CHARACTERISATION OF THE PRODUCTION AND CONSUMPTION OF MILK IN THE COMMUNAL LIVESTOCK PRODUCTION SECTOR OF THE EASTERN CAPE PROVINCE, SOUTH AFRICA

By

Kaguru Tinashe Kumbirai

(201414115)

A dissertation submitted in fulfilment of the requirements for the degree in

Masters of Science in Agriculture (Animal Science)

Department of Livestock and Pasture Science

Faculty of Science and Agriculture

Private Bag X 1314

Alice 5700

Republic of South Africa

Supervised by

Prof J.F. Mupangwa (Main supervisor)

Prof V. Muchenje (Co supervisor)

Dr J.M. Just (Co supervisor)

January 2016

Abstract

Characterisation of the production and consumption of milk in the communal livestock production sector of the Eastern Cape Province

The study was conducted in Eastern Cape Province, South Africa with the objective of characterising milk production and consumption among the communal households. A pre-tested semi-structured questionnaire was used to collect data through a single visit survey between June 2014 and May 2015. The study was undertaken in five randomly selected communal districts using a multi – stage area probability sampling method. Household sample size was calculated using a statistical methodology through a fixed formula based on a rural population size of 4410000, at a confidence level of 95%. A total of 500 households were selected with a sample size of 20 households in 5 communities within five different communal districts within the province.Half of the total sample size was used to represent the number of non-milk producing households (250) to get a true reflection on consumption profiles for non-producers.

Across the province the average communal family size was between 5-10 members with a monthly income of ZAR1340 per household. On average, pasture land size of the sampled households was 1 ha, with a range of 0.25-1.7 ha. The numbers of animals per species found in the studied province was highest for sheep (310) followed by cattle (227) and goat (87). Average livestock holding per household in the study area was 9.85 TLU (Tropical Livestock Unit). According to the respondents the predominant milking livestock numbers were between 1-3 animals milking per household. In the studied area traditional hand milking of livestock was the major milking practices at 12% in goats, 15% in sheep and 45% in cattle milk production. Consumption was the predominant reason for milk production recorded at 27% across the province. Milk production was 43% most preferred in cattle followed by 32% in

goat and least at 29% in sheep across the province. In general from the study it was noted that the majority (38%) of the respondents across the province indicated 0-5mins as the time it took to milk most milk producing livestock. The majority of the milking practices was done (37%) predominantly once a day, followed by 2% twice daily across the province. The daily milk production was on average (0.45±1.07) 2-5 litre in cattle, (4.86±0.814) 0-1litre in goats and (2.62±0.42) 0-1 litre sheep per producing house hold with in the province

The monthly raw milk consumption in the province was (2.20± 1.42) 2-5 litres of cattle milk, (4.78±0.79) 2-5 litres of goat milk and (4.98±0.69) 2-5 litres of sheep milk per consuming household. Pasteurised milk was found to be the most regularly consumed and preferred milk product at 4.78±0.84 litres per consuming household each month across the province. Other monthly provincial cattle milk products consumed were 0.5 kg-1 kg of powdered milk and 2-5 litres of sour milk. Household composition and consumer preference were significantly ($P<0.05$) the primary reasons for the consumption of milk and milk products. The standard price ranges for milk and milk products were R8.50-R9.50 per litre of fresh milk, R7.50-R8.50 per litre of sour milk, R33.00-R35 per kg of powdered milk and R11.50-R12.50 per litre of pasteurised milk. In general, training of selected few household heads as extension staff and para vet practices is of paramount importance so as to improve animal health together with milk production techniques. In conclusion, there was low milk production and consumption of milk and milk products in the communal households and livestock sector. The results from the study conclude there was no difference in milk production but a difference in the consumption of milk and milk products across the communal livestock production of the Eastern Cape Province, South Africa.

Keywords: Milk producing livestock, Milk yield, milk preference, consumption frequency, fresh milk.

Declaration

I, the undersigned, declare that this dissertation has not been submitted to any university, and that it is my original work conducted under the supervision of Professor J.F. Mupangwa and Professor V. Muchenje. All assistance towards the production of this piece of work has been Acknowledged in the Acknowledgements and Reference sections.

…….

T. K. KAGURU

I hereby certify that this statement is correct

……..

(Main Supervisor)

Prof J. F. MUPANGWA

…….. ……

(Co-Supervisor) (Co-Supervisor)

Prof V. MUCHENJE Dr J.M. JUST

Dedication

“Honour your father and mother, that your days may be long upon the land which the LORD your GOD is giving you, (Exodus 20; 12)”. I dedicate this project to my late mother who always had faith and unconditional support towards me, may her soul rest in peace. To now my parent’s (Mr and Mrs Kaguru) words cannot explain how grateful i am for keeping me in line, looking out for me and being my unshaken strengthen may the LORD GOD bless you with good health, long life and wisdom. Last but not list i also dedicate this project to my beloved sister and her family. To my nephew Dylan and niece Kyla,i have set the pace, your responsibility is to raise the standard.

Acknowledgements

This project would have never been a success if it was not for the consistent drive given to me by my main project supervisor Prof J.F. Mupangwa (Department of Livestock and Pasture), Prof V. Muchenje (Research Professor Department of Livestock and Pasture, University of Fort Hare) my project co-supervisor. I would also like to thank my external supervisor Dr. J. Rust (Research Officer at Dhone Research Station) and Mr. M. Mkhungela (Technician at Dhone Research Station) for assisting in carrying out the survey on ground. I would like to also extent my thanks to the National Research Foundation (NRF) for sponsoring my study for my up keep. Without this funding my dreams of furthering my studies would be still dreams. In addition, I sincerely thank my family for the dying support by sponsoring me and persistent encouragement though out the project. Not forgetting my friends, extended relative colleges and fellow classmates for their support. Also taking into mind my project mentor Ms. R. Kaguru for enlightening endless possibilities, paving the path, encouraging and making me have the faith in myself and the project's success. Last but not list and ever first i thank the God Almighty for all the wonderful works he has manifested and showered in my life for if it were not for that i would never be where i am now.

Table of Contents

List of Tables

List of Figures

List of Abbreviations/Acronyms

ANOVA	Analysis of Variance
CSA	Central Statistical Authority
HH	Household Head
PRSP	Poverty Reduction Strategic Paper
r	Correlation coefficient
RSA	Republic of South Africa
SAS	Statistical Analysis System
SE	Standard Error
SPSS	Statistical Package for Social Sciences

CHAPTER 1: GENERAL INTRODUCTION

1.1 Background

Milk is one of the most essential foods to humans and contains nearly all essential nutrients. It is often regarded as being nature's most complete food (Oni *et al*., 2012). This is because it is an excellent source of proteins, vitamins, minerals and essential amino acids (Mutukumira, 1996; Maphekula *et al*., 2009). In addition to the major constituents, milk contains a large amount of lactose sugar, phosphate, peptone and nitrogen based enzymes (Njarui *et al*., 2010). Those nutrients should be consumed especially by adults, females, children and young people of all ages each day (Oni and Fashoghon, 2012). Recognized health benefits of the macro- and micro-nutrients of milk entails improved bone constitution and decreased protein-deficiency malnutrition (Kalkwarf *et al*., 2003).

In South Africa there is a rising demand for milk products (Dugmore *et al*., 2004; Maphekula *et al*., 2009). Improvement of the smallholder dairy production has the potential to increase food security and income for resource-poor farmers (Ngongoni *et al*., 2007). In the smallholder sector, milk is largely obtained from indigenous cattle and their crosses with exotic beef breeds (Mapiye *et al*., 2007). These cattle breeds also have numerous functions in the smallholder areas which include meat, cash through sales, draught power, manure production, social security and ceremonies (Dugmore *et al*., 2004; Maphekula *et al*., 2009). Smallholder farmers do dairy farming as a source of food and income, and it also provides with by-products like manure to support crop production (Banga *et al.,* 1998; Bereda *et al*., 2013).

However, there are no records for milk production methods, the amount of milk produced and consumption patterns in the smallholder sector. Its contribution to the household and national economy is also largely unknown. To design sustainable improvement programmes, it is

crucial to evaluate the current production levels and milk consumption patterns. Therefore it is the aim of this study to highlight and create base line information of consumption and production patterns of milk in the Eastern Cape smallholder sector.

1.2 Problem Statement

The Eastern Cape Province is considered to have the largest livestock population of all provinces in South Africa., besides this dairy production in the province is low (Maphekula *et al*., 2009). Despite these high livestock numbers, this province is ranked as the poorest in South Africa. The highest livestock's population in the Eastern Cape Province are recorded as being sheep followed by cattle, meaning dairy activity is vastly present in these communal areas. Milk and dairy products play a key role in healthy human nutrition and development throughout life (Kalkwarf *et al.*, 2003) and especially in childhood (Oni and Fashoghon, 2012). It should be used by the communal farmers in this province as a cornerstone to thrive to increase dairy production for food security.

The unavailability of documented information on milk production and consumption in communal areas make it difficult to use dairy production as a tool to alleviate poverty, diversify individual household incomes and increase human nutrition in this province. The lack of information on milk production trends and consumption dynamics makes it difficult for agricultural development institutions to develop strategies (Grobler *et al*., 2008). The underlying forces driving these trends are set to continue, and the potential for increased demand for livestock products remains vast in large parts of the development of this industry (Dugmore *et al*., 2004).Therefore this project aimed to map out the current situation of these milk production and consumption trends in the communal areas of the Eastern Cape Province.

This study will provide baseline data and source of information for development programmes basically implemented for food, nutrition security and poverty reductionthat can be used at national development level.

