that there was no significance difference in DMI, CP, Ca, P and ME offered to lactating cows in the study area.

Table 17: Feed offered, milk yield and live weight of animals from monitoring

Parameter	Mean	Mbutu	Kizani	Kidagaa	Kwachale	SEM	P-value
Body wt (kg)	420	440	413	434	394	17.9	0.3
Milk (Litres)/Day	8.97	9.9	7.7	9.7	8.5	1.17	0.52
DMI (kg)/Day	9.00	9	8.9	9.7	8.5	0.64	0.59
CP (g)/Day	758	784	727	768	751	60.83	0.92
Ca (g)/Day	22.9	27.7	22.0	20.2	21.9	4.0	0.58
P (g)/Day	18.15	18.6	16.5	20.2	17.25	1.7	0.5
ME (MJ/Kg)/Day	87.5	88.8	88.6	85.4	86.8	5.1	0.95

*= P<0.05; **=P<0.001

CHAPTER FIVE

5.0 DISCUSSION

5.1 Description of Respondents

Many youths less than 30 years of age were not engaged in dairy farming, since this age group constituted the minority in the study area. Mussa (1998) argued that older people have more experience, wealth and decision making all of which affect rate and extent of adoption of new technology. The age of the producer is one of the factors which affect the decisions and actions made in the enterprises, because people's thoughts, behaviors and needs are primarily related to their ages (Simsek, 1999). Even though most of the dairy cattle keepers range from 46-60 years old there was no significant ($P>0.05$) difference in ages among respondents in the study area.

The study revealed that majority of the respondents were males, and they were mostly involved in dairying enterprise (Table 1). Only one third of the respondents were females indicating that smallholder dairy farming provides self-employment to women and therefore, contributes to the improvement of the living standard in this particular group. For instance; in Kigamboni division, the introduction of crossbred dairy cows was initiated in 1990s by the Heifer Project International. The aim was to train farmers about dairy production and enable farmers, particularly women, to acquire the means of production and so improving their livelihood. Results show that the majority of the respondents were married couples. The advantage of the family in dairy enterprise is to provide family labour to dairy cattle like milking and feeding in the absence of hired labour so that production level can be maintained. More than two third of the respondents were able to read and write, also to

communicate with extension service providers in different ways such as through posters, leaflets, magazine. High level of education increases farmers ability to acquire innovation easily, however this is only true for complex technologies as pointed out by Mussa (1998). Due to high literacy level, community is more likely to aggressively participate in seeking skills regarding their dairy cattle management as a means of improving milk yield. Since education is an important tool to bring fast and sustainable development and had roles in affecting household income, adopting technologies, demography, health, and as a whole the socio economic status of the family as well. This might had a good contribution to adopt technologies to the study area.

Also the importance of education is related to ability of farmers to keep farm records on production and reproduction, so that they can be able to quantify their performance and lay down targets for improvement.

5.2 Performances of Dairy Cattle in the Study Area

5.2.1 Milk yield

Milk yield and milk related traits are influenced by a number of factors including effects of feeds quality and quantity, breeds, effect of the age of the dam, season, effect of milking intervals and milking frequency on milk yield and effects of diseases on milk yield. The observed mean milk yield in monitoring approach was

8.9 litres with range of 8.5-9.9 litres per cow per day under zero grazing system similar to that reported by Urassa (1999) in Tanga district that, cows under zero grazing had higher milk yield (9.1 L/day) than those under full grazing (7.3 L/day). In the baseline survey the reported mean milk yield in the study area was 8.1 litres with range of 4-13 litres of milk per cow per day for pasture grazed and zero grazing system which were not significantly different (P>0.05) to milk yield in monitoring approach. In Rungwe district 7.9 litres with range of 5.0 to 18.5 litres per cow per day reported by Gimbi (2006) for smallholder famers. Epaphras *et al.* (2004) reported mean daily milk production of crossbred Aryshire cows reared under coastal tropical climate of Tanzania of 7.1 litres which was slightly less than that in the study area. Msangi *et al.* (2001) reported daily milk yield of 6.3 litres for pasture grazed cows and 7.5 litres for zero grazed cows in the sub- humid northern coast of Tanzania. The reported mean milk yield was more than 5.7 litres per day reported by Lyimo *et al.* (2004) for smallholder farmers in sub-humid coastal Tanzania.

The variation in milk yield in the study area was probably caused by diseases in particular mastitis, age of the cow because about 20% of cows in the study area were over six years which is the age of milk decline. In the study area 93% of the respondents did not conserve feeds as a result milk fluctuation during the time of feed shortage. Also 40.5% of respondents own between 0.25 to 0.5ha which is a small area for both grazing animals and other family activities. The size of land owned has an influence in milk yield. In the study area dairy cattle kept by trained farmers produced more milk yield than untrained farmers.

The observed higher milk yield during field monitoring than the reported milk yield of cows during the baseline survey was due to the fact that those cows under monitoring were zero grazed while under baseline survey there were zero gazed and full grazing cows. Also cows under monitoring were probably supplied with concentrates and minerals more often than full grazing cows because milk yield is strongly influenced by the amount of concentrates (Gimbi, 2006). In addition most of monitored cows were in between second and fourth month in lactation period which is believed as the peak milk yield stage while in the baseline survey lactation period range from first to seventh month into lactation. Also the variation in milk yield between monitored and the baseline survey in the study area could be due to the fact that dairy cattle which grazed fully fritter away some energy during to and from distance which in one way or another contributed to low milk yield. Besides there was a slight deviation in milk yield among the villages but the difference was not significant.

