PRODUCTION PERFORMANCEAND CONTRIBUTION OF DAIRY GOATS TO INCOME OF SMALL-SCALEFARMERS IN MUFINDI DISTRICT, TANZANIA

GERALD GALUSI MTAMA

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

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ABSTRACT

A study was conducted in Mufindi district to determine the production performance and contribution of dairy goats to income of small-scale farmers. Purposive sampling was employed to select eight villages from five wards, and a sample of 80 dairy goat farmers and another set of 80 non-dairy goat farmers. The farmers were individually interviewed using a structured questionnaire. Non-dairy goat farmers were included as a control to ascertain the effect of dairy goat production on household income.Theresults show that keeping dairy goats is very important as it was found to play multiple roles to the households' needs such as providing milk for home consumption (42.5%), household income (47.5%) and manure(10.0%).The dairy goat breeds kept were Toggenburg and Saanen. Average milk yield recorded from the two dairy goat breeds was 171.4 ± 8.89 litres per goat per lactation. Toggenburg dairy goats had slightly higher milk yield with a mean of 171.6 ± 11.9 litresper lactation compared toSaanen dairy goats which had a mean lactation yield of 171.3 ± 12.6litres. The mortality rate for Toggenburg kids (45.9 ± 4.4%) was relatively higher compared to that of Saanen kids (39.6% ± 4.8).The results also show that the mean total income obtained from dairy goat enterprises was TZS 197 897.49 ± 23 699.29 per year and accounted for 26.2% of household income.Apart from keeping dairy goats farmers got income from other sources such as crop production, other type of livestock species and doing small business. Diseases, lack of concentrate feeds, few breeding bucks, higher price of inputs and inadequate extension services were the major constraints faced by small-scale farmers in the study area. It is recommended that production performance of dairy goats should be improved through improving management practices in terms of feeding, breeding and disease control.

DECRELATION

I**, MTAMA GERALDGALUSI**, do hereby declareto the Senate of Sokoine University of Agriculture that this dissertation is my own original workdone within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

_____ _____

Mtama, Gerald Galusi Date

(MARD Candidate)

The above declaration is confirmed

_____ _____

Prof. Chenyambuga, S.W. Date

(Supervisor)

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DEDICATION

This dissertation is dedicated to my Savior, Jesus Christ of Nazareth for his guidance throughout my life. Also it is dedicated to my children Victoria, Philipo, Daniel, Godlove and Hopeness, to them it should save as an inspiration to study hard and do more than me, and this is by abundant grace of God.

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LIST OF ABBREVIATIONS

AFK	Age at first kidding
DALDO	District Agricultural and Livestock Development Officer
HPI	Heifer Project International
KI	Kidding interval
LL	Lactation length
Max	Maximum value
Min	Minimum value
MLDF	Ministry of Livestock Development and Fisheries
MR	Mortality rate
MY	Milk yield
SE	Standard Error of Mean
SEA	Small East African goats
SPSS	Statistical Packages for Social Science
TZS	Tanzanian shillings
URT	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

In Tanzania, goat population is estimated at 15.6 million, the local goats being the predominant population (MLFD, 2011). According to Kilongozi *et al.* (2006)the population of dairy goats is estimated to be 126 000 which is less that 1% of the goat population. However, their role in providing highly needed milk is widely recognised, especially by the poor farming households.

Economically, goats serve as savings and living banks for the resource poor rural people, since they can easily be converted into cash when a need arises (Dossa*et al*., 2008; Gurmesa*et al*., 2011). They are considered as an account that is used under emergency conditions such as tax payments, health problems, school fees, death of a family member, and payment of credit and purchase of food items during crop failure (Shirima, 2005; FAOSTAT, 2010). Socially, goats serve as a source of protein in human diets (during festival gatherings), but also provide a good and stable source of income, especially for the poor in the rural areas. Their efficient utilization of small land holdings due to their small size and early maturity, short generation interval and higher digestion efficiency of roughage make them suitable for use for wealth creation, enhancement of family nutrition, income generation and increased farm productivity under small-scale farming system.

Small-scale dairygoat production has been promoted as a way of increasing consumption of animal protein as well as raising income level of rural poor people. Dairy goats contribute to income generation through sales of milk, milk products, live animals and manure (Kosgey, 2004; Macha and Mbaga, 2009; FAOSTAT, 2010). Dairy goats are also

named as “poor man cows” for the poor farmers because of low initial and maintenance costs which can be afforded by smallholder farmers, and they can be looked after by any member of the family, even children (Mahmoud, 2010).

Dairy goats in Mufindi district were introduced in 2005 by Heifer Project International - Tanzania to resource poor farmers in rural areas as part of efforts for poverty alleviation and improving household nutrition. Dairy goat keeping has provided an alternative source of milk to households that cannot afford to keep dairy cattle. There are two major products that are obtained from dairy goats, namely, milk and kids which are sold to generate income. Kids are products in goat keeping and help to increase the number of stocks and, thus lead to accumulation of capital assets. Other products include manure and skins which are by-products of goat keeping.

1.2 Problem Statement

In Mufindi district efforts have been made to improve productivity of local goats through introduction of exotic dairy breeds. The exotic breeds are normally used for crossbreeding with indigenous Small East African breed. The reason behind the introduction of dairy goats in Mufindi district was to address the challenge of poor milk production and low growth rate of the Small East African goats, the dominant breed in the country. The introduction of dairy goats has led to increased goat productivity, hence, improved nutrition, income and overall livelihoods of the small-scale farmers. Introduction of dairy goats was also considered as a means of creating employment and enhancing market access by the rural poor farmers (Eik*etal*., 2008; Safari *etal*., 2008). Dairy goats were introduced inMufindi district in2005 by Heifers Project International- Tanzania.

In Mufindidistrict, the number of dairy goats has increased mainly through the goat pass-on schemes. Goat milk has become popular in the nutrition of resource poor farmers in rural areas.Since the introduction of dairy goat breeds in Mufindidistrict no study has been done to assess their performance under the prevailing environmental conditions. Therefore, information on the performance of the various dairy goat breeds in different parts of the district is scarce. There is not adequate information on production performance of various breeds introduced in rural areas and their contributions to smallholder economies and food security in Mufindi district and other parts of the country are not well documented.

1.3 Justification of the Study

Since the introduction of dairy goats in Mufindi district, no effort has been made to evaluate the project's progress or impacts of goat project. In particular there are no reports on systematic study that assessed the viability of the project as judged by the performance of the introduced breeds. Currently, it is not well known whether the introduced dairy goats are performing according to expectation and which breed is suitable in Mufindi district.

There is a need to assess the performance of dairy goats under farmers' management condition and determine the factors which affect their reproduction and lactation performances. Furthermore, there is scarce information on the contribution of dairy goats to income of small-scale farmers in rural areas. The present study was carried out to assess the production performance and contribution of dairy goats to income of small-scale farmers. These results could assist stakeholders and farmers to know the appropriate genotype for keeping in Mufindi district. Elucidation of the contribution of dairy goats to household income will awaken other farmers to join the enterprises. Also the information generated will help the government, development partners and other relevant stakeholders

in developing appropriate strategies for sustainable dairy goat improvement and form the basis for the provision of extension services to farmers in the district.

Also the findings from this study provide the lessons learned from the villages where the goats were introduced and the lessons learned can be used in the formulation of improvement strategies and implementation plans.

1.4 Objectives

1.4.1 General objective

The general objective was to assess the production performance and contribution of dairy goats to income of small-scalefarmers in Mufindidistrict.

1.4.2 Specific objective

Specifically the study intended:

i) To identify the roles of dairy goats in smallholder production systems in Mufindi district.

ii) To determine lactation and reproductive performances of dairy goats in the study areas.

iii) To determine the contribution of dairy goat to household income of small-scale farmers.

iv) To examine the constraints faced by dairy goat keepers.

1.4.3Research hypotheses

The hypotheses tested in this research were:

i) The lactation and reproductive performances of different dairy goat breedsare not significantly different.

ii) Dairy goat production does not contribute significantly to the income of small-scale farmers in Mufindi district.

1.5 Research Questions

This study was guided by the following research questions:

i) What functions do dairy goat keeping play under smallholder production system?

ii) Do different dairy goat breeds kept in Mufindi district perform equally?

iii) Does dairy goat keeping result into improvement of farmers' income?

iv) What are the constraints of dairy goat production in the study areas?

1.6 Conceptual Framework

In order to meet the information needed to achieve general and specific objectives, a framework was developed. It shows a set of independent variables which influence the production performance and contribution of dairy goats to farmers' income. These components have a primary relationship toward the determination of farmer's income. Dairy goat performance determines the level of household income which leads to the improvement of farmers' welfare.The conceptual framework is presented in Fig. 1.