1.3 Justification

Livestock production provides 50 percent of the value of agricultural output globally and one-third of the value in developing countries (Nouman *et al*., 2014). According to Smith *et al*. (2013), livestock production is an indispensable part of the solution to global food security; a reasonable amount of the world's food supply comes from systems of which livestock are an important part. Livestock has the biggest land use activity globally, and is expected to double by 2020 with an annual increase of 3.2 percent in milk production (Nouman *et al*, 2014). In many African countries as well as in South Africa, many rural households earn a living from livestock farming and consider keeping livestock as a store of wealth (Mandleni and Anim, 2012). However, livestock farming and especially dairy production has great potential to alleviate household food insecurity and poverty in communal areas of the world, including South Africa (Musemwa *et al*., 2008). Currently, there is little information available on milk production, milk consumption and processing in communal production systems of Eastern Cape (Maphekula *et al*., 2009). Few studies have concentrated on the dynamics of production and consumption of milk at communal household level. The reasons for this are not known and information on the dairy production systems in these sectors is scanty **(**Grobler *et al*., 2008). This information could be useful in designing strategies that would help to improve milk production in communal farming systems. This study intends to investigate these trends and establish dynamics for milk production and consumption in the Eastern Cape Province and to create a better understanding of the South African communal dairy farming situation.

1.4 Objectives

To establish the milk production and consumption patterns on a household level in the communal livestock production system of the Eastern Cape. The specific objectives of the study were:

1. To characterise the level and dynamics of milk production among the communal livestock farmers in the Eastern Cape Province, South Africa.

2. To characterise the consumption patterns, preferences and purchasing behaviour of milk and milk products at household level in the communal areas of the Eastern Cape Province, South Africa.

1.5 Hypotheses

The null hypotheses that were tested were:

1. There is no difference in milk production among the communal livestock farmers in the Eastern Cape Province.

2. There is no difference in the consumption patterns, preferences and purchasing behaviour of milk and milk products at household level in the communal areas of the Eastern Cape Province.

1.6 References

Banga, C. 1998. Dairy herd improvement services in Zimbabwe: past, present, future. In *proceedings of International Workshop on Animal Recording for Smallholders in Developing Countries.* Anad, India. Pp 173-179.

Bereda, A., Yilma, Z., and Nurfeta, A. 2013. Handling , processing and utilisation of milk and milk products in Ezha district of the Gurage zone. Southern Ethiopia. *Wudpecker Journal of Agricultural Research,* **1(11):** 459.

Dugmore, T.J., Oosthuizen, P. A, and Toit, J.F. 2004. Strategies for dairy production in rural areas. *South African Journal of Animal Science,* **5:**45–47.

Grobler, S.M., Scholtz, M.M., Bester, J., Mamabolo, J.M. & Ramsay, K.A. 2008. Dairy production systems in the emerging and communal sectors of South Africa: Results from a structured survey. *Applied Animal Husbandry and Rural Development*. **1:** 25-30.

Kalkwarf, H. J., J. C. Khoury, and B. P. Lanphear. 2003. Milk intake during childhood and adolescence, adult bone density, and osteoporotic fractures in U.S. women. *American Journal of Clinical Nutrition,* **77:** 257–265.

Mandleni, B. and Anim, F.D.K. 2012. Climate change and adaptation of small-scale cattle and sheep farmers. *African Journal of Agricultural Research*, **7 (17):** 2639- 2646.

Mapekula, M., Chimonyo, M., Mapiye, C., and Dzama, K., 2009. Milk production and calf rearing practices in the smallholder areas in the Eastern Cape Province of South Africa. *Tropical Animal Health and Production*, **41:**1475–1485.

Mapekula, M., Chimonyo, M., Mapiye, C., & Dzama, K. 2011. Fatty acid, amino acid and mineral composition of milk from Nguni and local crossbred cows in South Africa. *Journal of Food Composition and Analysis,* **24 (4):**529-536.

Mapiye, C. Chimonyo, M., Muchenje, V., Dzama, K., Munyaradzi, C., and Raats, J.G., 2007. Potential for value-addition of Nguni cattle products in the communal areas of South Africa : a review. *African Journal of Agricultural Research*, **2:**488–495.

Musemwa, L., Mushunje, A., Chimonyo, M., Fraser, G., Mapiye, C. and Muchenje, V. 2008. Nguni cattle marketing constraints and opportunities in the communal area of South Africa. *African Journal of Agricultural Research*, **3(4)**:239-245

Mutukumira, A. N., 1996. Investigation of some prospects for the development of starter culture for industrial production of traditional fermented milk in Zimbabwe. PhD Thesis. Department of Food Science. Agriculture University of Norway, Norway

Ngongoni, N.T., Mapiye, C., Mwale, M., and Mupeta, B. 2006. Factors affecting milk production in the smallholder dairy sector of Zimbabwe. *Livestock Research for Rural Development*, **18 (5).**

Nouman, W., Basra, S., Siddiqui, M., Yasmeen, A., Gull, T. and Alcayde, M.A.C. 2014. Pontential of Moringa Oleifera L. as livestock fodder crop: a review. *Turkish Journal of Agriculture and Forestry*, **38 (1)**:1-14.

Oni, O. and Fashogbon, A.E. 2012. Rural household consumption of milk and products in nigeria. *Journal of Agricultural and Biological Science*, **7 (12):**1062–1069.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Milk forms an essential part of the outputs in any communal livestock production system (Banga, 1998; Diwyanto, 1998). A number of research findings over the past years are contributing significantly to our understanding of the current situation of livelihoods in communal areas of South Africa (Scholtz, 2000; Dovie *et al*., 2006). These studies confirm that the bulk of communal households are reliant on outputs from livestock production (Scholtz, 2000). In general, the total number of cattle, sheep and goats in South Africa was 42.5 million in 2003. The overall number of cattle in South Africa is about 13.5 million, comprising of numerous beef and dairy cattle breeds (National Department of Agriculture, 2003). Most milk produced by farmers is not entering the commercial market, but some are used at household level or sold in the immediate vicinity *(*Meissner *et al.,* 2013). Over 65% of livestock is owned by communal farmers (National Department of Agriculture, 2004). According to Meissner *et al.* (2013), majority of the milk producing communal households with herd sizes less than 15 milking cows tends to produce an average of 10 litres of milk per day. If one takes that into account milk entering the formal market comes from only about 1250 herds which equates to 440 000 cows in milk. Although the Eastern Cape Province general has the largest number of livestock (Figure 2.1), the productivity of the livestock is generally low (Mapekula *et al*., 2009).Mutukumira *et al*., (1996) reported low milk yield produced by cows in communal areas.

The communal grazing practises are to a large degree responsible for the low productivity and complex sustainability of communal farming systems (Webb *et al.*, 2003). Nutrition, comfort and genetics play a major role in a cow's milk production (Mapekula *et al*., 2009). Poor quality roughage is the main feed resource for livestock in communal production system (Dovie *et al*., 2006). Furthermore, seasonal supplementation is necessary to promote better utilisation of the

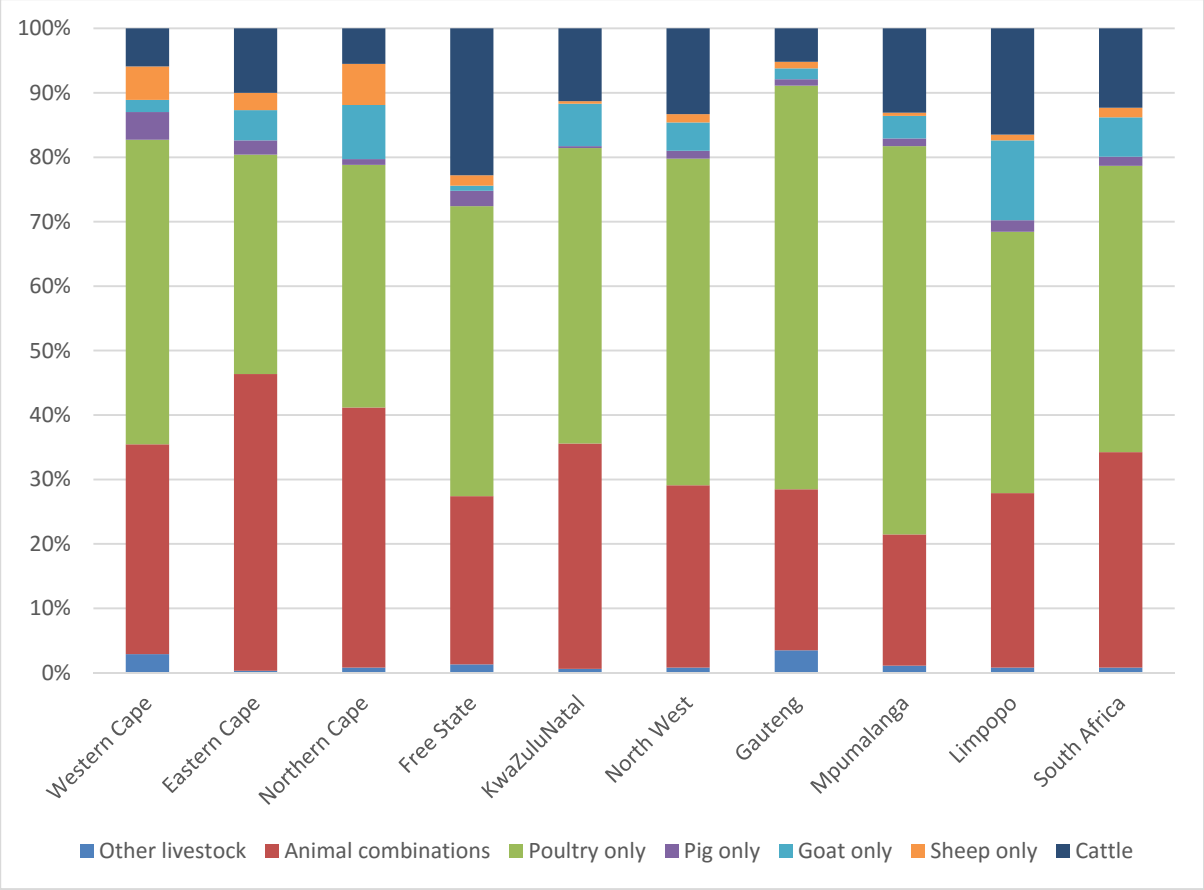

Figure 2.1 Livestock percentages per province in South Africa

Source: Statistics South Africa. (2011)

existing poor quality roughage taking into account livestock age group or reproductive stage for best supplementation response (Pedersen and Madsen, 2000). Besides these large livestock numbers there is less information and few comprehensive research data on the trends of production and consumption patterns of milk occurring in the communal areas of Eastern Cape as a whole.