Another reason is the frequency of drinking water. Monitored cows had access to water throughout the day while those cows under full grazing drink water once or twice a day.

Water availability and quality are extremely important for animal health and productivity. Limiting water availability to cattle will depress production rapidly and severely.

Other reasons for differences in milk yield in the study area could be genetic as well as the differences in management practices. Also another reason is lack of record keeping. It is difficult for a farmer to recall correct figures of milk production without records, and in the study area most of dairy farmers do not keep records. The large range between the lowest and the highest values for milk production in the present study implies that there is an opportunity for enhancement in milk production of dairy cattle in peri-urban areas of Temeke.

5.2.2 Age at first service

As the farm economic depends on reproductive lifespan of dairy cows, it is important for the heifers to show estrous as early as possible. By showing estrous as early as possible a female animal can contribute more to the economy of the farm.

Results showed that the female animals for majority of the respondents attained first service in two years. The observed age at first service was higher than those reported by Gimbi (2006) in Rungwe and in Turiani (Safari *et al,* 2000). The age at first service revealed in this study is shorter than the mean of 36.8 ± 0.8 months reported by Gebeyehu *et al*. (2005) indicating that the heifers in study area were well managed to allow them grow normally. The mean age of heifers at first service reported by other researcher was 24.9 months (range 18 to 36 months) with the mean age at first calving of 34.8 months (range 27 to 46 months) (Hunduma, 2012). The presented current results are in agreement with the previous findings of Nuraddis *et al*. (2011), with 23.2 months in Gonder town Ethiopia, Mureda and Mekuriaw (2007) with 25.6 months of age at first service in Dire Dawa Ethiopia for other crossbreeds of exotic and local cattle. A substantial delay in the attainment of sexual

maturity may mean a serious economic loss, due to an additional, non- lactating, unproductive period of the cow over several months (Mukasa, 1989).

5.2.3 Average number of services per conception

The minimum number of service per conception is one of the indicators of economically profitable dairy farm. The overall mean service per conception obtained in the present study was 2.16 similar to 2.0 reported in Holstein Friesian dairy cattle in Nigeria (Ngodigha *et al.,* 2009) and 2.11 for Holstein Friesian in Pakistan (Niazi and Aleem 2003). In other experiment by Shamsuddin *et al*. (2001) showed an average service per conception of 2.2 in some selected parts of Bangladesh which was slightly higher than the observed number of services per conception in the study area. Number of services reported by Lovince (2004) was 1.66 in Turiani and Bukoba which is lower than in the study area. Animals with larger number of services per conception have long days open and in the long run long calving intervals thus perform poorly in reproduction. In view of the fact that the most important target of any dairy enterprise is to take advantage of the number of pregnancies per lifetime of the cow, thus the cow with larger number of services per conception will have low number of pregnancies in its lifetime.

The mean values for number of services per conception for crossbred cows found in the present study were higher than 1.62 reported in central highlands of Ethiopia (Shiferaw *et al.,* 2003). Also the finding is higher than 1.61 services per conception reported by Haile-mariam *et al.* (1993) in Abernossa Ranch. It is, however, slightly similar to 2.0 services per conception reported for cows at Asella (Negussie *et al.*,

1998). The variation in number of services per conception could be attributed to management practices and breeding/mating system used. In the study area it was found that majority of interviewed dairy cattle farmers depended fully on natural mating even though a large number of dairy cattle farmers did not own bulls. They got bulls from their neighbours by borrowing or hiring. Few farmers use AI as their main source of breeding material although some of the dairy farmers were complaining that they use AI more than once before the animal conceive. AI service is available in the study area but it is not used by majority of dairy cattle farmers probably because they have limited awareness on the advantages of AI therefore there is a need of disseminating education on AI as a way of improving productive and reproductive performance of their dairy cattle as well as reducing the cost of keeping bulls and minimizing reproductive diseases. Breeding failure has a clear negative influence on milk production and farm income and determines the future sustainability of a dairy farming operation. Successful service or insemination depends on many factors such as quality of semen, skill of the inseminator, proper time of insemination and cows related factors. Management, nutrition and climate conditions may also affect the achievement of insemination.

5.2.4 Age at first calving

In the study area majority of the respondents show that cows calve for the first time at 36 months which is supported by Kishinhi (1999) who found that the age at first calving (AFC) for various crossbred kept under small-scale production in Tanzania are within the range of 28.5 to 38.9 months. The AFC obtained in the study area was also similar to average values reported by Lovince (2004) of 35.1 months and higher

than other study of 29.3 months that was reported for Tunisian Friesian-Holstein cows by Ajili *et al.* (2007); 823 days (27.2 months) in Holstein Friesian cows in Pakistan reported by Niazi and Aleem (2003) and slightly higher than 988 ± 9.81 days (32.7 months) reported by Sattar *et al*. (2005). In many studies AFC were higher than 24 months as recommended (Nkemwa, 2009).

The prolonged AFC of cows in the present study compared to literature results could be attributed to factors such as poor nutrition and management practices including poor heat detection at the time of mating the heifers. With good nutrition it is expected that heifers would exhibit fast growth and attain higher weights at relatively younger ages. The better-managed and well-fed heifers grew faster, served earlier and resulted in more economic benefit in terms of sales of pregnant heifers and/or more milk and calves produced during the lifetime of the animal. Younger age at first calving is beneficial in that it can potentially lead to an earlier return on investment.