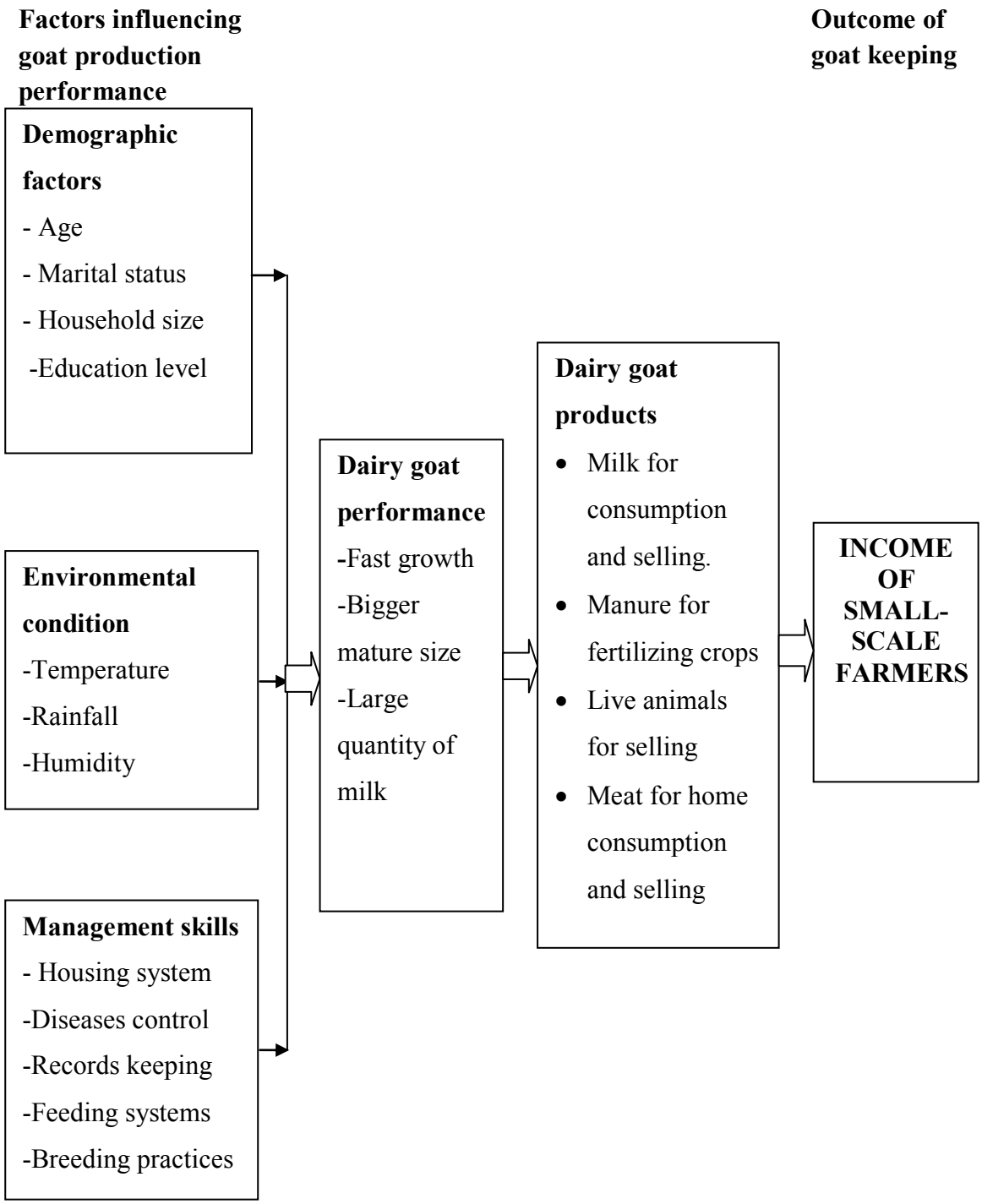

Figure 1: Conceptual Framework for dairy goat production

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 History of Dairy Goats in Tanzania

Rearing of dairy goats in Tanzania started in missionary centres, government institutions and research stations. Serious research in dairy goats started in early 1960s when exotic dairy goat breeds were imported. Earlier research efforts concentrated on on-station studies, but in 1980s dairy goats spread to small-scale farmers in rural areas (Kiango, 1996). Dairy goat keeping in rural areas was promoted by development agents and did well as opposed to the on-station-based approaches. This resulted into increased interest on the strategy of using dairy goats for poverty reduction by government and non-governmental organizations (Ogola*et al*., 2009). Introduction of dairy goat breeds in rural areas was aimed at upgrading the local breeds and increase their growth rates, milk yield, and hence, improve food security as well as household income.In most parts of the country, dairy goats have gained popularity as source of milk and income, particularly to the poor people and their milk is normally consumed at household level (Shirima, 2005; Tadele, 2007).

2.2 History of Dairy Goat Project in Mufindi

Heifer Project International (HPI-Tanzania) introduced dairy goats in Mufindi district in 2005, mainly Saanen and Toggenburg. The aim was to assist low income families to improve consumption of animal protein and increase their income. Before distribution of dairy goats to selected farmers, training was conducted on general animal husbandry, especially improved management of dairy goats. Few farmers from the selected villages were later on trained on health aspects of goats, and became community health workers for identification and treatment of various diseases affecting goats of the group members.

Thereafter, dairy goats were distributed to few selected farmers, and the condition was that when a doe gives birth to a female kid, the weaned kid has to be passed-on to the next farmer. Marketing channel for dairy goats is through the association even today.

2.3 Reproductive and Lactation Performance

2.3.1 Reproductive performance

This parameter is a major determinant of productivity and economic viability of goat enterprises. Failure to reproduce regularly leads to economic losses, in terms of milk for sale, young stocks for replacement and, hence, reduced selection intensity. Reproductive performance is determined by the rate of growth of an animal which, in turn, affects the time taken to reach critical body weight for the onset of puberty. Puberty in females depends on adult body size of animals (Gimenez and Rodning, 2007). Reproductive traits are controlled by both genetic and non-genetic factors and interaction between them. Puberty, the time of first sexual activity, has a consequent effect on lifetime production. Breed and potential size at maturity are the main factors that cause considerable variations in the time taken to reach first sexual activity in goats. Regardless of preceding factors, puberty is a function of both age and body weight (Gimenez and Rodning, 2007). Other environmental factors which affect the reproductive traits include season of the year, age of the dam, nutrition, diseases, parity of dam and housing condition. The nutritional status of the herd is the most important factor influencing reproduction. It is also the factor on which the producer has the most control by either increasing or reducing nutrient consumption (Gimenez and Rodning, 2007).

2.3.2 Age at First Kidding (AFK)

Age at first kidding of different goat breeds is expressed as the age at which does kid for the first time as indicated in Table 1. The earlier the doe starts to kid the longer the

productive life would be. Age at first kidding is an important factor in determining life time productivity. Age at first kidding (AFK) is influenced by age of the animal and body weight at mating, growth rate, and level of feeding and disease control. If doelings are not at an optimum weight, breeding should be delayed since puberty is more dependent on body weight than age of the animal. However, delaying breeding for a long time decreases the margin of profit by decreasing lifetime production (Mruttu, 2001).

Effect of season on AFK is in relation to availability of feed. Female kids born in the season with ample feed availability grow faster and attain sexual maturity earlier and hence, are younger at first kidding. This is due to quality and quantity of feeds available and this confirms that puberty depends on body weight rather than age (Delgadillo*et al*., 2007; Zeshmarani*et al*., 2007; Bushara and Nikhaila, 2012). Female kids born during the rainy season give birth to their first kids at a relatively younger age compared to those born during cool dry season (Bushara and Nikhaila, 2012). The slow growth rate is mainly attributed to poor nutrition, management and other non-genetic factors (Gbangboche*et al*., 2006). However, season effect is more pronounced in extensive than in intensive management system. Nutrition influences the onset of puberty, conception rate, health and vigour of the newborn kid. Overfeeding doelings in order to attain heavy weight quickly does not guarantee that a high percentage will show oestrus early.

Table 1: Age at first kidding of different goat breeds

Breed	AFK(days)	Place	Author(s)
SEA	638-984	Tanzania	Mtenga*et al*. (1994)
Red Sokoto	513	Nigeria	Ajala*et al*. (2008)
Arsi-Bale goat	810	Ethiopia	Dadi*et al*. (2008)
Togo	450	Mali	Wilson and Light (1986)
Sahel	390	Mali	Wilson and Light (1986)
Maradi	420	Mali	Wilson and Light (1986)
Norwegian	525	Tanzania	Kiango (1989)
Indigenous goat	408	Ethiopia	Tesfaye (2009)
Norwegian	408	Tanzania	Safari *et al*. (2008)
Norwegian crosses	527	Tanzania	Kiango (1996)
Mali goats	529	Nigeria	Mack (1983)
Black Bengal	456	India	Lal*et al*. (1987)
Mozambique goats	693	Mozambique	Wilson *et al*. (1989)
Native goat	382	Korea	Song *et al*. (2006)
KamoraxSEA	757	Tanzania	Das and Sendalo (1990)
Norwegian crosses	732.1	Tanzania	Hamad (2001)
Black Bengal	387	India	Dhara*et al*. (2011)
Zairabi goat	691	Egypt	Kamal and Nikhaila (2009)
Saanen	497.7	Mexico	Tores –Vazquez *et al*. (2009)

2.3.3 KiddingInterval (KI)

As shown in Table 2, this trait is expressed as the number of days between two consecutive kiddings. It is an important trait in animal production due to its effect on animal population turnover rate and total lifetime productivity. It is a major component of reproductive performance that has significant influences on productivity. It contributes largely to the production efficiency and it is affected by breed, age, season and level of nutrition (Ndlovu, 1990). Kidding interval (KI) is a function of many aspects of reproduction including conception rate and cyclicity pattern. If the does are not cycling,

they are not going to conceive and this lengthens the KI and negatively impacts profits. Kidding interval comprises of day open and gestation length. Thus, lactation length and dry period are components of KI.