Milk production potential of livestock and utilisation by communal farmers is still however, unclear despite the fact that milk is one of the main motives for cattle rearing by communal farmers (Tapson and Rose, 1984).The rearing of cattle used for milk accounted only for 10.2% of the total use although there is a observed need for milk production in the rural development areas of Southern Africa (Grobbler *et al*., 2008). Raw milk sales in 2014 were on average 250 000 000 litres per month, which means that the average yield per cow per day was 250 000 000 litres/440 000 cows/30 days = 18.9 litres (Meissner *et al*., 2013). In the existing communal milk production system, these farmers mostly utilise beef cows or non- descript dairy/beef crosses for milk production due to the fact that nothing else is available (Mapekula *et al*., 2009; Amaresekera *et al*., 1998). The improvement in livestock milk yield would have the benefit of improving the nutrition level in a community (Bembridge, 1984). Goat milk production and goat milk consumption can play a pivotal role in this regard as well (Webb and Mamabolo, 2004). The potential of goats to substitute cows as primary milk producers should also be investigated (Bembridge, 1984). Levels of household dairy consumption are significantly correlated with the personal attributes (Oni and Fashogbon, 2012). Research by Nelson. (1970); Trung *et al.* (2012) pointed to several characteristics of the health belief model as well as overall nutrition awareness which can predict buying and consumption intention intended for milk and yogurt products in urban areas.

Taste and preferences are more important determinants of dairy consumption than household income (Oni and Fashogbon, 2012). Shopping preferences of packaged fluid milk is affected mainly by consumers who read contents and are concerned about food safety (Uzunoz and Akeay, 2012). Dairy product's share of household food budget increases with household income (Oni and Fashogbon, 2012). With the exception for ghee and cards, united percentage increase in own – prices yield percentage in budget shares as for instances, 1% increases in the prices of milk will result in 7% increase in the budget share of milk (Heinrichs *et al*., 1997). Little data is available on the characteristics of milk production and consumption in rural areas (Oni and Fashogbon, 2012). The implementation of a project of this nature will give a clearer understanding and will form the basis of information on which future dairy development and improvement projection can be developed.

2.2 Characteristics of cattle production in communal production systems

Communal production systems are characterized by grazing lands that are shared among the community members (Trail, 1981). In these grazing lands, all animals are entitled to graze irrespective of the animal type and without considering the stocking rate (Scholtz, 2000; Bester *et al*., 2003). Livestock production and crop production are the farming systems practiced by communal farmers (Hanyani-Mlambo *et al*., 1998). Unpredictable rainfall and high occurrence of droughts in the majority of the communal areas of South Africa, and particularly in the Eastern Cape Province, influence most of the resource-poor farmers to rely on livestock production for their up keep and livelihoods (Trail, 1981). Hence, livestock farming holds a potential solution to alleviate communal household food anxiety and scarceness in South African communal areas (Coetzee *et al*., 2004)

Farming systems in South Africa remain limited by the water supply and range between highly sophisticated intensive farming (dairy being a prime example) and extensive ranching or

traditional livestock management on communal grazing, depending mainly on rangeland feed resources determined by the availability of rainfall and underground water (Vuuren, 2006; Dugmore *et al*., 2004). South Africa comprises twofold agricultural economy which is characterized by a firm commercial sector and a mostly subsistence-orientated sector in the rural areas (Trail, 1981). Livestock is spread throughout the country, but the farming areas are frequently in the Northern Cape, Free State, Eastern Cape and Mpumalanga Provinces, where the population is less urbanised (Findlay, 2006; Mapiye *et al*., 2007).

2.3 Current state of communal cattle productions system in South Africa

Roughly 80% of agricultural land which non-arable in South Africa is suitable for livestock farming (Trail, 1981). The communal lands cover approximately 17% of the overall farming area, 17% of the total sheep population, 52% of the cattle, 72% of the goats (Vuuren, 2006). Although the Eastern Cape Province is known to have the greatest population of livestock with sheep amounting to 2.7%, goats 4.7% and cattle 10%, productivity is generally low .Over 65% of livestock is owned by communal farmers (Trail, 1981). The smallholder sector includes the communal production system, resettlement and small-scale commercial farming areas (Bembridge, 1984). In communal production systems, farmers share the same grazing land, but each individual farmer manages his/her animals using his/her own experience (Trail, 1981).

Cattle production in the communal production systems is complex (Vuuren, 2006). This is the result of multiple ownership of the grazing land by both livestock farmers and community members with no livestock and grazing of different types of livestock species on the same grazing land (Trail, 1981). In communal production systems, livestock is kept for various reasons (Trail, 1981). These include draught power, wealth, manure, milk, as a means of investment, savings, sociocultural roles (*lobola*) and meat (Devendra, 2001). Notwithstanding

the lactose intolerance factor, milk and especially processed milk is seen as one of the major components of a dairy diet for consumers (Vuuren, 2006; Muehlhoff *et al*., 2013).

2.4 Milk production in communal areas

Commercial dairy breeds are notoriously difficult to maintain and require high dietary inputs for production and reproductive performance (Pandey and Voskuil, 2011). Both milk yield and composition need to be evaluated under communal farming systems. In South Africa it is pertinent to identify constraints to milk production in communal areas, and, consequently, to develop systems to improve the availability of milk for the communal farmers (Dugmore *et al*., 2004). Cows are usually milked once per day in the morning and there is also no supplementary feeding in place (Bailey, 2005). This indicates that, although cow milk is an important produce required by farmers from the cows, there are no efforts done by farmers to increase milk yield by cows (Vuuren, 2006).

According to the National Department of Agriculture (2004) in 2002, the Western Cape contributed the highest commercial milk production at 24 % followed by the Eastern Cape 20 %, KwaZulu-Natal at17 %, North West at 11 %, Free State at 14 %, Mpumalaga at 9 % and the last four provinces contributing 5 %. At hand there are approximately 5 200 commercial cattle milk producers in South Africa (Dugmore *et al*., 2004). There is a need for communal livestock farmers to get involved in milk production to meet the milk demand, especially for the rural areas situated far from the formal milk distribution centres (Devendra, 2001). Milk production in communal areas is also in support of the policies of the National Department of Agriculture of wealth creation in rural areas (Vuuren, 2006).

2.5 Milk composition

According to Ngongoni *et al*. (2006) the composition content of milk fluctuates and at any given moment can have a wide variation. These contents are reported by Muchenje, *et al* (2007) to be fat, protein, lactose and minerals, which all brings about different composition qualities in milk composition. This author also stated that quality milk composition relies on the type of milk producing livestock but also between the livestock breeds (Table 2.1) and between the individual animal within that specific breed. Furthermore, Vuuren (2006) stated that composition content depending on climate and feeding could result in change from day to day. However, milk content can also vary from the first and last lactation. On the other hand Pandey and Voskuil (2011) reported that the variation in milk composition is due to water being the main constitute and not climate, feeding, time or day of milking.

Milk proteins are responsible for calf growth, growth hormone and enzyme production that are necessary for digestion, respiration and other physiological functions (Chilliard *et al*., 2003). Fatty acids also form part of milk composition and are responsible for fat formation to protect the calf against cold environments (Heinrichs *et al*., 1997). Milk has plenty of energy sources for the calf which is in the form of lactose (Gurmessa and Melaku, 2012). Lactose provides energy to the newly born calf until a calf can feed on grass. Milk is also a source of minerals (Ozrenk and Inci, 2008). There are macro (phosphorus, potassium, magnesium, calcium, and iron) and micro minerals (cobalt, chlorine and zinc) (Chilliard *et al*., 2003). Vitamins are also

Table 2. 1 Mean composition (%) of milk from domesticated ruminants

Composition			
	Cow	Goat	Sheep
Fat	3.5	4.5	7.4
Protein	2.9	2.9	5.5
Carbohydrates	4.9	4.1	4.8
Calcium	0.12	0.13	0.2
Phosphorus	0.10	0.11	0.16

Source: Chilliard *et al*., (2003)

found in milk which form part of calf's feed (Heinrichs *et al*., 1997). These are fat soluble and water soluble vitamins which have different functions in the body of a calf (Walshe, 2002). Since communal cows' milk is also consumed by humans in communal areas, it is important to determine its nutrient status (Pandey and Voskuil, 2011). However, there is currently little data available on milk off take from cattle in the communal farms of the Eastern Cape (Trail, 1981).