5.2.5 Calving interval

Calving interval is an important index of cow reproductive performance and calving interval of 365 days is desirable for efficient production (Esslemont, 1993). In the study area calving interval of the cows was twelve months as reported by 41.0% of the respondents which is generally considered as the most economically desirable situation for dairy cows (Msanga *et al*., 2005). Other respondents (45.8%) indicated 24 months CI for their cows and for few respondents (13.2%) the calving interval for their cows were more than the recommended period of one year.

For smallholder dairy cattle in urban and peri-urban parts of Tanga region, the calving interval was averaging 16 months (Lyimo *et al.*, 2004; Swai *et al*., 2005b) which is longer than the CI indicated in the study area. Most of these intervals are considerably longer than the standard recommendation of 14 months under tropical conditions and they reflect evidence of poor reproductive performance in such farms (Mujuni, 1991). Argument against long Cl shows that cows that get pregnant sooner after calving have high average milk yield per day of lactation period and per year. This is due to shorter CI reducing the prolonged periods of lower milk production in later lactation than comparable cows with delayed conception (Little, 2004). Long CI of cows under zero grazing was contributed by fewer bulls kept in Kibaha (Nkenwa, 2009) as a result lower conception rate and eventually a cow cannot calve annually. Poor nutrition that leads to poor body condition prevents cows from showing oestrus during lactation.

5.2.6 Number of calves (calf crop) and calf mortality

Calf crop is the determinant of dairy cattle sustainability due to the fact that without new born calves there will be no replacement of dairy cows in a herd. Calf crop determined by the calving interval of cows in a herd which means that the long calving interval results to reduced calf crop. Of course, a cow must have a calf to begin lactating and the need to create the next generation must not be forgotten.

Calf mortality in the study area was low as indicated by majority of respondents, probably because most of the farmers provide routine prophylaxis against the

common prevalent diseases and use acaricides against ticks which cause substantial losses in cattle production, in terms of diseases and often death (Rajput *et al.,* 2006). The few studies on calf mortality on smallholder farms in Tanzania show mortality that range from 9% to 45% (Chenyambuga and Mseleko, 2009). It was found that more calves die than the other groups of dairy cattle. This might be due to poor management practices of calves and their higher susceptibility to diseases and environmental stresses than older animals. Gebre-egziabiher *et al.* (1991) reported that with an increase in age, mortality decreased probably because of improved adaptation of animals to both climatic and nutritional factors.

5.3 Factors Affecting the Productive Parameters

5.3.1 Feed quality, quantity, conservation and its availability

The small scale farmers in the study area have limited resources available for feeding their dairy cattle. They do not have the luxury of being able to select the basal diet but use whatever is available at no or low cost. The available resources are essentially lowly digestible forages such as tropical pastures both green and mature, and agricultural by-products which are generally low in protein.

Green fodders are not available in sufficient quantities especially in extreme hot condition and most of the animals are under-fed. Other by-products are commonly used to overcome feed shortages, but don’t meet the actual requirements of the animals. There is a strong relationship between nutrition, reproductive and productive performances in dairy cattle (Gimbi, 2006). Therefore feeding is a fundamental aspect in dairy cattle production as well as reproduction. For optimal

production of milk, a dairy cow must be supplied with sufficient feeds to meet both its maintenance as well as production requirements. Normally a dry matter consumed by a dairy cow within 24 hours should be 2.5-3% of body weight. For a cow weighing 600kg require 15.4kg Dry Matter when grazing for 8 hours (Mc Donald *et al.,* 1995). Dairy cows compared to other farm animals produce large amount of milk, hence require sufficient and quality feeds with all necessary nutrients, which are energy, protein, minerals and vitamins. In the monitoring study the average quantity of forages offered to the lactating animals was 40-60kg fresh weight which was slightly low compared to what they were supposed to be fed according to their body weights and amount of milk produced. In the study area mean weight of lactating cow was 420kg with an average milk yield of 8 litres supposed to be fed 11.3kgDM, 93.17 ME, 1059g CP, 37.6g Ca, and 28g P but it was offered 10.8kgDM, 87.5 ME, 78g CP, 22.9g Ca and 18.5g P per day.

The study shows that few respondents conserve feed to be used by their animals during the time of feed shortage in a particular dry season. Majority of the respondents did not conserve feed. Lack of feed conservation can be a major cause of reduced milk yield during dry season.

Concentrates or supplements are given in addition to roughage. Although more expensive than roughage, they are essential when roughage alone cannot satisfy the animal's maintenance and production requirements. Improvement in milk yield (1.5L/day) was observed when crossbred cows were supplemented with 4kg of maize bran, 2kg of cotton seed cake and 100gms of mineral powder per day in

various district in Tanga region (Urassa, 1999). In the study area majority of dairy cattle keepers supplemented (Table 5) their animals with concentrates and minerals.

Even though majority of dairy farmers in the current study reported that they supply minerals to their lactating cows it has been observed that these minerals do not meet animal body requirements. This could probably be that the animals get inadequate amount or improper mixing ratios. Also the ingredients which have been indicated in the mineral powder manual by manufacturers might not be the actual ingredients mixed in the powder because some of manufactures are business oriented and are not faithful. In the study area the amount of mineral powder offered per cow per day was reported to be 23gms of calcium and 18gms of phosphorus, while the requirement should be 38.03grams of calcium and 28.5grams of phosphorus per cow per day.