Kidding interval of pure exotic breeds introduced in the tropics is longer than that of indigenous goats. The longer KI found in the pure exotic breeds of goats in the tropics is due to the fact that eostrus activity in tropical breeds is greater than in temperate goats. According to Kamal and Nikhaila (2009) another factor that can lead to long open period is under nutrition which results into extended KI. The high plane of nutrition after kidding shortens the interval from first breeding to conception and, thus, reduces KI.Dadi*et al*.(2008) explained that inadequate nutrition delays the occurrence of postpartum oestrus. The kidding interval could be affected by change in the quality and quantity of forages, which occurs during various seasons of the year, as the natural forages are the main sources of goats' diet. The ratio of male to female, quality of bucks and availability of buck can also affect KI. Mating system in the area can affect the KI. Uncontrolled mating can result in KI that is different from controlled mating. Variation in KI has been observed between intensive and extensive production system (Faruque*et al*., 2010).

Studies have revealed that 1st, 2nd and 3rd parities have longer KI compared to 4th parity (Bushara*et al*.,2011). Studies have shown that, as parity increases KI decreases(Bushara*et al.*, 2011). Young animals take longer time to regain body conditions after kidding (Dadi*et al*., 2008; Kiango, 1996). However, findings by Alphonsus*et al*. (2010) indicated that KIs increase as the parities increase. This is because of preferential treatment of young does compared to older ones (Dadi*et al*., 2008).

Ahuya *et al*. (2009) observed KI of 302 days equivalent to 10 months. Results by Eik*et al*. (2008) indicate that KI of dairy goats is 12.8 months. Tesfaye (2009) reported KI of 8.4 months. Other studies have shown that KI of goats is about 9.2 months (Ince, 2010; Webb

and Mamabolo, 2005).A study done by Alphonsus*et al*. (2010) in Nigeria found the KI to be 6.9 months (207 days), which is close to 204 days reported by Sodiq (2004) in Indonesia on goat raised under traditional management system. Under normal conditions and good management, both temperate and tropical goats should kid at least three times in two years. Bearing this in mind, therefore, kidding intervals should not exceed eight months.

Table 2: Kidding interval (KI) of goats in the tropics

Breed	KI (days)	Country	Author
Norwegian crosses	353.5	Tanzania	Hamad (2001)
Local goat	252	Ethiopia	Tesfaye (2009)
Norwegian	318	Tanzania	Safari *et al*. (2008)
Local	324	Zimbabwe	Ndlovu (1990)
KamoraixSEA	373	Tanzania	Das and Sendalo (1990)
Galla	285	Kenya	Kiwuwa (1986)
Sahel	312	Burkina Faso	Wilson (1988)
Mali goats	296	Mali	Wilson and Durkin (1988)
Norwegian crosses	400	Tanzania	Mwatawala (1997)
Boer	285	Kenya	Kiwuwa (1986)
Alpine x SEA	323	Rwanda	Wilson and Murayi (1988)
Korean goat	211.6	Korea	Song *et al*. (2006)
Blended x Galla	388	Tanzania	Das and Sendalo (1989)
Norwegian crosses	338	Tanzania	Kiango (1996)
Indian local goat	238	India	Alexandre*et al*. (2001)
Mali goats	265	Mali	Alexandre*et al*. (2001)
Kecang goats	204	Indonesia	Sodiq (2004)
Red Sokoto	207	Nigeria	Alphonsus*et al*. (2010)
Nubian goats	278	Sudan	Kamal and Nikhaila (2009)
Toggenburg	302	Kenya	Ahuya*et al*. (2009)

2.3.4 Litter size

Twinning rate is expressed as the ratio of twin births to the total number of live births. Litter size or number of kids in the litter is the total number of kids born per kidding per goat. Litter size is an important factor which determines the reproductive efficiency of the farm (Hamad, 2001). Litter size has significant influence on goat prolificacy. Litter size increases with age and is more related to weight of a doe at conception than age (Sangare and Pandey, 2000). As the age of the animal increases, the hormonal status of the animal body, metabolic activity, secretory cells and nutrient intake which are used in milk synthesis increase too (Carnicella*et al*., 2008; Hansen *et al.,* 2006). Litter size at birth tends to improve over years and with parity. This may be due to the efficiency of reproduction as the doe matures.

Does with singles have less milk production than those with multiple litter size (Argüello*et al*., 2005). The high milk yield in does with twins is induced by high lactogenic activities during prepartum stage which cause greater development of mammary gland and increase in the potential for milk synthesis and, hence, high milk yield during early postpartum. The small amount of milk produced by does with single kids have higher protein and lower fat contents (Salama*et al*., 2005).

Litter size is influenced by breed and, there is variation within and between breeds. The variation in litter size in tropical goats have great advantage as reproductive performance could be improved by selection or by crossbreeding without affecting their adaptive characteristics for hot and harsh environment (Mruttu, 2001). Studies conducted by Dadi*et al*. (2008), Alphonsus*et al*.(2010) and Bushara*et al*. (2011) revealed positive correlation between litter size and parity, that is as parities increase litter size increases as well. This was also observed by Faruque*et al*. (2010) who found litter size in the 1stparity

to belower (1.43) than in the 7th parity (3.0). This phenomenon supports the notion that young does take longer time to return to their reproductive status compared to older does (Wilson and Light, 1986).

The effect of season on litter size is attributed to availability of feeds, which in turn, affects the conception rate. Conception rate is high when mating is accompanied by high plane of nutrition, especially two months prior to mating. The larger litter size in dry season kidding is related to high conception rate in the late rains or post rainy season due to abundant availability of good quality pasture during the rainy season (Hamad, 2001).

2.3.5 Mortality rate

Mortality is a major constraint to goat production in the tropics. Kid mortality from birth to weaning is one of the crucial elements in the economic process of goat raising programmes. Factors influencing kid mortality are closely related to the systems of production and include low birth weight, low milk production of the doe, season of birth, type of birth, sex of kid, season of kidding, parity order, predators, diseases and accidents (Kamal and Nikhaila, 2009). Birth weight and sex of the kid have significant influence on pre-weaning mortality rate (Hailu*et al*., 2006). Kid born with lower birth weight has a greater chance of expressing higher mortality rate compared to kid born with higher birth weight (Turkson*et al*., 2004). Kid mortality normally decreases as the birth weight of kid increases (Ershaduzzaman*et al*., 2007; Girma*et al*., 2011). Generally male kid exhibits higher birth weight compared to female kids. Conversely female kids have higher kid mortality than male kids. However, a study conducted by Turkson*et al*. (2004) observed higher mortality in male kids than in female kids.

Type of birth is another factor which affects kid mortality. Single born kids have the lowest mortality rate while twin born kids have higher mortality rate (Snyman, 2010; Mtenga*et al*., 2006; Ndamukong, 2006). High mortality rate for multiple - kids could be associated with limited availability of nutrients in the uterus and amount of milk consumed after birth. Age and parity of does have significant effect on mortality rate at birth and from birth to weaning. This may be attributed to the physiological maturity of older does and their ability to provide more milk, which increases the survival rate of the kids (Marai*et al*., 2002).Mortality rate is reduced with increase in parity number (Bushara*et al*., 2011). Higher incidences of mortality have been observed in 1st and 2nd parities than in3rd and 4th parities (Mourand*et al*., 2000). Higher mortality rate have been reported in primiparous than in multiparous dams (25.3 vs. 13.2%) (Bushara*et al*., 2011). This supports the fact that age and parity of the doe significantly affects the reproductive traits.

Breed is another factor which affects kid mortality. Indigenous goats are more tolerant to diseases and stress, hence, have higher survival rate compared to exotic breeds (Barbind and Dandewar, 2004).Mortality rate increases as the level of exotic blood increases. Exotic breeds easily succumb to diseases and this result into higher mortality rate of kids than their indigenous counterparts. Meat goats also have been found to express lower kid mortality rate than dairy goats.

Studies have shown that kids born during the wet season exhibit higher mortality rate than those born in the dry season (Turkson*et al*., 2004). The higher mortality rate in the rainy season is associated with high rainfall and high relative humidity (Mazumdar*et al*., 1980), both of which are known to promote disease and parasitic infections. Kids seem to be less able to withstand attack by both physical and biological agents due to their lack of immunity. This makes them more susceptible to enteric and respiratory infections

(Bushara and Nikhaila, 2012). High mortality rate in post weaning period is associated with weaning stress and worm burden. High pre-weaning mortality rate is influenced by low birth weight and low milk yield (Girma*et al*., 2011).

2.4 Lactation Performance

Quality and quantity of feed provided to animals prior and after parturition influences milk yield, milk quality, lactation duration, kid vitality and growth rate (Salama*et al*., 2005). The actual amount of milk produced during lactation period is affected by several factors. These include breed, litter size, parity, stage of lactation, and health of does during pregnancy, season of kidding, physiological state, disease, feed availability and stress from the environment (Mellado*et al*., 2003).

2.4.1 Lactation yield

Breed of dairy goats has an effect on milk yield. It has been documented by many authors that temperate breeds produce more milk than tropical breeds (Güney*et al*., 2006; Norris *et al*., 2011). Tropical breeds have low milk yield due to their low genetic potential and prevailing environmental conditions like stress caused by harsh weather and diseases. Level of milk production depends on breed and there is variation in milk yield among breeds and within the breed (Kendall *et al*., 2009). Also high variations are due to variable production environment. Genetic differences among the dairy goat breeds affect ash and fat contents of the milk, and it has been found that tropical breeds give higher percentage of these contents than temperate breeds (Zahraddeen*et al*., 2007). Milk from tropical goat breeds has higher total solids, due to higher fat and protein contents than the milk from temperate dairy goat breeds. These concentrations of nutrients are connected to the small amount of milk produced by tropical breeds (Abd*et al.,* 2005). Protein and fat contents are

high on early lactation then drop at peak milk yield and slowly increases until the doe dries off (Salama*et al*., 2005).