Majority of the countries dairy production industries state a total of 5 – 10 % calories in most milk and milk products as the standard in a humans daily diet (Ozrenk and Inci, 2008). Milk is digested easily and tasteful, it has a high source of protein with several important minerals and vitamins (Mapiye *et al*., 2007). It is a natural outstanding major source in human nutrition with essential amino acids (FAO, 2013) and essential elements namely calcium and phosphorus (MacDonald *et al*., 2005). A report from FAO, (2013) highlighted milk as the most important source for calcium which should be included in all human diets at all stages of life. (Melnik *et al*., 2013). The nutritional importance of milk has made it an important inclusion in the diet of old age people and growing children (Mutukumira, 1996).

Ozrenk and Inci (2008) reported the required amount of milk per person per day to be between 0.75 – 1 liter. There are approximately between 8,000 to 10,000 different milk products accessible worldwide (Melnik *et al*., 2013) making it an exceptionally wide spread raw product (Pandey *et al*., 2011). The solid content of milk are directly associated with the economic value of milk (Muchenje *et al* 2007, 2008). Studies from Ngongoni *et al*., (2006) report the economic and nutrition value of milk increases as solids content of milk increase.

2.6 Composition of milk

Milk quality describes the percentage of nutrients and somatic cell counts in milk. These nutrients include protein, indispensable amino acids, vitamins, minerals, milk fat, lactose and fatty acids (Chilliard *et al*., 2003). Milk from Holstein-Friesian cows contains approximately 4.9% lactose, 3.4% total fat and 3.3% protein (Figure 2.2) (Gurmessa and Melaku, 2012). The knowledge on milk quality is important because milk is the basis for nutrients in calf feeding prior to feeding on forage material (Lentes *et al*., 2010). The calf needs well-balanced nutrients in order to survive in the new environment, which is very different from that of the uterus (Chinogaramombe *et al*., 2008). From the milk a calf get immunity from the colostrum that help the calf to resist against infections and diseases (MacDonald *et al*., 2005).

The somatic cell counts remain an indirect and universal indicator of udder infection (Ouédraogo *et al*., 2008). If a cow's milk has more than the normal standard number of somatic cell counts, that milk is regarded as being unsuitable for human consumption (Chilliard *et al*., 2003). Individual cow somatic cell counts should be less than 100 000 SCC (Ouédraogo *et al*., 2008). Milk with somatic cell count above 400.000/ml and isolated pathogenic microorganisms in it is considered to be mastitis milk (Ouédraogo *et al*., 2008). Although communal farmers milk there cows for human consumption, there somatic cell count of the milk is largely unknown (Vuuren, 2006). There are various factors affecting milk production and stage of lactation, parity, season of calving, lactation, geographic region, breed and management factors (frequency of milking, handling, nutrition) are among the these factors (Gurmessa and Melaku, 2012). It is important that milk produced by communal cows meets the human's nutrient requirements.

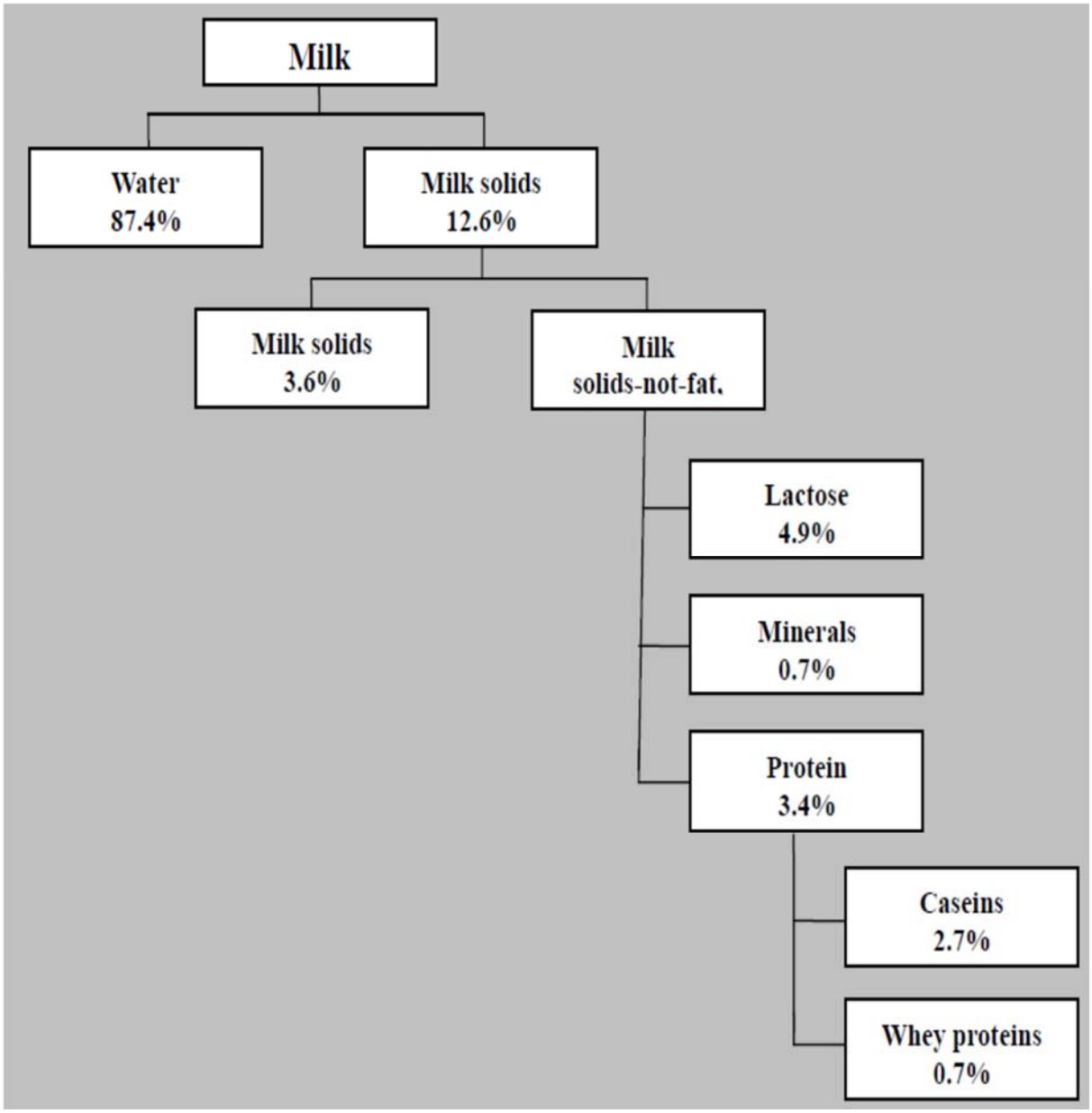

Figure 2. 2 Nutritional composition of milk

Source: Chandan, (2006).

2.6.1 Water

The unique nutritional balance of milk makes its nutritional value greater than its own individual nutrients (Schlink *et al*., 2010). The water content in milk is approximately 90% reflecting its balance. Water is one of the major nutrient required in large amount within all livestock and milk does supply a great amount of water (Beede *et al*., 2006). The water levels in milk are responsible for control in amount of which mammary gland secretory cells produce synthesized lactose (Schlink *et al*., 2010). Blood delivers water in the mammary gland which is then deposited into the milk. If drinking water is unavailable or limited, this shortage of water has a rapid declining effect in milk production. (Linn and Raeth-knight, 2001; Beede *et al*., 2006). According to Beede *et al*. (2006), this sharp decline in milk production is the main reason why there should always be plentiful supply and free access of drinking water.

2.6.2 Carbohydrates

Lactose is the major carbohydrate sugar in milk and is sweet to taste (Chilliard *et al*., 2003). Milk lactose concentration is made up of an average of approximately 5% (4.8-5.2%) (Heinrichs *et al*., 1997) and low concentrations of galactose (12 mg/100g) and glucose (14 mg/100g) (Chilliard *et al*., 2003). However, not all contain proportions of milk lactate are similar in milk products (Oni and Fashogbon, 2012) it alters during processing like fermentation resulting in low concentrations in products like cheese and yogurt (Bereda *et al*., 2013). The concentration of lactose in milk is not easily altered opposed to fat concentration in milk but it is generally similar in all milk breeds (Leng, 1990). In a study conducted by Pandey and Voskuil (2011) a significant portion of the human population, showed incapability to digest lactose in the digestive tract due to insufficiency in enzyme lactase. He went on to state low activity of lactase in consumers causes intolerance symptoms to large amounts of lactose and results in moderate consumption of milk amounts without discomfort (Kiplagat *et al*., 2012).

However, Oni and Fashogbon (2012) reported that pre-treated milk with lactase reduces lactose intolerance problems.

2.6.3 Protein

Protein concentration in milk is approximately between 3.0 to 4.0 grams per litre (Bobe *et al.*,2008). Bobe *et al*., (2008) classifies milk protein as caseins (80%) and whey proteins (20%) as the two major groups. It is proportional to the amount of fat in milk and varies in percentage within breed of cow (MacDonald *et al*., 2005). Chilliard *et al*. (2003) reported a positive correlation between protein and fat in milk. He also states that protein is directly related to cheese yield with particular emphasis on casein protein content of milk (Chilliard *et al*., 2003). The protein in milk is occasionally responsible for body allergic reactions in consumers particularly young children (Mutukumira, 1996). In cases of reactions goat milk is usually used as a substitute (Vuuren, 2006; Chilliard *et al*., 2003)

2.6.4 Fat

Milk contains approximately 3.5% to 6.0% fat but varies with livestock breed and feeding practices (Looper, 2012). Linkages in glycerol and fatty acids form triglycerides which is the basic form most milk fats are found (Chilliard *et al*., 2003). The melting point of milk fat is determined by the different lengths and proportions of fatty acids (Looper, 2012). Milk fat is visible in water in the form of small suspended globules and remains emulsion as long as the milk structure is intact (Darshan *et al*., 1989).