5.3.2 Breeds kept, effect of age of dairy cattle and frequency and interval of milking on milk yield

Milk production is affected by the breed of the dairy animals. The increase in blood of *Boss taurus* in crossbred cows has been shown to be associated with increase in milk production. Milk production increased as the level of *Bos taurus* increased from 50%, 75% and 87.5 %. Msanga *et al.* (2000) found that, 62% *Bos taurus* inheritance were producing more milk than 50% *Bos taurus*. In the current study it was observed that those who kept dairy cattle which were 75% *Bos taurus* or more were able to produce more than 10 litres of milk per day.

The amount of milk produced increases with advancing lactations (age), since an increase in body weight results in an enlargement of the digestive system and the mammary gland (Ruiz-Sanchez *et al.*, 2007). In the current study the age of majority of dairy cattle ranged between 3-6 years old.

The present study indicated that majority of the respondents milked their cows two times a day while few interviewed farmers milked their lactating cows once a day. The study shows that cows milked two times produced more milk than those cows milked once a day. Cows were hand milked and calves were allowed to suckle before milking to stimulate milk let -down and after milking (to feed the calf) by majority of respondents. Also majority of dairy farmers in the study area milked their cows at equal intervals; this is probably due to milk collectors who collect milk at specific time although it has an advantage of more milk available compared to less milk yield to cows milked at unequal intervals. Cows milked at unequal intervals produce less milk than those milked at equal intervals (Stelwagen *et al*., 2007).

5.4 Socio-economic Contribution of Dairy Cattle

Results showed that majority of the respondents engaged in dairy cattle enterprise with target of both getting milk for home consumption and for income generation. Others kept dairy cattle for savings in case of sudden problems. All farmers interviewed acknowledged that dairying enhanced their livelihood through the provision of food in the form of milk, ready cash and social status. Dairy cattle enterprise in peri-urban areas of Temeke provided good self employment to the communities which could not be employed in other sectors.

The average milk yield in the study area is 8 litres and the price of milk differs from one place to another within the study area which ranges from 600 Tsh to 1400 Tsh per litre. The variation in milk price is due to the fact that farmers do not have the mandate on the milk price setting. The problem of milk marketing can be avoided by establishing cooperative societies whereby those activities concerning dairy like milk collection and selling can be managed by the members of the cooperative societies.

Majority of the respondents indicated that cost of veterinary drugs was expensive while others said that the cost of drugs was moderate. This cost depends on the type of drug used to treat a particular disease that attacked the animal. For instance it is more expensive to treat the animal attacked by ECF than treating the animal attacked by Trypanosomosis. Also the drug seems to be expensive due to monopoly of drug sellers and lack of drugs subsidies from the government. Even though dairy cattle in the study area do not produce to their potential the enterprise appears to be profitable (Table 12). Dairying generates a daily income. Although no clear data is available to show how this income is used, signs indicate that basic needs such as sugar, cooking oil, kerosene, salt, school uniforms and fees, are paid for from milk sales. Also some assets like motor bicycles are bought from the milk sales.

5.5 Constraints on Milk Yield in Dairy Cattle

Diseases pose a major threat to dairy cattle production in the study area. Clinical symptoms perceived by the respondents were used for identification of a particular

cattle disease. According to the respondent's awareness, mastitis was the major threat in the study area most likely because it has a direct effect on milk industry. The poor hygiene of cows' shelter, shortage of space and absence of mastitis control measures such as udder disinfection and dry-cow therapy, as well as low level of management were observed as the major reasons for the high prevalence of mastitis in the study area. However mastitis was named as a major stubborn disease the difference amongst prevalent diseases were not statistically significant ($P>0.05$).

ECF was mentioned as the second major diseases affecting dairy cattle in the study area (Table 9). ECF was not directly related to reproductive system but could affect reproduction and milk production indirectly through loss of appetite, decreased energy intake, loss of body condition and negative energy balance. However majority of dairy cattle farmers indicated that they provide routine prophylaxis against various diseases, it was observed that farmers in the study area did not vaccinate their animals regularly for the important contagious diseases but treat their animals when ever the diseases occurred. Most of the farmers in the area of study spray their animals with acaricides but still there is a problem of ECF; probably this is due to inadequate knowledge on the proper mixing ratios of the acaricides. The high incidence of infectious diseases may have a direct effects on the dairy cattle productivity that include reduced feed intake, changes in digestion and metabolism, increased mortality and decreases rates of metabolism, weight gain, milk production and high treatment costs.

However *cut and carry* system is the one which is applied by most of the respondents to get forages for their animals was affected by land scarcity, and housed cattle are fed on fodder cut from riverbanks, roadsides and other areas where green vegetation is abundant. The average land holding in the study area is 0.5 ha and this is hardly adequate to sustain forage production to satisfy livestock needs. Average land allocated by farmers for improved forage production was insignificant which point out further works in creating awareness in forage and pasture development in the municipal. The dependence of farmers in Temeke municipal on indigenous natural pastures from unutilized land as a source of basal diet for dairy cattle is related to the small plots of land owned and hence very small plots allocated for growing pastures. The results shows that majority of small scale dairy cattle farmers own small pieces of land less than one hectare while few respondents own more than three hectares. The total area of land owned by a farmer has an impact on milk production due to the fact that the larger the area owned the more chance of pasture availability of both natural and established pastures and vice versa. During the dry season dairy cattle in the area of study are fed on poor quality dried pastures. In some few parts ruminants are herded on rice stubbles in harvested paddy fields. However, the quality of available pasture is normally low and the quantity is sometimes not enough, in such situations there is a need to increase forage supply and quality in both wet and dry seasons.