In a study conducted by Zahraddeen*et al*. (2007) milk yield of goats was found to be higher during the wet season than in the dry season. This is in close agreement with the findings of Iloeje*et al*.(1981) who reported that in Nigeria does that kidded from January to March produced more milk than those that kidded from April to July. Generally, does that kid during the rainy season produce more milk than those kidding in the dry season. This may be attributed to availability of good quality feed resources during the rainy seasons and vice versa during the dry season (Norris *et al*., 2011). On the other hand, when does kid in the wet season there is low dry matter intake, reduced grazing time, high prevalence of diseases, especially worm infestation which cause low milk yield (Hoste*et al*., 2005; Singh *et al*., 2009).

Parity is another factor which influences milk production. As the number of parities increase from the first to the third; milk yield increases with increasing rate, thereafter milk yield increases with decreasing rate up to the fifth parity (Hansen *et al*., 2006). Effect of parity on total lactation yield and daily milk yield shows an almost steady increasing trend from first to fourth lactation. Singh *et al*. (2009) observed increase in milk production from second parity to fifth parity, thereafter declined substantially. During the first kidding, does have low weight and this contributes to low daily milk yield. As the number of parity increases, the animal is attaining maturity and energy competition between growth and milk synthesis is reduced, hence, high milk yield (Mellado*et al*., 2003; Busharа*et al*., 2011; Norris *et al*., 2011). Milk yield increases with age, as the age of the animal increases, the hormonal status of the animal body, metabolic activity, secretory

cells and nutrient intake which are used in milk synthesis increase too (Hansen *et al*., 2006; Carnicella*et al*., 2008). Older does are larger in body size and produce more milk.

Management practices which include frequency of milking, nutrition and body condition are the other factors influencing milk production. Milking once per day yield little amount of milk compared to milking twice a day (Salama*et al*., 2005). Shortage of feeds during pregnancy affect milk yield due to a carryover effect after kidding. Good body condition of doe at late pregnancy has positive effect on early lactation milk yield. Morand-Fehr *et al.*(2007) reported that apart from genetic limits, nutrition during lactation is the primary factor that influences milk yield and milk fat content decreases as the milk yield increases. Does' body condition scores significantly influence milk yield (Zahraddeen*et al*., 2007). Average milk yield, total lactation yield, time of peak milk yield, persistency, fat, and protein contents depends on the quality and quantity of feed consumed by the animal.

2.4.2Lactation length

Lactation length is the period in which the doe is in milk. The total amount of milk to be harvested is partly influenced by lactation length. Lactation length has an obvious effect on milk yield with greater quantities of milk and milk components being obtained for longer lactations (Goetsch*et al*., 2011). Lactation length is a breed's property. Each breed has its own lactation length depending on its producing ability, but usually lasts for about 240 (8 months) to 300 days (10 months). Also variation is found from goat to goat within a breed. A study by Ahuya*et al.* (2009) found the lactation length of 225 days (7.5 months). Study conducted by Eik*et al*. (2008) showed lactation length of 10.0 months. Lactation length of 8 months has been obtained by Safari *et al*. (2008). Report by Kamal and Nikhaila (2009) showed a lactation length of 181 days (6 months).

2.4.3Dry period

Dry period is a critical part of the lactation cycle in dairy animals and is essential for achieving optimal milk yield in the subsequent lactation. The non-lactating period is required for mammary gland remodeling processes, including regression, proliferation and differentiation of mammary cells to prepare for the ensuing lactation (Dallard*et al*., 2010). The greater the production the more likely that her body will be depleted of the nutrients used in milk secretion and the longer the dry period required to replenish the losses and store adequate reserves for the next lactation. The dry period should range from 45 to 60 days. During this period the doe should be managed in such a way that she is restricted from becoming too fat. It is the time when the endocrine system is readjusting to the next service period and pregnancy. Does which are not given normal dry period usually produce only 65 to 75% as much milk in the subsequent lactation compared to does given extra care during the dry period (Barnet and Frederick, 2009). Long dry periods decrease the productivity of doe by extending kidding interval beyond the normal, hence, causing a decrease in the lifetime production.

2.5Contribution of Dairy Goat Enterprise to Household Income

Dairy goat enterprise is an important avenue for poverty reduction among small-scale farmers due to its contribution to income generation through sale of milk, milk products, live animals, hides and manure. Income from such production often accrues to women, who use these products to provide better nutrition and education to their children (World Bank, 2001). Dairy goats are an alternative source of milk to most rural people who cannot afford to keep dairy cattle. This is due to their small body size whereby the initial and maintenance costs are low. Also most of the small-scale farmers have limited access to land and capital, and so the rearing of dairy goats using common property resources at least gives them an opportunity to improve their income position (Riethmuller, 2003).

Small-scale dairy farming has been shown to contribute significantly to household income; and this seems to be higher compared to other enterprises. Manure from the dairy goats cause substantial improvement in soil fertility, increase crop yield, hence, improve food security and income to household (Peacock*et al*., 2005; Safari *et al*., 2008; Lwelamira*et al*., 2010). Generally, income determines the purchasing power at household level, the higher the income the higher the ability of the households to meet their basic needs.

Goat milk greatly improves the diet of many rural families because it is rich in basic food nutrients. It is traditionally valued for the elderly, the sick, babies, children who are allergic to cow milk, and patients with ulcers. Goat milk also contributes to reduction of malnutrition among the vulnerable groups. It is even preferred for raising orphan foals and other young domestic animals. As shown in Table 3, goat milk is richer than cow milk in some important nutrients like vitamin A, niacin, choline, and inositol; but it is poorer in folic acid (Pinoy, 2008; Kipserem*et al.*, 2011; Norris *et al*., 2011). Protein level, fat and mineral contents in goat milk are relatively higher than that of cow's milk. Goat milk has been reported to contain a higher proportion of short and medium chain fatty acids with smaller globules than cow milk. This makes goat milk promising in relieving stress and constipation (Gurmesa*et al*., 2011; Ozung*et al*., 2011). It has been found to have higher medicinal value (curing people with migraine and asthma), vitamin B content and has higher digestibility than cow's milk(Ochepo and Momoh,2010).

Table 3: The nutritive value of goat milk versus cow milk

Components	Goat milk	Cow milk
Protein (%)	3.2	3.4
Fat (%)	3.6	3.8
Lactose (%)	4.7	4.1
Mineral matter (%)	0.7	0.8
Non fat solid (%)	8.8	9.1
Total solid (%)	13.0	12.8
Vitamin A_1	2074.6	1560.0
Vitamin D	23.7	-
Thiamine (B_1)	0.4	0.44
Riboflavin	1.8	1.8
Nicotin acid	1.9	0.9
Ascorbic acid (Vitamin C)	15.0	21.1
Choline	150.0	121.0

Source:Ozung*et al*. (2011)

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the Study Area

This study was conducted in Mufindi district, Iringa Region. The selection of the study area was based on the fact that the district is one of the areas where small- scale dairy goat production is practiced. Mufindi is among the four districts of IringaRegion in the Southern Highland of Tanzania. It lies approximately between latitude 8°6' and 8°92' South of equator and between Longitude 34°35' and 35°35'E. The district is located at an altitude that ranges from 1,700 to 2,200 meters above sea level (m as l). It is bordered by Iringa district to the north, Kilombero and Ulanga districts of MorogoroRegion to the east, Wanging'ombe district of NjombeRegion to the south and Mbalali district in Mbeya Region to the west.

3.1.1 Climate and agro-ecological condition

According to URT (1997) the district is delineated into three geographical zones: the highland, Midland and lowland zones. The highland agro-ecological zone lies between 1600 and 2700 meters above sea level (m a s l) withmean temperature ranging from 13.2 to 18.4°C while annual rainfall ranges from 1200 to 1600 mm (URT, 1997). The midland agro ecological zone lies between 1200 and 1600 m a s l with mean temperature of between 15 and 20°C and rainfall ranging from 600 to 1000 mm annually. The lowland agro-ecological zone lies between altitudes of 900 and 1200 m a s l and has temperature of between 20 and 25°C and rainfall of between 500 and 600 mm annually. Generally the rainfall pattern is unimodal with a single rain season which starts in November and ends in May and it is followed by a cool dry period up to October.

3.1.2 Population, ethnicity and economic activities

According to 2002 population census (URT, 2003), the population of Mufindi district is 430 992 of which 282 071 are males and 148 921 are females. The main ethnic groups are Hehe and Bena, followed by Kinga. The economic activities in the three zones are principally agricultural based with crop production being the major occupation. Food crops grown include maize, wheat, sweet potato, sunflower, Irish potato, cassava and beans. Cash crops include pyrethrum and Tea. Livestock keeping is practiced under small scale production system and livestock kept include cattle, goats, pigs, sheep and chicken.

3.1.3 Study location

In this study five wards of Ifwagi, Nyololo, Kasanga, Mtwango and Igowole were selected for research activities. Four villages namely: NyololoShuleni, NyololoNjiapanda, Njojo,andMaduma in Nyololo ward, Igowolevillage inIgowole ward, Ikongosivillage inIfwagi ward, Sawala village in Mtwango ward andKasanga village in Kasanga ward were selected.

3.2 Research Design

The study was carried out using a cross-sectional research design whereby data were collected at a single point in time and data collection was done at once. According to Babbie(1994) this approach is suitable for descriptive study.