2.6.5 Minerals and vitamins

Majority of the minerals necessary for growth during earlier stage of life are present in milk (Jensen, 1995). Calcium and phosphorus are found in the highest concentrations in milk (Table 2.2) and the most essential (Pandey and Voskuil, 2011). The association of casein in milk with calcium and phosphorus makes the digestibility of these minerals higher than usual (Bobe *et*

al., 2008). Milk provides a good source of calcium which is responsible for bone growth in infants and adult bone integrity maintenance. It also has a low level of iron that is essential for limiting bacterial growth in milk. (Enb *et al.*, 2009; Pandey and Voskuil, 2011).

2.7 Factors affecting milk composition

2.7.1 Nutritional factors

2.7.1.1 Level of feeding

Several factors influence the composition and constituents of milk. The main components of milk are water, protein, lactose, fat and minerals (McDonald *et al*., 2002; Chilliard *et al*., 2003). Increased feed consumption in late stages of pregnancy increases milk production and the yields of fat and protein (Muchenje *et al*., 2007). Studies has shown that for each 30 kg rise in live weight at calving, milk yield rises by 122 kg, fat yield by 8 kg and protein yield by 4 kg throughout the first 20 weeks of lactation (Pandey and Voskuil, 2011) . Level of feed consumption is affected by stage of lactation which in turn has an effect on the milk composition (Bobe *et al*., 2008).

If feed consumption is increased throughout early lactation, milk production will increase with consequent increase in protein and fat yields (Huber, 1996). As animal feed level intake increases, the percentage of milk fat will decline, but protein percentage will increase slightly (McDonald *et al*., 2002).

2.7.1.2 Diet quality

The effects of type of pasture diet on milk yield and composition. The use of species associated with improved Increase in pasture species quality results in raise in milk, protein and fat levels (Lentes *et al*., 2010). In a trail by Luginbuhl *et al*., 2002 he discribes the effect of forage specie on milk composition. (Table 2.3.). He reported that an increase in milk yield will result in increased fat yields. However, Pandey and Voskuil (2011) reported that species differences in

livestock diets are largely caused by inherent differences in intake which is the resulting cause of varied milk composition .

2.7.1.3 Concentrates and Fibre ratio

According to Lentes *et al*. (2010) providing supplementary ratio of cereal grain feed to milk producing livestock will results in improved milk, protein and fat yields. Furthermore the author also stated that variations in concentrations and fibre in feed results in percentage of milk fat decreasing .Pandey and Voskuil (2011) also reported that increases in protein percentage in concentrate feeds results in an increase in milk protein yield Feeding lupines in concentrates causes a raise in milk protein and milk fat yields. Lupins if fed as a supplement unlike other cereal grains has no decreasing effect to fat percentages (McDonald *et al*., 2011). Protein supplements can also be used in concentrates as a source of energy rather than a supply of protein. Lentes *et al*. (2010) reported improvement in milk composition can be through consumption of energy sources like protein supplements.

Processing degree of concentrates when fed to livestock has an effect on fat percentage in the milk. According to a report done by Petit (2010), fat and fiber percentages can be reduced as a result of over processig. He went on further to state that during the processing of grain the outer shell has cracked to permit sufficient digestion. Fibre is essential in total diet feed to livestock. If it is not fed in adequate quantities livestock milk fat percentage decreases and protein percentage remains constant (Pandey and Voskuil, 2011).

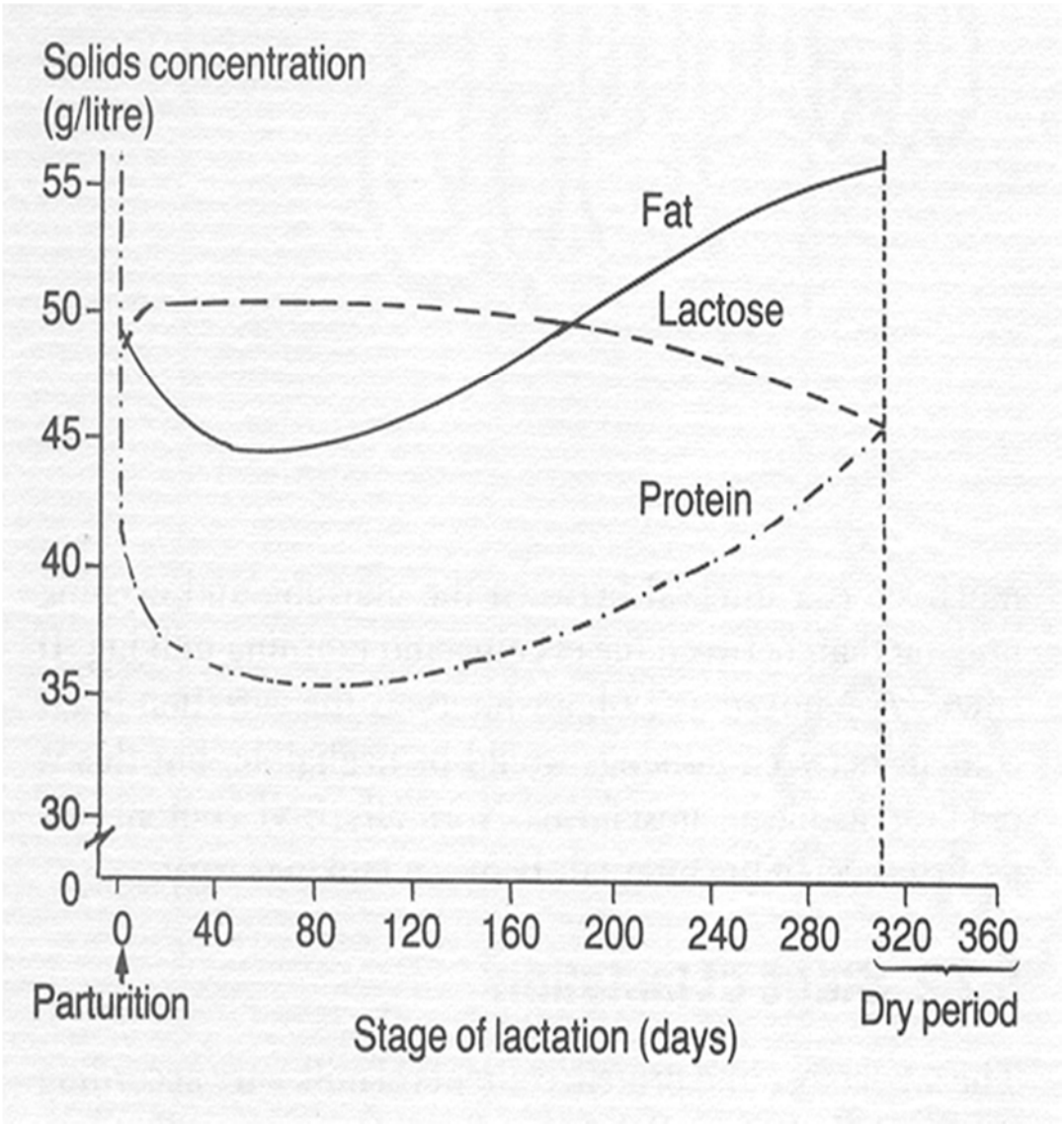

Figure 2. 3 Changes in the concentrations of fat, protein and lactose over a lactation of a cow

Source: McDonald *et al*., (2002)

Table 2. 2 Effect of pasture species on milk production and composition

	Trial I		Trial 2	
	Kikuyu	Ryegrass	Ryegrass	Clover
Milk yield (L/day)	13.4	19.4	16.5	18.9
Milk Fat (%)	3.7	3.5	3.7	3.5
Milk Fat kg/day	0.51	0.70	0.59	0.69
Protein %	2.9	3.2	3.0	3.2
Protein kg/day	0.40	0.64	0.51	0.62

Source : Luginbuhl *et al*., (2002).

Feeding hay in livestock diets is one of the best sources of fibre. However, Pedersen and Madsen (1998) reported that cattle require low quantities of hay approximately between (2 to 3 kg/cow/day) if they are grazing on decent quality pasture.

2.7.2 Rumen function effect on milk composition

2.7.2.1 Feed intake

There are many tactics that livestock milk producers can use to improve or increase rumen function and the composition of milk components (McDonald *et al*., 2002).Feed provides the nutrients that are the precursors, either directly or indirectly, of the principal milk solids (Lentes *et al*., 2010). Therefore, an elevated feed intake usually results in the production of a greater quantity of milk (Aharoni, 1999). Overall, the relative improvement in fat, protein and lactose yields is roughly similar to the proportional rise in milk volume (Ngongoni *et al*., 2006). It is critical to exploit feed consumption of cattle so that undesirable energy deficit is reduced throughout early lactation (Lentes *et al*., 2010).