Changes in quality and quantity of natural pastures due to seasonal variation in rainfall are common throughout the tropics (Aminah and Chen, 1989). Feed scarcity during the dry season is an important constraint to adequate feeding of animals and

often results in lower milk yields and hence lower income. It showed that this problem is very crucial because poor feeding would result in poor health consequently low milk yield; therefore there is a need to improve feed quality and quantity through pasture establishment, hay and silage making to enhance intake, digestibility and crude protein content especially during dry season.

In the study area it has been revealed that majority of the dairy cattle farmers do not get extension services as required and others are visited by extension officers when need arise. The situation reveals that there is poor flow of information concerning dairy husbandry in the study area. Extension officers are the once who can easily disseminate any new incoming technology concerning dairy husbandry to dairy farmers because very few farmers are able to find information on dairy cattle husbandry by themselves. Also other problems like milk fever needs timely assistance and the one who can provide such a help is an extension personnel but if he/she is not around the problem area the animal can eventually die. If extension officers would provide services fairly dairy cattle in the study area would be improved as a results increased milk yield. Therefore extension officers should have a working schedule because most of the extension officers in the study area are mobile because they have motor cycles.

5.6 Factors Affecting Productive and Reproductive Performance of Dairy Cattle

Regression results in Table 10 show factors affecting productive and reproductive performances of dairy cattle kept by small scale farmers. The findings show that the reproductive performance of dairy cattle was explained by 46% of independent

variables. Either the findings show that calf mortality was significant (< 0.05) contributor to reproductive performance. Furthermore the findings in Table 10 show that the productive performance of dairy cattle was explained by independent variables 54%. Either the results show that land owned, and land used for grazing were the only significant (< 0.05) contributors to the productive performance of dairy cattle.

Variable Inflation Factor (VIF) were used to diagnose the presence of multicollinearity where VIF of five or greater indicates severe multicollinearity. This study used VIF because of its strength to capture how much the standard error of the estimation is inflated by the multicollinearity. The results showed all VIF values are less than 5 signifying the absence of multicollinearity in regression results.

The beta coefficient B_1 of X_1 is the expected change in Y (dependent variable) for each one unit change in X. A negative beta coefficient means that a 1 unit negative change in X is expected to result in a negative beta coefficient change in Y. In relation to land owned the findings showed that the size of the land has an influence on milk yield since the larger the land size owned assuring the farmer to get pastures for a long period of time without variation. Also the findings showed that land used for grazing has an influence in milk yield due to the fact that the animals had the opportunities of receiving pastures of different types for a certain period of time.

5.6.1 Training of dairy cattle farmers before engaging in dairy enterprise

Results show that most of dairy cattle producers did not get training pertaining to dairy cattle husbandry before engaging in project. This contributes to poor management which leads to poor performance of animals and low milk yield. In the study area it has been indicated that those who got training before engaging in dairy cattle enterprise get high milk yield from their dairy cattle compared to those who did not get training. Also the study shows that calf mortality was high to untrained dairy farmers and low to trained dairy farmers although difference was not statistically significant ($P>0.05$). This reveals that education on proper dairy husbandry to farmers is very important and has a great impact on milk yield as well as reducing the level of calf mortality. Through well-trained extension workers farmers can acquire important technology and increase milk yield. The tendencies of extension workers to visit dairy cattle producers irregularly slow the improvement of dairy industry in the area; however this was contributed by lack of incentives and motivation, lack of reliable transport like motorcycles and other working facilities. To develop a sustainable dairy cattle enterprise, extension worker should have a regular visiting schedule which can assist them to visit smallholder dairy cattle producers at a regular interval; this would help these producers to get current information pertaining to dairy cattle husbandry.

5.7 Nutritive Value of the Feeds and Nutrients Intakes by Lactating Cows

The CP content of mixed forages observed in the study area was slightly higher than that reported by Nkenwa (2009) but lower than CP reported by Gimbi (2006). Also the CP content of mixed forages in the study area was lower than those reported by

Urassa (1999) in Tanga, Muheza and Lushoto. The variation could be due to the difference in the type of the soil where forages were grown, type of plant species available in the study area, and growth stages of the forages. The observed value of calcium (0.24%) was similar to that reported by Nkenwa (2009) but lower than those reported by Urassa (1999) in Tanga, Muheza and Lushoto in both wet and dry season and Gimbi (2006) in Rungwe district. The observed P contents from mixed forages of 0.17% DM were similar to those reported by Nkenwa (2006) in Kibaha and Urassa (1999) in Muheza and Lushoto. The IVDMD of the mixed forages in the study area shows that Mbutu village has higher value of IVDMD followed by Kidagaa. Kizani and Kwachale have similar Value of IVDMD. The observed values of IVDMD in the study area were similar to those reported by Urassa (1999) during the wet season but higher than those reported by Urassa (1999) during the dry season. Furthermore the observed IVDMD in the study area was slightly lower than those reported by Nkenwa (2009) in Kibaha. In the study area IVDMD requirement for higher milk production was 72% and 60% for mixed forages and mixed concentrates respectively.