3.3 Sampling Design and Sample Size

A purposive sampling design was used to select farmers who keep dairy goats and have an experience of at least five years on dairy goats keeping. In addition, farmers who do not keep dairy goats within the same area were randomly selected and interviewed using a structured questionnaire (Appendix 1). A total of 160 smallholder farmers were involved

in the study, of whom, 80 farmers had dairy goats and 80 had no dairy goats. A purposive sampling procedure, as described by Bryman (2001), was adopted to ensure that the selected households comprised the dairy goat farmers. Non-dairy goat farmers were randomly sampled. The difference between the two groups was possession of a dairy goat enterprise while other economic activities were the same. Non-dairy goat farmers were included in this study as a control group to assess the contribution of dairy goats in comparison to other enterprises within the household.

3.4 Data Collection

A structured questionnaire was prepared (Appendix 1) and pre-tested before being administered. Then, refining and corrections were made in accordance with the respondents' perceptions. The respondents were visited individually at their premises after making appointment with the researcher. Before carrying out the interview, the first session was used by the researcher for introduction to build confidence with farmers so that they could participate fully and without any reservations. Data were collected by interviewing household heads engaged in small-scale dairy goat keeping. Furthermore, heads of the non-dairy goat keeping households were interviewed. In addition, some data were collected through direct observation on dairy goat herd size and composition, and the housing condition of the respondent's dairy goat housing.

3.4.1 Type of information collected

3.4.1.1 Reproductive and lactation performances of dairy goat breeds

Household surveys were conducted to determine the performance of dairy goats. Information on age at first kidding, kidding interval, litter size, kid mortality rate, daily milk yield, lactation length and dry period were gathered through face to face interview using a well structured questionnaire.

3.4.1.2 Input and output relationships of the dairy goat enterprises

Information on quantity and price of inputs used for raising dairy goats were collected. The inputs included feeds, veterinary services, drugs, labour (family/hired), repair and maintenance of goat houses. The outputs obtained included sales of live animals, milk, and manure.

3.4.1.3 Assessment of contribution of dairy goat enterprises to household income

The information on income from other enterprises contributing to annual household income apart from dairy goats was collected from the farmers with dairy goats and those with no dairy goats. This included crops(such as maize, sunflower, wheat, and beans) produced, other livestock species and small business within the household. Inputs included drugs, labour, feed, veterinary services, repair and maintenance of animal shed, cost for breeding of animals and land preparation costs, seeds, weeding, harvesting, transport cost for crops. Information on quantity and price of inputs for each enterprise were collected and total costs of production were computed. Outputs were considered as sales of products from each enterprise; these included sale of milk, milk products, sale of live animals and manure. For crops, amounts harvested were converted into cash and revenues from each enterprise were computed.

3.5 Data Processing and Analysis

Primary data were verified, coded and analyzed using the Statistical Package for Social Science (SPSS) software. For objectives one, two and four descriptive statistics which include frequencies, means, standard deviation, and percentages were computed. For objective three independent T test was carried out to compare the income of dairy goat farmers and non- dairy goat farmers.

CHAPTER FOUR

4.0 RESULTS

4.1 Characteristics of the Respondents

This study involved a total of 160 smallholder farmers, among them 80 were dairy goat farmers and 80were non- dairy goat farmers. Table 3 shows the characteristics of the respondents. Of the 80 dairy goat farmers 50% were from Nyololo ward. Also for non-dairy goat farmers 50% were from the same ward. The remaining respondentswere from Mtwango(12.5%), Igowole(12.5%), Ifwagi (12.5%) and Kasanga (12.5%) wards for both dairy goat farmers and non dairy goatfarmers.Generally, 50% were men and 50% were women for dairy goat farmers and 65% were men and 35% were women for non-dairy goat farmers.

4.1.1 Education level of the respondents

The majority (67.5%) of dairy goat farmers had completed primary school education while few (22.5%) had completed certificate and diploma education and8.7% had completed secondary school education. Very few farmers (1.3%) had no formal education. For non-dairy goat keepers, 71.5%had competed primary school education, 16.2% had completed secondary school education, 9.8% had completed certificate and diploma and 2.5% had no formal education.The findings in this study indicate that the majority of the farmers are primary school leavers and are able to write and read and thus can acquire more knowledge and skills through reading.

4.1.2Head of household and ageof the respondents

Out of the 80 dairy goat farmers, 53.8% were heads of their households and 40% were spouses. The remaining 5.0 and 1.2% were daughters and sons, respectively. For non-dairygoat farmers, 48.7% were head of their household, 42.5% were spouses, 5% were daughters and 3.8% were sons. Theproportion of respondents with the age below 35 years

old was 8.7% while those with 36 to 55 years old comprised58.8% and those respondents above 56 years old were 32.5%.

Table 4: Characteristics of the respondents (n=160)

Dairy goat farmers			**Non- dairy goat farmers**	
Variable	**n**	**%**	**n**	**%**
Ward of respondents				
Nyololo	40	50.0	40	50.0
Mtwango	10	12.5	10	12.5
Ifwagi	10	12.5	10	12.5
Igowole	10	12.5	10	12.5
Kasanga	10	12.5	10	12.5
Sex of respondents				
Male	40	50.0	52	65
Female	40	50.0	28	35
Age of household head (yrs)				
<35	7	8.7	34	42.4
36 to 55	47	58.8	41	51.3
>56	26	32.5	5	6.3
Family size				
<3 people	19	23.8	9	11.3
4 to 7 People	37	46.2	34	42.5
>8 People	24	30.0	37	46.2
Education level				
Informal	1	1.3	2	2.5
Primary education	54	67.5	57	71.3
Secondary education	7	8.7	13	16.2
Tertiary education	18	22.5	8	9.8
Category of respondents				
Head of Household	43	53.8	39	48.7
Spouse	32	40.0	34	42.5
Daughter	4	5.0	4	5.0
Son	1	1.2	3	3.8

4.2 Dairy Goat Keeping,Management, Flock Size and Reasons for Keeping Dairy Goats in the Study Area

Dairy goat keeping was introduced in 2005 and only one (1.3%) respondent indicated to have started keeping dairy goats before the introduction of dairy goats by HPI- Tanzania. The results show that ten respondents received dairy goats between 2007 and 2008.The majority (76.0%) of the respondents in the study area started keeping dairy goats between the year 2010 and 2012 and only few (9.7%) started keeping dairy goats in 2013 and 2014. As shown inTable 5, 80.0% of the respondents received dairy goats from the development project, 12.5% bought dairy goats from other farmers and the remaining 7.5% received dairy goats through pass-on arrangement under the project. Two main breeds of dairy goats were kept in the study area and these were Toggenburg and Saanen.Toggenburg was kept by 40.0% of the respondents while60.0% of the respondents keptSaanen.

Table 5: Breeds of dairy goats kept and management practicesused by small-scale dairy goat farmers(n=80)

Variable	n	%
Means of acquiring dairy goats		
Given by development project	64	80
Bought	10	12.5
Pass-on	6	7.5
Breed kept		
Toggenburg	32	40
Saanen	48	60
Type of housing		
Raised floor	63	83.8
Normal ground floor	17	17.2
Feeding system		
Zero grazing	64	80
Tethering	16	20
Concentrate supplementation		
No	5	6.3
Yes	75	93.7
Record keeping		
No	8	10
Yes	72	90
Type of records kept		
Production	46	57.5
Reproduction	16	20
Treatment	15	18.8
Purchase and sales	3	3.7
Routine disease control		
Yes	8	10
No	72	90
Number of services per conception		
Once	33	41.2
Twice	42	52.5
Thrice	5	6.3
Criteria used for selecting breeding bucks		
Performance	51	63.8
Shape/Conformation	23	27.7
Size	5	6.2
Colour	1	1.3

The majority(83.8%) of the respondents kept dairy goats in houses with raised floor and 80%of the farmers kept their goats under zero grazing system. The study found that most of dairy goat farmers (93.7%) provided supplementary feeds to their goats. The majority60.0% of the respondents supplied drinking water to their dairy goat*ad-libitum* while 30.0% and 10.0%of them supplied water once and twice per day, respectively. All respondents said that they control external parasites through spraying or dipping of the dairy goats. Out of the 80 respondents, 90.0% of them indicated that they keep farm records and 57.5% said that they keep production records, while 20.0% kept reproduction records and the remaining 18.8% and 2.7% kept treatment (health) records and purchase and sales records, respectively.

The study found that the majority (55%) of the respondents were keeping about four to six animals per household (an average of four animals per farmer) while 38.7% of the respondents were keeping one to three animals. About5%of the farmers were keeping seven to ninedairy goats and1.3%were keeping more than ten dairy goats.When the respondents were asked to mention the roles of keeping dairy goats, they said that dairy goats play multiple roles in their households and they keep dairy goats mainly for providing milk, household income and manure as reported by 42.5%, 47.5% and 10.0% of the respondents, respectively (Table 6).

Table 6: Flock size kept and reasons of keeping dairy goats (n=80)

Number of animals	**n**	**%**
0	-	-
1-3	31	38.7
4-6	44	55.0
7-9	4	5.0
>10	1	1.3
Reasons of keeping dairy goats		
Milk production for home consumption	34	42.5
Generation of income through sales of milk and live animals	38	47.5
Provision of manure	8	10.0

4.3 Ranking of Different Livestock Species in Small-holder Production System in Mufindi District

Respondents were asked to rank the importance of dairy goats in comparison to other domesticated animals in a household. Table 7shows that keeping dairy goats was ranked as the most important economic activity as indicated by most (78.8%) of the respondents. The remaining 21.2% ranked dairy goat keeping as very important. Compared to other type of livestockkept, keeping chicken was reported to be comparable to keeping dairy goats and the majority (86.3%) of the respondents ranked poultry keeping as very important to most important economic activity. Other livestock species like cattle and sheep were ranked as less to least important in most of the households as indicated by 77.5% and 98.8% of the respondents, respectively.