As cows intake additional energy than they require, body weight is recovered, drop in body state are reduced and cows produce milk of usual fat and protein composition (Nyoni *et al*., 2000). Moreover, improved feed consumption, and the outcome general increase in energy, can rise milk protein levels by 0.2 to 0.3 percent (Pandey and Voskuil, 2011). Cows that produce highly should intake 3.5 to 4.0 percent of their body weight everyday as dry matter. If a high producing cows consume less than this, production of solids corrected milk may be restricted (Pandey and Voskuil, 2011). Sarakul *et al.* (2009) and Looper (2012) reported the main factors that can affect feed consumption as feeding sequence, feed bunk management, abrupt ration changes, ration moisture between 25 and 50 percent, social interactions and grouping strategy of the herd, feeding frequency and environmental temperature.

2.7.2.2 Concentrate and forage ratio

Inclusion of a dry matter source is determined by lowest ratio of forage to concentrate vital to preserve usual milk fat percentage is roughly 60 to 40 (Petit, 2010). This ratio should assist solitary as a guide; other dietary factors influence the overall influence that a reduced ratio has on rumen fermentation (Pandey and Voskuil, 2011). These effects include reduced rumen pH, increased propionic acid production and decrease in fibre digestion (Amaresekera *et al*., 1998). Obviously, type and physical form of ingredients that contribute to the forage or concentrate portion of this ratio must be considered (Looper *et al*., 2002).

2.7.2.3 Feeding grain

The appropriate feeding of concentrates includes mixture of correct forage to concentrate ratios and non-fibre carbohydrate inclusions (Pandey and Voskuil, 2011). Feeding suitable non-fibre carbohydrate amounts can improve both milk fat and protein levels, whereas overfeeding leads to milk fat reduction of one unit or more and often rises milk protein percent by 0.2 to 0.3 unit (Petit, 2010). Grain feeding strategies to increasing the potential of milk fat and protein production involve maximum grain consumption to a limit of 30 to 35 pounds per cow daily (Looper *et al*., 2002).

2.7.2.4 Grain processing

The processing technique and the nature of the grain have an important impact on degree and location of starch digestion from a specific diet on the milk yield, composition and constitution. (Looper *et al*., 2002). According to Pandey and Voskuil (2011) trundled, steam flaked, heated, crushed, or pelletized grain increases starch propionic acid production and digestibility in the rumen. It is further stated that milk protein yield and milk production increased in sorghum or steam flaked corn associated with dry rolled or steamrolled corn consistence. In six comparisons, steam flaked corn increased milk protein percentage and yield and decreased

milk fat percentage compared to steamrolled corn (Mosavi *et al*., 2012). Milk fat yield stayed unchanged in these trials. Twenty four contrasts of dry rolled and steam flaked sorghum produced similar results (Petit, 2010). These study out comes can be linked to raised overall tract starch digestibility, improving recycling of urea in to the intestinal tract and enhance microbial protein movement to the small intestine (McDonald *et al*., 2002; Petit, 2010).

2.7.2.5 Ration fibre levels

The quantities of feed fibre and physical particle size contribute as fibre source to stimulate rumination which assists in milk protein and fat maintenance (Looper *et al*., 2002). Feeding of finely ground forages inadequately stimulates rumination and lowers saliva production. This results in a rumen fermentation pattern that produces a higher proportion of propionic acid and, in turn, reduces milk fat percentage (Petit, 2010). Fibre from forage should not be included at less than 1.40 percent of body weight which is approximately 40 to 50 percent constitute of dry matter in a diet (McDonald *et al*., 2002). Pandey and Voskuil (2011) reported that dairy cows require at least 5 pounds of roughage feed inclusion in a diet that is at a minimum of 1.5 inches in length daily.

2.7.2.6 Protein Feeding

Normally, dietary crude protein level has an effect on milk yield and only has an effect on milk protein percentages when crude protein is deficient in the diet (Bobe *et al*., 2008). Usually variations in dietary protein levels do not constantly have an effect on milk fat percentage (Looper *et al*., 2002). Theoretically, Bobe *et al*. (2008) states that insufficient quantities of rumen degradable protein could result in reduced milk fat percentage. He further reveals that optimal microbial growth and digestion of fibre is supported by rumen concentrations of ammonia.

2.7.3 Other factors

2.7.3.1 Genetics and Environment

Composition and component milk yields can be influenced by level of milk production genetics and environment, season and age, disease (mastitis), stage of lactation of cow (McDonald *et al*., 2002). Genetics of a breed can affect the averages for percentage of milk fat, total protein, true protein and total solids (Bobe *et al*., 2008). The alteration in milk composition can be affected by breeding technique. If out dated breeding techniques are used manipulation in milk composition occurs slowly, however if new breeding techniques are used genetic manipulation is faster (Looper *et al*., 2002). The environment of a milk producing livestock can be influenced by humans artificially to manipulate milk composition (Chilliard *et al*., 2003). The improvement of factors like feeding quality pastures and supplementary feeding is practiced by most farmers. McDonald *et al*. (2002) states that provision of high quality feeds increases quality of milk composition. Reduction in stress causative to milk producing livestock has also been seen in research done by Petit (2010) to improve the milk composition in several mineral and vitamin levels.

2.7.3.2 Level of Production

There are several factors that affect level of milk production and the composition constitutes and quality (FAO, 2013). The main factors affecting milk composition are age, feed type and animal breed. According to Looper *et al*. (2002)the age of a milk producing livestock varies in milk compositions at different stages, were depending on the age of the animal certain constitutes of milk are at a peak or drop. They went on to state that consumption of high quality feed in livestock greatly increase production levels of milk and milk composition. Studies by Gurmessa and Melaku (2012) report that water is on of the most essential nutritional inputs required for higher levels of production out puts in milk producing livestock. Levels of

production in protein, non-fat and total solids are strongly positively correlated in terms of milk yield (Luginbuhl *et al*., 2002).

2.7.3.3 Stage of Lactation and Age (Parity)

The levels of milk fat and protein is peak in primary and late lactation and least throughout peak milk production over mid-lactation (Gurmessa and Melaku, 2012). Usually, an improvement in milk yield is charted by a reduction in the percentages constitutes of milk protein and fat, whereas the yields of these compositions remain constant or rise (Melnik *et al*., 2013). Extensive research done by Schroeder (2012) reported that with accumulative age milk content changes. He goes on to highlight that aging of milk producing livestock results in protein content gradually decreasing and fat content remaining relatively constant. A survey done by Palmquist (2009) who has done extensive work for the Holstein Dairy Herd Improvement Association (DHIA) reports lactation results showing that milk protein content normally decreases 0.10 to 0.15 unit past five lactations or more lactations or approximately 0.02 to 0.05 unit per lactation

2.7.3.4 Disease

Many diseases have an impact on milk composition (Luginbuhl *et al*., 2002; Lentes *et al*., 2010). Mastitis is the predominant disease known to have a direct effect on milk constitutes and production s (Ouédraogo *et al*., 2008). Looper *et al*. (2002) reported that milk constitutes like casein and fat are reduced with the occurrence of mastitis. However, he went on to state that mastitis occurrences have an increasing effect in whey content of milk.

2.7.3.5 Season

Research done by Cannas *et al.* (2002) reports that seasons between spring and summer throughout fall and winter, milk protein and fat percentages are at their highest. This change is related to changes in both the nature of feed accessible and climatic conditions. Lush spring

grazing pastures poor in fibre reduce milk fat (Luginbuhl *et al*., 2002; Lentes *et al*., 2010). Hot season weather and reduces dry matter consumption and enhances feed sorting, resulting in lower consumption of fibre and forage and fibre (Kasulo, 2012).

2.8 Factors affecting milk production in communal areas

2.8.1 Breed

In most communal areas of South Africa, majority of the livestock are non-descript, as there has been uncontrolled crossbreeding with imported breeds (Vuuren, 2006). The use of improved animals (exotic breeds) requires high management, large amounts of concentrates/cow and low forage to concentrate ratio of the magnitude 40:60 (Petit, 2010). Exotic milk producing livestock should not be encouraged due to the lack of these breeds in the communal areas (Devendra, 2001). Pedersen and Madsen (1998) reported that the use of exotic livestock to be problematic in communal environment due to management and feed constraints. They stated that the exotic Friesian cows, which produces 1736-2540 kg/lactation results in lower milk production levels per lactation due to the harsh communal environment.

The interval from calving to recommencement of ovarian activity in non-descript cows was observed to be considerably longer than the 72–78 days interval documented for zebu cows (Maiwashe *et al*., 2013). The Holstein cow has the highest level of milk production and the highest in producing milk fat, protein and lactose (Ozrenk and Inci, 2008) but they are not kept in communal production systems. Majority of South African communal farmers have crossbreds and there is no information available indicating milk yield and quality of these crossbreds but reports state that milk yield in communal farming is low (Bester *et al*., 2003).

Table 2. 3 Mineral and vitamin quantities in milk

MINERALS	mg/100 ml	VITAMINS	µg/100ml[1]
Potassium	138	Vit. A	30.0
Calcium	125	Vit. D	0.06
Chloride	103	Vit. E	88.0
Phosphorus	96	Vit. K	17.0
Sodium	58	Vit. B1	37.0
Sulfur	30	Vit. B2	180.0
Magnesium	12	Vit. B6	46.0
Trace minerals[2]	<0.1	Vit. B12	0.42
		Vit. C	1.7

Source : Enb *et al*., (2009).