The ME contents of mixed forages in the study area was higher in Mbutu village than Kizani, Kidagaa and Kwachale village but similar to that reported by Nkenwa (2009) in Kibaha and those reported by Urassa (1999) in Tanga, Muheza and Lushoto. The ME contents in mixed forages in the study area was higher than that reported by Gimbi (2006) in Rungwe. However, there was no significant difference ($P>0.05$) in weight for cows among the villages, it has been shown that dairy cattle kept in Mbutu village are heavier than those kept in Kizani, Kidagaa and Kwachale

village. The intake of ME was similar in Mbutu and Kizani but slightly higher than Kidagaa and Kwachale although there was no significant difference among the villages. Crude protein, calcium and phosphorus intakes were similar in all villages but did meet the requirements of the animals in the study area.

It has been revealed that dairy cattle in the study area are producing below their genetic potential mainly due to underfeeding in particular crude protein. The estimated daily nutrient intakes of ME 87.5, 758g CP, 22.9g Ca and 18.5g P offered to lactating cow weighing 420kgs in the study area did not meet up the higher production of these cows to produce 12 litres of milk per day. According to NRC (2001) a cow weighing 420kg requires 108 ME, 1357g CP, 46.2g Ca and 34g P. Therefore supplementary ration of 20.5 ME, 599gCP, 23.3g Ca, and 15.5g P per day will be required to cover the deficit of 3 litres of milk per day.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

It can be concluded from this study that small-scale dairy farming in Temeke Municipal contributes a great deal to the household welfare in terms of food security, income generation and other social services. The study revealed that smallholder dairy farmers in peri-urban areas of Temeke municipal carried out dairy enterprise as a source of income. Some of smallholder dairy cattle farmers' particularly in urban areas carried out dairy enterprise as an income supplementing activity rather than a main source of income.

The study observed that smallholder dairy farmers of Temeke municipal rely on natural pasture without full control of the feed resources. The inability to feed animals adequately throughout the year is the most widespread technical constraint. Much of the available feed resources are utilized to support maintenance requirements of the animals with little surplus left for production.

It can also be concluded that extension services in the study area were unreliable which slow down good flow of information concerning dairy cattle.

Results of the study revealed that productive and reproductive performance of crossbred cows was found to be comparatively low. Lack of access to land, disease prevalence, lack of proper or poor breeding management such as lack of accurate heat detection and timely insemination might have contributed considerably to late

age at first calving. Feed shortage in terms of quality and quantity also contributed to short lactation length and low milk production.

It may also be concluded that smallholder dairy production is an important undertaking and, if adequately supported by appropriate policies and adaptive research technologies, it may contribute significantly towards the household economy, self-sufficiency in milk and national gross domestic product.

6.2 RECOMMENDATIONS

In order to protect, promote and develop the smallholder dairy enterprise, the following recommendations need some due consideration by all the stakeholders in dairy cattle industry at all levels that is district, regional and national authorities. This includes both local and central governments;

- Provision of training in dairy cattle husbandry to the smallholder dairy farmers. Through training courses, introduce new varieties of tropical high quality grass and legumes to farmers, promote farmers to create their habits of utilizing both grass and legumes in a mixture for their animals, and encourage farmers to make silage and use fermented roughage frequently for dairy cattle in a year round, instead of the traditional habit of only providing dairy cattle with abundant green forage in rainy seasons and dried roughage in months of feed scarcity.
- To establish insurance services for dairy cattle to reduce risks for farmers in the sector because insurance can be considered as the most important risk management strategy for dairy producers besides keeping production costs lower.

- Planned technical and institutional support intervention for improved services delivery such as appropriate breeding program, improved heifers, adequate veterinary health services and provisions of credits support to smallholder dairy farmers.
- Introduction of permanent and coordinated recording system, which will assist on research, extension and in dairy production development programs.
- The small-scale dairy farmers should struggle to establish co-operative unions through which they could establish milk collecting centers and also provide the inputs such as supplementary feeds, drugs and extension services at affordable costs to its members; and more importantly to make decision on milk price.

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APPENDICES

Appendix 1: Survey questionnaire on milk production by smallholder farmers in Temeke peri-urban

Questionnaire number…….. Enumerator name……

Municipality name…… Date……

Name of respondent……

Ward……village/street……

A. Household demographic information

1. Head of household

a. Sex: M… F…

b. Marital status: 1.Married… 2...Single… 3. Divorced… 4.Widowed…

c. Age (1) <30 (2)31-45 (3)46-60 (4)>60

d. Highest level of education: No formal education… STD V11… O-Level…A-Level…Other (specify)…..

2. What is your principal occupation...?

3. What is the size of your household? Adults: M….. F…..Children: M…….F……

4. How much land do you own (ha)?

5. How much land is used for grazing (ha)?

6. What is your main source of income? (Rank number according to importance)

1. Livestock……..

2. Crops…….

3. Salary/wage……..

4. Business……

B. Cattle herd composition and feeding practices

1. When did you start keeping dairy cattle? …

2. How did you acquire your first dairy cattle? Inherited? (1)Given (2) Bought (3) other (specify)….

3. What breed of dairy cattle do you keep? (Personal observation)

i. Friesian……..

ii. Aryshire…….

iii. Jersey…….Other (specify)……..

4. What is the composition of your cattle herd?

Calves (less than 7 months). Male….Female….

Heifers….. Steers…. Cows….. Bulls….

5. What is your feeding practice?

i. Grazing ….

ii. Stall feeding…

iii. Tethering…

iv. Other (specify)…

If stall feeding what are the sources of feeds.....

If grazing, distance to grazing areas (Km)……

6. How much pasture (Kg) does each lactating cow fed per day...

7. Do you feed concentrates supplement?

i. Yes…….

ii. No……..