Table 7: Ranking of livestock in order of importance to household income (n=80)

Ranking	Dairy Goats%	Poultry%	Cattle%	Sheep %	Pigs %
Most important	78.8	18.8	2.5	-	2.5
Very important	21.2	67.5	3.7	1.3	8.8
Important	-	6.3	16.3	12.5	45.0
Less important	-	3.7	22.5	86.2	5.0
Least important	-	3.7	55.0	-	38.7

4.4 Lactation Performances of Dairy Goats in the Study Areas

The lactation performance of dairy goats was assessed based on lactation length, dry period and milk yield according to the type of breed kept by a farmer.

4.4.1 Lactation length (LL) of dairy goats in Mufindi district

The mean Lactation length (LL) of dairy goats in Mufindi was 102.8± 2.8days and ranged from 30 to 150days. The mean LL of Saanen breed was 101.9± 3.9 days and ranged from

30 to 150 days. There was no significant difference in lactation length between the two dairy breeds (P>0.05) (Table 9).The mean LL of Saanen was found to be lower than the LL of Toggenburg breed which had a mean of 104.1± 4.3 days and a range of 30 to 150 days.

4.4.2 Milk yield (MY) of dairy goats in Mufindi district

Milk yield recorded for the two dairy goat breeds revealed that the overall mean lactationyield was 171.4 ± 8.89 litres and ranged from 30 to 260 litres per goat per lactation. Toggenburg dairy goats had relatively higher milk yields with a mean of 171.6 ± 11.9 litres and a range of 30 to 300 litres while Saanen dairy goats had a mean lactation yield of 171.3 ± 12.6 litres and ranged from 30 to 360 litres(Table 9).

4.4.3 Dry period of dairy goats in Mufindidistrict

The duration of the dry period was measured in months. The overall mean dry period was 2.4 ± 0.2 months and ranged from one to three months. TheSaanen breed exhibited longer dry periods of 2.5 ± 0.9monthswith a range of two to three months whilethe dry period of Toggenburg breed was 2.0 ± 0.6 months and ranged from one to three months. The dry period values did not differ significantly between the two dairy breeds (P> 0.05) (Table 9).

Table 8: Lactation length, milk yield and dry period ofToggenburg and Saanen dairy goat breeds

Variable	Toggenburg breed	Saanen breed	Overall mean
	Mean ± SE	Mean ± SE	Mean± SE
Lactation length in days	104.1 ± 4.3	101.9 ± 3.9	102.8 ± 2.8
Lactation yield in litres	171.6 ± 11.9	171.3 ± 12.6	171.4 ± 8.89
Daily milk yield	1.4 ± 0.1	1.2 ± 0.1	1.3 ± 0.1
Dry period in months	2.0 ± 0.6	2.5 ± 0.9	2.4 ± 0.2

4.4.4 Reproductive performance of dairy goats in Mufindi district

The reproductive performance of dairy goats in Mufindidistrictwas evaluated by determining the age at first kidding, kidding interval and kid mortality rate.

4.4.5 Age at first kidding (AFK), Kidding interval (KI), and Mortality rateof dairy goats in Mufindi district

Overall mean for AFK was 14.1 ± 0.2 months and for individual breeds was 12.7 ± 0.3 and 13.3 ± 0.4 months for Toggenburg and Saanen breeds, respectively. TheAFK for Toggenburg ranged from 13 to 14 months while that of Saanen ranged from 13 to 20 months and the overall AFK for dairy goats in Mufindi district ranged from 12 to 20 months.The overall mean kidding interval was 8.7 ± 0.1 months and ranged from 7 to 10 months both for Toggenburg and Saanen, respectively. The Mean kidding interval is shown inTable 10.The overall mean mortality rate was 42.4 ± 3.4% and ranged from 0 to 100%. Mortality rate forToggenburg kids (45.9 ±4.4) was relatively higher compared to that of Saanen kids (39.6% ± 4.8) (Table 9).

Table 9: Age at first kidding, Kidding Interval and Kid Mortality rate of dairy goat Breeds in Mufindi

Variable	Toggenburg breed	Saanen breed	Overall mean
	Mean ± SE	Mean ± SE	Mean ± SE
Age at first kidding in month	12.7 ± 0.3	13.3 ± 0.4	13.1 ± 0.2
Kidding interval in month	8.7 0 ± 0.13	8.7 ± 0.12	8.7 ± 0.1
Kid mortality rate	45.9 ± 4.4	39.6 ± 4.8	42.4 ± 3.4

4.5 Comparison of Household Income between Dairy Goat and non -Dairy Goat Farmers

T-test was used to compare the income of the households of dairy goat farmers and that of non-dairy goat farmers in the study area.The results show that the mean household income was TZS 866 467.5±505 111.5 for dairy goat farmers. Total income contributed by dairy goat enterprises was 197 897.49± 23 699.3. There was a significant difference ($P<0.05$) in income between dairy goat farmers and non-dairy goat farmers. Mean total household income for non- dairy goat farmers was 662 295±47 794.0.

4.6 Contribution of Dairy Goat to Household Income in MufindiDistrict

Results show that 26.2% of the totalhousehold income was contributed by dairy goat enterprise in Mufindi district (Table 11). Crops were found to contribute 61.5%, otherlivestock contributed 8.3%and small business was found to contribute 4% to income of the household per year as shown inFigure 2.

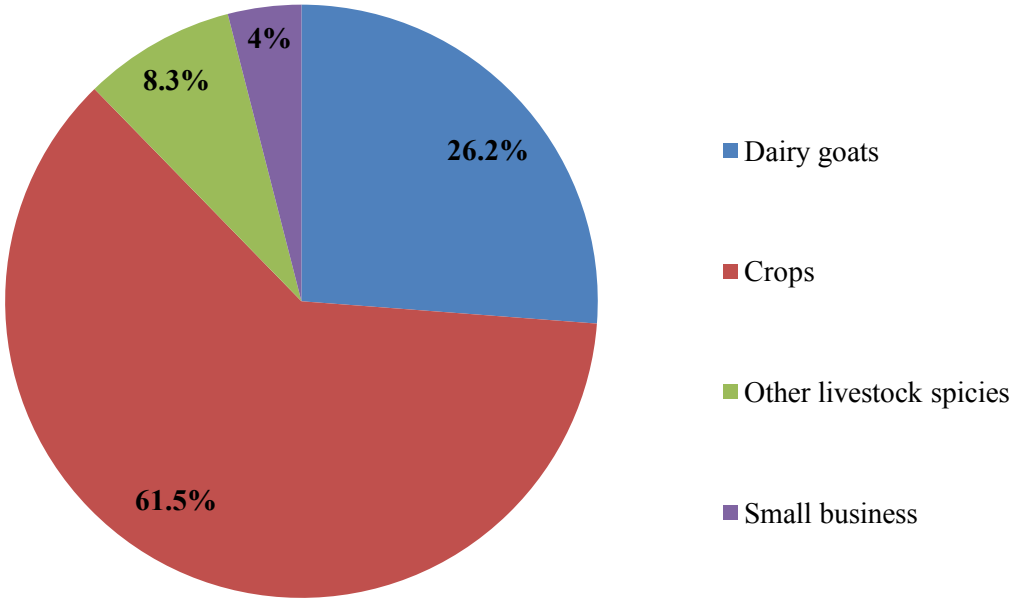

Figure 2: Contribution of dairy goat to household income

Table 10: Comparison of household income between dairy goat and non-dairy goat farmers in MufindiDistrict

Enterprise	Dairy goats farmers	Non-Dairy goats farmers
Dairy goats	197 897.5 (26.2)	_
Crops	465 712.5 (61.5)	518 712.5 (76.6)
Other types of livestock	62637.5(8.3)	107 000 (15.8)
Small business	30 500 (4)	51 250 (7.6)
Total Income	**756 747.5**	**676 962.5**

Numbers in brackets are percentages

4.7 Use of Income from Dairy Goat Enterprises

The results from the survey show that the respondents from the study area spent the income earned from sales of milk and live goats on purchasing land for tree plantation, paying school fees for their children, paying medical bills, house construction/ renovation, purchasing food, purchasing other assets like motorbike, increasing the number of animals in the flock, establishing pasture plots and constructing fish pond. The results show that

they spend more income for paying school fees (26%) and they spend low income for construction fish pond (0.8%) (Table 11).

Table 11: Uses of income from dairy goats enterprises (n= 80)

Uses of income	%
Purchase of food	12.0
Buying land for tree plantation	17.0
Paying school fees	26.0
House construction/ renovation	16.0
Paying medical bills	14.0
Purchasing other assets like motorbike	8.0
Construction of fish pond	0.8
Establishing pasture plots	2.0
Increasing flock size	4.2

4.8Constraints Faced by Dairy GoatFarmers

The constraints facing dairy goat farmers are shown in Table 12.The findings indicate that the major constraints that affected dairy goat keeping in Mufindi district as reported by almost all respondents include lack of supplementary feeds, lack of extension services, higher prices of inputs, livestock diseases like pneumonia, insufficient breeding bucks and plant poisoning. All these constraints were reported by 98.7% of the respondents and only 1.3% of the respondents reported the problem offew project bucks available for breeding.