Crossbreeding of local stock with imported dairy breeds has been considered as the method for producing dairy cattle in many regions of the developing world (Devendra, 2001). Research conducted by Devendra (2001) in East Africa, after up to 30 years selection for milk production under good management, the indigenous Zebu produced more than 960 kg of milk per lactation. Consequently, the use of crossbred or newly developed tropical dairy breeds could be the solution to increasing milk production in South African communal areas (Scholtz, 2000). Further research also by Scholtz (2000) showed that on-station studies on milk production indicated that Nguni cows produced about 1200 kg of milk over a lactation period of 298 days. Therefore, a choice of a cattle breed producing high milk yield, and adapted in communal production systems would be a solution to improve milk yield in communal farming (Vuuren, 2006).

2.8.2 Water resource

Water has the most dramatic effect on milk yield (MacDonald *et al*., 2005). The majority of Southern African communal livestock source water from rivers, boreholes and wells. These sources are unreliable especially during the dry season (Linn and Raeth-knight, 2001). Mutibvu *et al*. (2012) went on further saying, that most (53 %) of the household's sourced water from dams or rivers while 19 % had boreholes and 28 % used wells. Linn and Raeth-knight, (2001) and Mutibvu *et al*. (2012) also stated that in some communal areas, milk producing livestock have to travel long distances in searching for water. Studies by Petit (2010) showed that it becomes a very big problem if a cow cannot get water because milk production and digestibility of feed takes place in the presence of water and milk composes of more than 80% water as its composition. Peden *et al* (2007) also reported that water intake by one tropical livestock unit in feed can be approximately 5 m^3 per day.

Unavailability of water is also a common constraint in communal areas. According to Ensley (2000) the major factors that influence water intake are: percentage of dry matter (DM) in diet and (DM) intake, composition constitutes of the diet, milk production, source and nutrient value of the diet, particular minerals in diet. In some areas, water may be obtainable but is of inadequate quality to sustain healthy growth and performance (Schlink *et al*., 2010). Masikati (2010) reported that water constrains were predominant throughout the dry season, animals had to walk distances of up to 14 km per day to access water. A report by Mutibvu *et al*. (2012) stated water sources are sometimes restricted and large numbers of livestock's use the same water sources leading to high risks of diseases transmission and land degradation. Water from dams and rivers sources get muddy during the rainy season while seasonal wells, rivers and some springs would dry up as the season progress (Schlink *et al*., 2010). Other studies have reported comparable findings in various locations (Darshan *et al.*, 1989; Linn and Raeth-knight, 2001; MacDonald *et al*., 2005).

2.8.3 Feed resources

Communal household livestock production in sub-Saharan Africa is inhibited by a variety of factors. Feed scarcities during the dry season poses the greatest challenge in terms of quality and quantity (Masikati, 2010). Crop residues are the most important common feed source for improving feed scarcity throughout the dry season (Mutibvu *et al.,* 2012). Supplementation is vital since the communal veld experiences seasonal difference in both the quantity and quality of vegetation given the seasonality of rainfall (Petit, 2010). Most crop-livestock production which area common in South African communal areas rely basically on rainfall, and adverse variations in amount and short duration patterns of rainfall are a major risk to production (Masikati, 2010). In South Africa main restraint to increasing livestock output and productivity is the lack of satisfactory provisions of good quality livestock feed in the dry season produced at a modest cost and without risking household food security (Chinogaramombe *et al*., 2008).

Research done by Masikati (2010) and Mutibvu *et al*. (2012) in other African communal areas also shows high occurrences of diseases and death mortality, with feed scarcities leading to low livestock output during the dry season.

Any restriction in feed and water supply reduces milk production (Schlink *et al*., 2010). Most Communal farmers in Africa lack funds to buy supplementary feed to ensure that there are sufficient feeds especially during the dry winter periods (Mapiye, *et al*., 2007; Lentes *et al.,* 2010). Decent quality forage and enhanced pasture may only provide adequate nutrients for upkeep and production of about 5.0 kg/d of milk (Trail, 1981). Concentrates are fed to supply energy and protein for increased milk production (Pandey and Voskuil, 2011). Supplementary concentrate feeding increases milk production. However, Chimonyo *et al*., (2000) showed that few communal farmers can afford to provide supplementary feeding to their animals. According to work done by Walshe *et al*. (1991) most of the households in the South African communal areas are unable to purchase satisfactory quantities of concentrate because of high concentrate price and distance from the source centre. In addition Ngongoni *et al*. (2006) states that limited availability, the high price of concentrates and the decreasing milk to concentrate cost ratio makes it difficult to feed satisfactory concentrates regularly resulting in low productivity.

2.8.4 Forage quality

Forage is the primary ingredients in the diet of dairy cattle because of the dramatic impact it has on dry matter and nutrient consumption (Lentes *et al*., 2010). The quality and form of forage are two of the factors that have been shown to influence dry matter consumption and milk production in dairy cattle (Petit, 2010; Pandey and Voskuil, 2011). Lentes *et al*. (2010) and Cannas *et al*. (2002) reported the following guidelines are critical to maximizing solids corrected milk production as proper ration formulation, properly feeding, maximum feed

intake, monitoring dietary composition, harvesting or buying high quality forage, and proper forage allocation

Quality assessment of forage can be done by communal farmers through the use of non-costly methods like visual appraisal. The maturity of a forage can be projected fairly accurately by the amount of buds, seed heads that are present (Holland and Kezar, 1990). Good curing throughout the haymaking process can be evaluated by the shade of the hay (Lentes *et al*., 2010). Colour can also be used to assess the extent of nutrient losses related with leaching resulting from exposure to rain and weather (Cannas *et al*., 2002). Lower levels of vitamin and crude protein can be visually assed through the process of bleaching. Hoffman *et al*., (2012) reported that legume-type forages and the leaf-stem ratio accurate approximation the nutrient value of forage. They further stated the crude protein content is a forage is high when there are many leaves and more stems. Lentes *et al*. (2010) also stated that when the digestible nutrients content is lower the content of structural carbohydrates is higher.

2.8.5 Palatability of forage

The palatability of a forage is affected by its taste (sweet, salty, bitter, acidic), olfactory and textural characteristics (Lentes *et al*., 2010). Studies done by Mutukumira (1996) reported taste is one of the major factor influencing palatability. Milk producing livestock's in communal areas are non-selective grazers and readily consuming a wide range of feeds (Petit, 2010). Generally all livestock's fist preference is consuming sweet forage which can be improved by adding molasses. Palatability of feed can be improved by adding salt to a feed mix, however a too large increase, decreases consumption (Chimonyo *et al*., 2000). In milk producing livestock palatability is not a major issue but the feeding on concentrates or rationed feeds results in

having have no choice (Weston, 1996). Palatability is usually reduced when spoilt feed is given to livestock. (Lentes *et al*., 2010).

2.8.6 Processing of forage

The reduction in consumption that occurs as forage develops can be countered to some degree by dropping the physical mass of the forage, which will permit it to pass through the rumen at a quicker rate (Holland *et al*., 1990). The passing rate from the rumen is dependent on particle density and size. Minor, dense particles are passed out of the rumen more rapidly than bigger forage particles, which are delayed in the rumen (Petit, 2010). As the ruminal passage rate rises, exposure to the digestive processes declines and the complete digestibility of the forage decreases but, because more can pass through the digestive tract, the animal will increase its dry matter intake and the effect is usually that the cow's digestible nutrient consumption rises slightly (Petit, 2010). This is why chopping of the forages is done prior to feeding. It is highly beneficial when average-quality forages are fed., although the cutting of forage into very small pieces will result in decrease in feed intake (Holland *et al*., 1990).

2.8.7 Milking intervals and frequency

Milking in communal farming is done mostly once per day and this contributes to low milk yield. Commercial farmers milk twice and even three times per day (Aharoni, 1999). Cows that are milked twice per day produce more milk than cows milked only once per day. According to work done in Eastern Cape Province by Mapekula *et al.* (2009), cows milked at unequal intervals produce less milk than those milked at equal intervals. Studies done by Bailey and Currin (1999 and Davis *et al*. (2003) concluded that 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. In South African communal farming, the effect of milking intervals and frequencies on milk yield and milk composition is unknown (Devendra, 2001)

Secretion rate increases when milk is removed more frequently Mahanjana and Cronjé (2000). They gave an example were thrice daily milking, especially for goat resulted in animals that retained a large proportion of milk in the alveoli as to the cisterna. It is well known that a higher frequency of milking increases milk production in cows, and equally, that an accumulation of milk in the udder will decrease milk yield (Aharoni, 1999). Intra-mammary pressure was traditionally assumed to be a resultant of this accumulation and the cause of reduced milk production (Chepkoech, 2010). Current studies have shown that it is the result of segments of whey protein (Muchenje *et al*., 2007) which upsets the multiplying and decrease of secretory cells.

2.8.8 Age and body weight of dam at calving

Body size and parity are almost related to age which affects milk production (Winks *et al*., 1978, l983). 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 (Ouédraogo *et al*., 2008). Recurring pregnancies can increase milk production from first to the fifth lactation by 30% (McDonald *et al*., 1995). The increase in milk yield is usually highest for mid lactations and declines as milk producing livestock gets older (Bereda *et al*., 2013).

2.8.9 Stress levels

Stress factors such as work, parasitic infestations and disease challenge just to highlight a few reduce milk yields. Although stress levels are associated with reduced milk yield in dairy cows under commercial dairy systems, its impact in communal production systems is not well understood (Toluić *et al*., 2009). There is little literature available on indigenous communal crossbreed livestock indicating the effects of stress in these animals on milk production. It is known that indigenous and non- descript breeds are hardy and are able to walk for long

distances searching for food and water (Scholtz, 2000; Bester *et al*., 2003) but stress effect of this in their milk yield is not well understood (Vuuren, 2006).