8. If yes what kind of concentrate and how much (kgs)?

(1)Maize bran only (2).maize bran with cotton seed cake (3) maize bran with sunflower cake (4) other (specify)……. ( )

9. Do you plant any kind of pasture?

i. Yes…Acreage…

ii. No

10. What are the main problems in the area of improved forage availability for milk cows?

1. Unawareness 2. Lack of seed 3. Lack of growing land 4. Poor adaptability

5. Combination of them (specify) ….. 6. Other (specify)….

11. What are the main problems in the area of concentrate feed availability for milk cows?

1. Unawareness 2. Poor availability 3. Costly 4. Combination of them (specify)

5. Others (specify) ……

12. Do you supply mineral to lactating cow?

i. Yes

ii. No

If yes what are they…….

13. What is the source of feeds during dry season?

i. Established pastures…….

ii. Buying from vendors……

iii. Green natural pastures……

iv. Grazing……..

14. What is the source of feeds during rainy season?

i. Established pastures

ii. Buying from vendors

iii. Green natural pastures

iv. Grazing

15. Do you conserve feeds to feed milk cows in times of feed shortage? 1. Yes 2. No

16. If yes, mention the types of feeds that you conserve….

17. If no, Why not……..

C. Cow productivity and calf rearing

1. At what age do your female animals reach puberty? (1) <1yr (2) 2yrs (3)3yrs (4)4yrs (5)>5yr ( )
2. What is the average age at first calving for your cows? (1)2yrs (2) 3yrs (3) 4yrs (4)>5yrs ( )
3. If your heifers calve late, what are the reasons? (Rank 1 as the most important)

i. Nutrition…

ii. Disease…

iii. Breed…

iv. Other (specify)…

4. On average, what is the calving interval of your cows? (1)1yr (2) 2yrs (3) 3yrs (4)4yrs (5) >5yr ( )
5. At what age do you cull your cows? (1)<5yrs (2) 5-10yrs (3) 10-15yrs (4) >15yr ( )
6. On average how many calves does each cow produce in its life time? (1) 1-3 (2) 4-6 (3) 7-9 (4) >10 ( )

7. In which season do most of your cows calve down? (1)Rainy season… (2)Winter Dry season ( )

8. Do you observe your cows during calving? (1) Yes (2) No ( )

9. Which calving problems do your cows experience? (1)Retained placenta (2) Dystocia (3)Metritis Mastitis (4) Agalactia (no milk) (5) other (specify)……. ( )

10. Are your calves born healthy? (1)Yes (2) No ( )

11. What do you do to calves that have lost their mothers...?

12. If you milk your cows after calving, when do you start milking them?

(1)<1wk after… (2)2wks after… (3)4wks after… (4)8wks after… (5)Other (specify)…

13. How many times do you milk your cows per day? (1) Once (2) Twice (3) >Three times ( )

14. On average how much milk does each cow produce per day?

15. What is your expectation? Litres…

16. What are the possible causes? 1. Breed…2. Age…3. Poor feeding…

17. How many times do you allow your calves to suckle per day? (1) Do not suckle… (2) Once… (3)Twice… (4) Whole day…(5)Other (specify)……

18. If you allow your calves to suckle, at what time (s) do you release them to suckle? (Tick

One or more) (1) 0600-0900hrs…. (2) 0900-12hrs… (3)1200-1500hrs… (4) >1500hrs

19. If they do not suckle, how do you feed them?

20. Do you experience early calf death problems? (1) Yes… (2) No…

21. If yes, how do you attend to the problems you have mentioned above...?

22. Which calf sex do you prefer? M… F…

23. Give reasons for the preferred sex...……..

22. What is the average length of lactation period for your cows?

(1)<6moths (2) 6-12months (3)12-18months (4) >18months ( )

23. At what age do you wean your calves? (1). <3months (2)3-6months (3) 6-9months (4)9-12months (5)>12months ( )

24. What method do you use to wean your calves? 1. Natural Separation…. 2.Metal plate….3. Other….

25. What are the chances of calf survival to weaning stage? 1. Low 2.Moderate 3.High 4.Excellent ( )

D. Breed, Breeding and Reproduction

1. What type of breeding practices do you prefer for your cows?

1. Natural (bull service)… 2. Artificial insemination (AI)… 3. Both…

2. Do you select superior males and females for breeding? 1. Yes… 2. No…

3. If yes, how do you select breeding cows?

1. Pedigree history 2. Physical appearances 3. Growth rate 4. Age at first calving 5. Calving interval 6. Mothering ability 7. Others (specify) …..

4. If yes, how do you select breeding males?

1. Pedigree history 2. Physical appearances 3. Growth rate 4. Service efficiency 5. Combination of the above (mention) 6. Others (specify) ……

5. Which breed sire mostly you use for natural mating?

1. Crossbred… 2. Local… 3. Both equally…4. Unknown…

6. What is/are your criteria(s) to mate heifers?

1. Age 2. Size 3. Both age and size 4. Whenever they manifest estrous 4. Other (specify)

7. Do you use AI to inseminate your cow(s)? 1. Yes 2. No

8. If you use AI, what is the source of it?

1. Government recruited technicians' 2. NGO's 3. Private 4. Others (specify)

9. Is there a problem of AI? 1. Yes 2. No

10. If yes, why?

1. No access 2. Unwillingness of AI technicians 3. Shortage of liquid nitrogen and semen 4. Others (specify) …….

11. If you prefer a bull, where is your source for the bull?

1. Neighbour… 2. Rent from neighbor… 3. Bull services (Rent)… 4. Others (specify)

12. Is mating seasonal? 1. Yes… 2. No…

1. If yes, why? 1. Due to feed shortage in some months… 2. Planned for heat period and time of calving… 3. Other (specify) ……

14. If your mating is natural as well as seasonal or planned, how cows and bulls are Protected from mating out of the season? 1. Isolation… 2. Others (specify)…..