Table 12: Constraints facing dairy goat keepers in Mufindi district

Constraints	n	%
Lack of concentrate feeds	79	98.7
Lack of extension services	79	98.7
High prices of inputs	79	98.7
Livestock diseases	79	98.7
Insufficient breeding bucks	79	98.7
Plant poisoning	79	98.7
Few project bucks available for breeding	1	1.3

CHAPTER FIVE

5.0 DISCUSSION

5.1Household Characteristics

The household survey revealed that the number of men and women dairy goat farmers were the same.However, for non-dairy goat farmers there were more males than females and this is the reflection of males' dominance in ownership of production resources. Similar observation has been reported by Bitende*et al*. (2001) who observed that in livestock keeping communities there is strong ethnic background biased against women. Education is a critical instrument in effective running of economic activities and it increases the ability to solve problems in a more skillful manner. In the present study, the majority of the respondents, both dairy and non-dairy goat farmers, had primary school education, implying that improving the knowledge of farmers on goat management through training would be easy. The proportion of farmers with primary education in the present study is the same as that reportedby Ogola*et al*. (2010) in Kenya.The age of an individual can affect productivity of dairy goats because the ability to carry out different dairy goat management activities, especially cutting and carrying fodders to feed the animals depends on the age. It is well known that too young people are likely to be less productive. In my study the result shows that only few respondents with less than 35 years old were youths. The active working group with the age of 36- 55 comprisedthe larger proportion of dairy goat farmerscompared to the old people with the age of above 56 years old.

5.2 Reasons for Keeping Dairy Goats in the Study Area

Knowing the reasons for keeping dairy goats is a condition for deriving operational breeding goals (Jaitner*et al*., 2001). The first reason for keeping dairy goats wasgeneration

of income through sales of milk and live animals. Production of milk for domestic consumption, especially for children, elders and sick people was the second reason for keeping dairy goats. Gurmesa*et al*. (2011) reported provision of milk for home consumption as the major reason for keeping goats. A study by Ogola*et al*. (2010) in Kenya and Teufel*et al.* (1998) in Punjab reported similar findings. However, a study conducted by Kosgey*et al*. (2008) ranked income as the most important purpose. In this study, generation of income was mentioned as the first reason. Provision of manure was the third reason and most farmers were using manure to improve soil fertility in their crop farms. All dairy goat farmers that were interviewed accepted that the application of manure improved crop yields in their fields. Similar findings have been reported by Shirima (2005).

5.3Reproduction Performance

5.3.1 Age at first kidding

Generally the observed mean AFK in this study is lower compared to the results reported by Ajala*et al*. (2008). They are also lower than the AFK obtained by Kiango (1996) in Toggenburg and Norwegian goats. The present results are lower to those reported by Safari *et al*. (2008) who found that Norwegian goat and their crosses at Gairo in central Tanzania have AFK of 13.6 months. Moreover, age at first kidding obtained in this study is lower than the recommended AFK in tropical areas which is 13 months under good management. The recommended AFK is the same as that observed by Safari *et al.* (2008) in Norwegian breed in Tanzania which has been shown to have 13.6 months, and this is due to availability of plenty of feed in the study area. Implication of lower AFK is delayedbreeding since puberty is more dependent on body weight than age of the animal. However, delaying breeding for a long time decreases the margin of profit by decreasing lifetime production (Mruttu, 2001).

5.3.2 Kidding interval

Results for kidding interval observed in this study are lower than those found in Nubian goats and their crosses (Webb and Mamabolo, 2005; Kamal and Nikhaila, 2009; Ince, 2010). The values for KI in this study are lower than those observed by Ahuya*et al*. (2009) in Toggenburg breed found in Kenya and Safari *et al*. (2008) in Norwegian breed in Gairo Tanzania**.** This can be contributed by the availability of feed in the study areas as well as good management to dairy goats. The relationship between availability of pasture and KI is that, the high plane of nutrition after kidding shortens the interval from first breeding to conception and, thus, reduces KI. Dadi*et al*. (2008) explained that inadequate nutrition delays the occurrence of postpartum oestrus. The kidding interval could be affected by change in the quality and quantity of forages, which occurs during various seasons of the year, as the natural forages are the main sources of goats' diet. The implication of having lower KI has an effect on animal population turnover rate and total lifetime productivity and this lengthens the KI and lead to negatively impact on profit.

5.3.3Kid mortality

The causes of kid mortality in the study areas were mainly diseases, like pneumonia, helminthiasis, and other factors such as poor conditions of a doe and accidents. Kid mortality rate reported in this study was from birth to weaning. It was difficult to acquire the information after weaning because most of the kids were sold soon after weaning.

According to Kamal and Nikhaila (2009) the high mortality rate might be associated with environmental condition. Mufindi district has a humid environment with prolonged rain seasons in a year.The relationship between humidity, rainfall and mortality isthat humidity environment makes the area to be cool and the animals are prone to pneumonia.Kids born during the wet season exhibit higher mortality rate, than those born in the dry season. In

the study area the mortality rate was caused by pneumonia, attack by predators and snake bites.

Findings by Ershaduzzaman*et al*. (2007) indicated higher kid mortality for female kids than for male kids. The reason behind is that female kids are born with lower birth weight compared to male kids due to the influence of sex on kid weight. According to Girma*et al*. (2011), high mortality rate is influenced by low birth weight andkid mortality decreases as the birth weight of kids increase.

5.4Lactation Performance

5.4.1 Daily and lactation milk yield

The results obtained in this study revealed that Toggenburg dairy goats had relatively higher milk yields compared toSaanengoats.According to Peacock (1996) Toggenburg goats are more tolerant to tropical conditions than Saanen breed. The milkyield observed in this study arevery low compared to the results obtained by Donkin and Boyazoglu (2000) in South Africa on Saanen breed.Low yield of milk production is due to poor feeding of does. Also the level of exotic blood can be another factor, as the blood levels increases from fifty to hundred percent, milk productions also increases.

5.4.2 Lactation length

The present study found that, the mean lactation length of dairy goats in the study area is lower than the mean lactation length of Toggenburg breed reported by Ahuya*et al*. (2009), Eik*et al*. (2008) and Safari *et al*. (2008) in Norwegian goats. The results are lower compared to 135 days (4.5 months) reported by Hassan *et al*.(2010) on Jamunapari goats under farm condition. During the survey in the present study farmers reported that most of

them stop milking the does during the period of feed scarcity. This implies that the length of lactation period is based on the farmer's decision and prevailing conditions.

5.5 Contribution of Dairy Goat Enterprises to Household Income in Mufindi District

The results were based on comparison of the contribution of income from various enterprises to total household income. The values were obtained after subtracting total variable costs from total revenue for each enterprise. The contribution of dairy goats to household income was about 26.2%. The percent contribution of dairy goats to income observed in this study is higher than the findings obtained by Panin and Mahabile (1997) who reported that dairy goat enterprise contribute 15% to total household income.Dairy goat enterprises contributed more than others probably due to the income from dairy goats used in preparation of crop farms and purchase of inputs. This indicates that dairy goats contribute to household income by supporting other enterprises.

5.6Uses of Income from Dairy Goat Enterprise

The most important use of the income obtained from dairy goats in this study was for paying school fees. The proportion observed in the present study is higher compared to that reported by Ogola*et al*. (2010) who reported that 16.7% of income from goat production is spent on school fees. The observation in this study is in agreement with Shirima (2005) who found that more children are sent to school through the use of income from dairy goat enterprise. This is supported by the findings of Nordhagen (2003) who reported that introduction of dairy goats in Tanzania has contributed significantly to the education of children. The percentage of income used for medical bills in this study was found to be in the ranges obtained by Kosgey*et al*. (2008) in Kenya.

The use of the income from dairy goatinclude purchase of food, buying land for tree plantation, construction of fish pond,establishing pasture plots and increasing flock size. Some farmers reported that they use income from dairy goat enterprise for preparation of their crop farms. These observations demonstrate the important role played by dairy goat enterprises in improving crop productivity and, hence, improved household food security and welfare. According to Gihad and El-Bedawy (2000) keeping dairy goats lowers financial risks and overcomes periods of cash shortage.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

The general objective of this research was to determine the production performance and contribution of dairy goats to income of small-scale farmers in MufindiDistrict.

6.1 Conclusions

i) The study found that average milk yield recorded from Toggenburg dairy goats was slightly higher than the milk yield ofSaanen dairy goats.

ii) The study found that dairy goats contributed 26.2% of household incomeand dairy goats play important roles for providing milk, household income and manure.

iii) Diseases, (particularly pneumonia), lack of concentrates feed, few project breeding bucks, higher price of inputs, and inadequate extension services are the major constraints facing small-scale farmers in the study area.

iv) Apart from dairy goat keeping, farmers got income from other sources which include: crop production, keeping other livestock species and doing small business. However, this study confirms that dairy goats keeping contribute positively and significantly to the household income.

6.2 Recommendations

i) Dairy goat productivity needs to be increased through improved management in terms of disease control,breeding and feeding.

ii) The local governments should continue to support and encourage development of dairy goat projects for the reduction of poverty as well as improving nutrition and income.

iii) The local government should provide education to dairy goat farmers, by conducting seminars, for example, on how to formulate supplementary ration by using locally available materials and how to establish pasture plots, and identifying poisonous plants.

iv) Also the government should provide subsidies for veterinary drugs in order to enable dairy goat farmers to purchase the drugs for their animals.

v) And the project should increase the number of breeding bucks in the villages rearing goats.

vi) Extension education on improved goat production is required to enable farmers in the study area to practice proper animal husbandry practices, particularly kid rearing in order to reduce kid mortality rate so as to increase flock size and household income.