15**.** What is the average number of service per conception?

16. Do you practice culling? 1. Yes 2. No

17. If yes, what is the main reason of culling?

1. Disease… 2. Age… 3. Infertility… 4. Low milk yield… 5. Financial constraint… 6. Feed shortage.... 7. Others (specify) …….

18. If you cull milk cattle due to financial constraint, which is your priority for culling?

1. Milking cow 2. Bull 3. Heifer 4. Male calves 5. Female calves 6. Pregnant cow

7. Infertile/cows with low milk yield 8. Others (specify) ……..

E: Socio-economic aspects

1. What prompted you to keep dairy cattle?

i. To get milk for home consumption…

ii. To get milk for income generation…

iii. Other (specify)…

2. What is the price (Tsh) of milk per litre?

3. On average how much milk (litres) do you get from lactating cow(s) per day?

4. If you consume milk, how much do you consume per day? Fresh…..Sour……Other

5. If you sell milk, how much do you sell per day? Fresh….Sour….Other

6. Income sources for your family from dairy production (multiple answers available) 1. Milk…2. Sell breeding animals…3. Sell manure and wastes…4. Sell processed milk…5. Other (specify)…

7. How do you evaluate the quality of your milk? Color… Water content… Taste… Other (specify)…

8. What is the market for your milk? Neighbours… Vendors… Others (specify)…….

9. How do you spend the money you get from milk selling?

i. Purchase animal feeds.

ii. Sending children to school.

iii. Buying goods for home consumption.

iv. All the above.

v. Other (specify)

10. What do you think is the most critical issue that reduce milk yield?

i. Diseases…

ii. Breed of the cattle…

iii. Poor quality feeds…

iv. Old age of the animal…

F: Diseases and diseases control measures

1. What do you do when your animal is sick?

1. Keep of waiting… 2. Culling… 3. Consult veterinarian… 4. Others (specify)…..

2. What type of services do you get concerning animal diseases?

Type of service	**Source of service**			
	Government	Private	NGOs	others
1. Vet				
2. Para vet				
3. Others (specify)				

3. Is there any problem with animal health services? 1. Yes 2. No

4. If yes, please mention…….

5. Do you use any control measures for ecto-parasites of milk cows? 1. Yes 2. No

6. If yes, specify:

1. ……

2. ……

3……..

7. If traditional method, specify…

8. How do you control internal parasites?

9. Which disease do mostly reduce milk yield of lactating cow(s)

1……..

2……..

3……..

G: Extension Services

1. Were you trained on dairy cattle husbandry before engaging in this enterprise?

i. Yes……..

ii. No……

2. How often are you visited by extension agent?

i. Weekly……..

ii. Fortnightly……

iii. When need arise……

3. Are you fulfilled with extension services?

i. Yes……..

ii. No……

H: Farmers constraints

What are the constraints do you face in dairy cattle production?

……
……

Appendix 2: ANOVA for nutrients available on the chemical composition, *in vitro* dry matter digestibility (IVDMD) and Metabolisable Energy (ME) contents of mixed forages by villages.

Dependent Variable: DM

Source	DF	Type III SS	Mean Square	F Value	Pr >
Villages	3	27.65281875	9.21760625	0.35	0.7910

Dependent Variable: CP

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	2.35605000	0.78535000	0.32	0.8110

Dependent Variable: Ca

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	0.00021875	0.00007292	0.04	0.9879

Dependent Variable: P

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	0.00115000	0.00038333	0.17	0.9154

Dependent Variable: IVDMD

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	259.4115250	86.4705083	3.65	0.0446

Dependent Variable: ME

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	8.31896875	2.77298958	4.78	0.0204

Appendix 3: ANOVA for nutrients available on the chemical composition, *in vitro* dry matter digestibility (IVDMD) and Metabolisable Energy (ME) contents of mixed concentrates by villages.

Dependent Variable: DM

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	10.37586875	3.45862292	0.71	0.5630

Dependent Variable: CP

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	7.38882500	2.46294167	2.21	0.1398

Dependent Variable: Ca

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	1.26451875	0.42150625	0.38	0.7672

Dependent Variable: P

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	0.34207500	0.11402500	0.64	0.6018

Dependent Variable: IVDMD

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	40.61052500	13.53684167	1.94	0.1775

Dependent Variable: ME

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	1.04862500	0.34954167	2.90	0.0786

Appendix 4: ANOVA for milk yield and nutrients intake of lactating cows by villages

Dependent Variable: Average Milk Yield

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	13.25541875	4.41847292	0.79	0.5206

Dependent Variable: ME

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	32.03496875	10.67832292	0.10	0.9579

Dependent Variable: Ca

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	129.6125000	43.2041667	0.67	0.5887

Dependent Variable: P

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	31.10566875	10.36855625	0.83	0.5019

Dependent Variable: CP

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	7116.156250	2372.052083	0.16	0.9210

Dependent Variable: DM

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Villages	3	3.22000000	1.07333333	0.65	0.5973