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APPENDIX

Appendix 1: Questionnaire on production performance and contribution of dairygoats to income of small-scale farmers in MufindiDistrict

1.0 Demographic information

a) Region…….District……

b) Ward…….Village……

c) Name of Interviewee…….Sex…… Age …… (yrs

d) Position of respondent in the Household i) household head…… ii) Spouse of head…….iii) Son ……..iv) Daughter…… (tick appropriate)

v) Others…… (specify)

e) Level of education of respondent (Tick appropriately):

i) Primary school……ii) Secondary school……..iii) Certificate/Diploma……..iv) University…… v) None…….. Others…… (specify)

f) Members within the household……Male……..Female……..

g) Active members…….. Non active……..

h) Other sources of income (Tick appropriately):

i)Cropfarming only……ii) Crop and livestock……..

iii) Salaries/ employment……..iv) Petty trader…….

i) Type of crops grown; i)…….ii)…….iii)……..iv)……v)……..

j) Land size owned (Tick appropriately):

i) 0.5 – 1acres…….ii) 2 – 3acres ……iii) 4 - 5 acres….. iv) 6 -10acres ……..v) above 10 …….. (specify)

2.0. Information on livestock

a) What type of livestock do you keep? (With priority) Tick appropriately

i) Cattle…….ii) Goats…… iii) sheep…….iv) Pig……v) Poultry (chicken)……

b) What are the reasons for keeping dairy goats? (tick appropriately)

i) milk……..ii) income…….iii) manure …….iv) insurance……v) Prestige……..vi) other …….(specify)

c) When did you start keeping dairy goats? (tick one)

i) 1998 (ii) 1999 (iii) 2001 (iv) 2002 (v) 2003 (vi) 2004 (vii) 2005 (viii) 2006 (ix) 2007 (x) other …… (Specify)

d) How did you obtain your first dairy goats?

(i) From the project ……ii) bought…… iii) Pass –on……iv) other (specify)……..

3.0 Flock structure (tick appropriately)

a) Dairy goat breed kept: (i) Toggenburg (ii) Saanen (iii) Anglonubian (iv) Others …….. specify

b) How many dairy goats do you have?.....

c) Male kids……50%.....75%.....100%.....

d) Female kids……50%.....75%.....100%.....

e) Bucks……50%.....75%.....100%.....

f) Does……50%.....75%.....100%.....

g) Male grower …….50%.....75%.....100%.....

h) Female grower……..50%.....75%.....100%.....

i) Type of House (tick one)**:** i**)** Raised floor…ii) normal ground floor …iii) kraal…….(iv) other……

4.0 Feed management

a) How do you feed your goats? (tick appropriately)

(i) Zero grazing (ii) tethered (iii) Free grazing (iv) other specify…….

b) Do you supplement your animals? Yes /no

c) If yes, what do you supplement? (tick appropriately)

(i) Sunflower seed cake + maize bran (ii) maize bran alone (iii) crop residue

(iv) green fodder (v) hay (vi) Cotton seed cake + maize bran (vii) other specify

……

d) What is the price per month…….

e) How often do goats drink water? (tick appropriately)

(i) once/day (ii) twice a day (iii) once after two days

(iv) Ad- libitum (v) other specify……..

5.0 Health management

a) Do you control external parasites? Yes / no. If yes which method do you use? (tick appropriately)

i) Spraying. Wet seasons: once/week once /two weeks…… once / month….

Dry seasons: once/week…….once /two weeks…… once / month……

ii) Dipping… Wet seasons: once/week… . . . once /two weeks…… once / month…..

Dry seasons: once/week…….once /two weeks…… once / month……

iii) Traditional medicine…….

iv) None ……..

b) What is the cost per treatment……..

c) Do you control internal parasites? Yes/ No… If yes, which method do you use?(tick appropriately)

i) Injection/drenching…Wet seasons: once/three months…….once /six months… once / year……Dry seasons: once/three months…….once /six months… once / year……..

ii) Traditional medicine……..

iii) None……

d) What is the cost per month……?

e) Do you vaccinate your goats? Yes…… No……..

d) If Yes, against which disease (tick appropriately): (i) CCPP (ii) Foot and mouth disease (iii) goat plague (PPR) (iv) not known (v) other specify…….

e) How many times per year do you vaccinate? (tick one) (i)Once……. (ii)Twice……(iii)Not regular (iv) other(specify)……..

f) What is the cost per month…….?

g) What other diseases are prevailing on your flock?(tick appropriately)

h) Foot and mouth (ii) pneumonia (iii) CCPP (iv) Helminths (v) other (specify)……..

i) Do you keep any records? Yes……. No……..

j) If yes, which type of records (tick appropriately): (i) Production records (ii) reproductive records

(iii) Treatment records (iv) Purchase and sales records (v) other (specify)……

5.0 Productive performance

a) What type of birth do you experience on your flock?

i) Single …….,…. ii) Twins…… iii) Triplet…….(iv) single and twins (v) single and triplet (vi) twins and triplet

b) What is the number of does in your flock? ……..

c) How many does give birth to twins in your flock? .....

6.0 Lactation performance

a) What is the average daily milk yield/doe (litre) for each genetic group?

i) 50%.....ii) 75%.....iii) 100%.....(iv) local

(Information below are corresponding with mentioned genetic group above)

b) For how many months do you milk your does after kidding? (tick one) :(i) 3months (ii) 4 months (iii) 5months (iv) 6 months (v) other (specify)……

c) How long does it take from kidding to mating for next kidding …….

d) Do you dry your doe prior to kidding? Yes/ no

e) If, yes for how long (i) 1month (ii) 2months (iii) 3 months (iv) none (v) other specify……

7.0 Reproductive performance

a) How many months does it take from birth to first kidding ……..

b) What is the interval between two successive kiddings? …….…….

c) How many kids were born in your flock for the last 12 months? .....

d) How many kids died before weaning? ….. Male…… Female…… causes of death …

e) How many growers died within last 12 months? ……. Male…….Female……causes of death ……..

f) How many adults died within last 12 months? ……. Male……. Female……causes of death ……

g) Are there any incidences of abortion/ still births on dairy goat? Yes/ no

If yes, what are the causes? ……

h) Where do you get the breeding bucks for mating?(tick appropriately)

i) Hired (ii) Own (iii) Dairy goat project (iv) other (specify)……

i) What criteria do you use for selecting breeding buck? (tick appropriately):

(i) shape/conformation (ii) size (iii) performance (iv) colour (v) other (specify)…….

j) How many times do you serve the does before they conceive? (tick one):

(i) Once (ii) Twice (iii) Thrice (iv) Four times (v) other (specify).

8.0 What cost do you incur on raising dairy goat?

Item	**Price per month**	**Price per year**
Drugs		
Dipping / spraying		
Labour cost		
Feed costs (concentrate)		
Mineral block		
Hiring breeding male		
Construction cost		
Goat house repair cost		
Veterinary/extension services		
Total costs		

9.0 Income obtained from sales of goats

How many goats did you sell for the last 12 months?

	Male		**Female**	
	Number	Price	Number	Price
Kids				
Growers				
Adults				

10.0 Income from milk and manure

	Units	**Price/litre**	**Sales/month**	**Total sales/year**
Number of does milked				
Milk/doe/day				
Amount sold				
Household milk consumed				
Manure				

a) Do you apply manure to your farm? Yes….. No……

11.0 Do you have other activities apart from dairy goat enterprises? Yes/ No.

If yes, list them……. (Information for the last 12 months)

Type of enterprises	**Acres**	**Activity**	**Cost incurred**	**Yield/season/year**	**Sales per @ unit**	**Total sales per year.**
Maize		Land preparation				
		Seeds				
		Weeding				
		Harvesting				
		Transport				
		Total cost				
sunflower		Land preparation				
		Seeds				
		Weeding				
		Harvesting				
		Transport				
		Total cost				
Beans		Land preparation				
		Seeds				
		Weeding				
		Harvesting				
		Transport				
		Total cost				
Sorghum		Land preparation				
		Seeds				
		Weeding				
		Harvesting				
		Transport				
		Total cost				

Pigeon peas		Land preparation				
		Seeds				
		Weeding				
		Harvesting				
		Transport				
		Total cost				
Coffee		Land preparation				
		Seeds				
		Weeding				
		Harvesting				
		Transport				
		Total cost				
Banana		Land preparation				
		Seeds				
		Weeding				
		Harvesting				
		Transport				
		Total cost				
Groundnuts		Land preparation				
		Seeds				
		Weeding				
		Harvesting				
		Transport				
		Total cost				

12.0 Other sales of livestock and their products (for last 12 months)

Type	**Number**	**Costs**		**Yields/month**	**Sales per @ units**	**Total sales per year**
		Feeds	Drugs			
i)Cattle - Milk - Live animal						
ii)Chicken - Eggs - Live chicken						
iii)Pig						
iv) Sheep						
v)Small business						
vi)Wages/salaries						
vii) (other specify)						

13.0 How do you use the income obtained from dairy goats?

i)……..ii)……iii)……iv)……..v)……

14.0 What challenges do you face in keeping dairy goats which needs to be addressed urgently?

1…… ……. …… …….

2…….....

3……..

4…….

5……

15.0 What are your views / comments concerning dairy goat project?

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"Thanks for spending your time and cooperation"