2.8.10 Temperature and humidity

According to Brouček and Šoch (2009) humidity also plays an important part in heat stress in livestock. Milk producing livestock are susceptible to heat stress in spite of heat resistant characteristics (Mahanjana and Cronjé, 2000; Webb and Mamabolo, 2004). Brouček and Šoch, (2009) states that there are three temperature-humidity ranges of concern. Temperatures of serious measures between 37.8°C and 20 percent humidity increase stress in cattle (Ruiz-Sanchez *et al*., 2007) which should result in cooling of the cattle. Aharoni (1999) mentioned that the risks occur as the temperature nears 100°C and 50 percent humidity. 100°C and 80 percent humidity are deadly ranges to cattle (Ruiz-Sanchez *et al*., 2007). This is why sprinklers are needed in a milk producing facility to aid in cooling the animal during heat stress (Masikati, 2010). However, extremely cold weather can reduce milk production. This is why it is also important to have circulating movement of air in any restricted area. During times of heat stress feed consumption is decrease by 8 percent to 12 percent and future increases with increase in temperature (Pandey and Voskuil, 2011). This condition of decreased feed consumption reduces production of fatty acid in the rumen, resulting in decreased milk production (Davis *et al*., 2003).

2.8.11 Diseases

Several studies in Africa have shown that diseases are a major constraint in the communal livestock industry in the tropics (Devendra *et al*., 2000; Chimonyo *et al*., 2000; Masikati, 2010) as particular diseases resulting in. reduction of production and increased morbidity and mortality (Ngongoni *et al*., 2006). Animal health concerns create barriers to trade of milk producing livestock and their products (Chawatama *et al*., 2005). The occurrence of diseases has multiple impacts on poor livestock producers (Chawatama *et al*., 2005) by marginalising

them from expansive livestock markets and limiting their capacity for quality-added trade (Marten, 1985). In South Africa, Chimonyo *et al*. (2000) found animal diseases to be a crucial constraint and goes on to highlight that animals of communal farmers are particularly susceptible to diseases because of the cost, unsuitability of livestock-health inputs (Chimonyo *et al*., 2000).

Resource limited communal farmers have fewer livestock and low reserves on which to live on during hard times. Therefore the loss of one animal has a considerable impact (Ngongoni *et al*., 2006). Smith *et al*. (2006) reported similar findings in a study where they stated that disease have the greatest impact on poor communal livestock producers who do not have medicine and proper disease control measures. Furthermore, movement of livestock and their by-products are difficult to monitor in the communal areas (Musemwa *et al*., 2008). As a result the outbreak of problematic disease like anthrax, foot and mouth, back-leg and contagious abortion in South Africa are a threat in particularly to the consumers and livestock production industry (Masikati, 2010). According to Comerford *et al.* (1989) diseases further cause multiple impacts by reduces calving rate, lambing rate, milk production, animal off take, herd size, draught efficiency by increasing veterinary care costs, calves, lambs and kids mortalities.

2.8.12 Length of dry period and lactation.

The length of the dry period is important as it allows the secretory tissue to regenerate (Looper, 2012). Schmidt and Van Vleck (1974) reported that milk yield is subsequently reduced due to short dry periods. However, one study showed halves of the udder had an effect to milk production and no decrease effect on milk yield even after an omission of a dry period (Fowler *et al*., 1991). According to Wallberg and Wallberg (2011) intentional long dry periods are implemented by some goat milk producers so as to retain the high production continuously in

high producing breeds. It was reported that in his study, prolonged dry period resulted in lactation of up to 22 months. However, the usual practice is annual in breeding which results in ten months lactation with a two month dry period. Aharoni (1999) reported that this in non-dairy breeds would only result in a prolonged effect of two months.

2.8.13 Stage of lactation

A thorough review on how dairy cow nutrition affects milk composition was doneby Schroeder (2012). He reported that at different stages of lactation affects milk fat, lactose and protein contents differently. Solids-non-fat solid content is frequently at peak during the first 2 to 3 weeks, afterward which it reduces slightly (Pedersen and Madsen, 1998). Milk fat content increases directly after calving but shortly starts to fall, continuously for 10 to 12 weeks, after which it tends to increase pending end of lactation (Chilliard *et al*., 2003).

2.9 Factors affecting milk consumption in communal areas

Milk consumption is an important index that can be used to find the relationship between environmental and personal factors. These relationships between factors reflect consumer behaviour of milk and therefore can be studied by enterprises involving milk business and the dairy industry. Out puts of such relationships area powerful and helpful in decisions making and strategic planning for the government (Trung *et al*., 2014).

2.9.1 Characteristics of household

The characteristics of a household in terms of age variation particularly infants have an impact on the amount and level of milk consumption (Oni and Fashogbon, 2012). In communal areas infants and old age people consume a lot of milk in its different processed states due to it nutritious state and the fact that it is easy to ingest (Mutukumira, 1996). Therefore households with high number of infants and elderly people will tend to have a high level of milk

consumption and demand (Dashan *et al*., 1989; Njarui *et al*., 2011). Several researchers have highlighted that presence of young children and gender in a household significantly affect the influence of decisions made in milk product purchases (Phuong *et al*., 2013).

2.9.2 Household income and Capital availability

Not all communal farmers have lactating livestock to obtain milk from (Vuuren, 2006). However, because some households have the working class this means there is a form of financial stability (Vigne and Whiteside, 1997). Financial stability comes with buying power and the reliance of owning lactating animals is over ruled (Phuong *et al*., 2013). Having buying power mean milk can be purchased (Oni and Fashogbon, 2012). However the opposite means the lower the income the lower the consumption pattern (Mutukumira, 1996). Ebru and Neslihan, 2013). Furthermore, a study by Ebru and Neslihan (2013) revealed that consumers from a higher level of education or higher income, consume more dairy products and are most likely to purchase milk products. Phuong *et al*. (2013) reported socio-economic and demographic characteristics to be the main influencing factors in dairy product consumption and expenditure in Vietnamese households. However, change occurrence in income can also affect the milk product demand (Pedersen and Madsen, 1998). This is common in high earning income countries where by an increase in income levels gradually results in to a variety in diet generally consumers drift (Nelson, 1970) away from consuming inferior standard staple products towards advanced value products (Weston, 1996).

2.9.2 Price of milk on market

Trung *et al*. (2012) reported the response trend to change in food price differ. He further reported that majority of the households decrease in budget spent on food with income and a less response in present in richer countries food price change. The United Kingdom is on such example stated by Weston (1996) were the response to demand of consumers for cheese is

highly responsive compared to liquid milk price changes. On the contrary, the most important factor affecting dairy products is the relative price of other complementary or complimenting products (Vuuren, 2006).

2.9.3 Livestock ownership

Livestock ownership has a great influence on the consumption of milk patterns in any household (Phuong *et al*., 2013). The number of lactating animals owned by a household head signifies the amount of milk that is produced by that household directly having an influence on the household consumption pattern (Oni and Fashogbon, 2012). In cases of dual or group ownership consumption patterns are affected in the sense that level of consumption is divided among the group number ownership also adding a different angle to the consumption patterns (Tran Quang Trung *et al*., 2014). This is very common with the communal livestock farmers who tend to have a complex ownership to their livestock (Mapekula, 2012).

2.9.4 Milk availability

Milk availability is another factor that affects milk consumption (Thorpe, 2001). Some communal farmers may not have ownership of lactating livestock but have a stable income can have their milk consumption affected by milk availability (Trung *et al*., 2012). The locality of some communal areas means that the regular purchasing of milk is not possible (Phuong *et al*., 2013). Therefor the availability of milk in the communality located shops and selling points affects milk consumption in the communal areas (Njarui *et al*., 2011).

2.9.5 Number of milking animals

The number of lactating animals owned by an individual farmer or household has an effect on consumption patterns of milk (Njarui *et al*., 2011). A high number of lactating animals means the household has potential to produce high levels of milk and the opposite if the number of

lactating animals is low (Mapekula, 2012). This directly means that milk consumption is will be high as well because milk production and consumption are inter related (Njarui *et al*., 2011; Mursik *et al*., 2014).

2.9.6 Level of education and health awareness

The education level of household individuals is highly linked with the health awareness of that individual (Oni and Fashogbon, 2012). According to Mutukumira, (1996) household dairy product consumption is positively affected by increase in presence of young children and having households heads or household food budgets with high level of education. Therefore this means that importance of what is included in a diet affecting milk consumption (Alden, 2007), of the household is directly (Findlay, 2006). As a result the various aspects of nutritious importance of milk are known and will always be emphasised to be included in the diet of the household (Hoyer and MacInnis, 1997). This directly affects the consumption of milk at a household level. Were the level of education is low the health awareness is likely to be low as well meaning the importance of milk in diet inclusions is not known affecting the level of milk consumption (Mutukumira, 1996). Health benefits is the most highly cited force and key driving factor responsible for food consumption (Grunert *et al*., 1996; Hartog *et al*., 2006), value standard of food (Alden, 2007), food manufacturing process, convenience and appropriate packaging (Hoyer and MacInnis, 1997) are the other common factors.

2.9.7 Personal preference and choice

Sanusi and Nelson, (1970) noted that consumer or personal preference clarifies how a consumer prefers one collection over another by ranks a collection of services or goods**.** Natural each individual has personal preference and choice in selection of an item (Njarui *et al*., 2011). This individual phenomenon of choice and preference also affects the consumption of milk in the communal area (Oni and Fashogbon, 2012). Taste is ranked as one of the major food choice

determinants (Hatirli *et al*., 2004). Although there have been several past studies enlightening consumers with the good health benefits and decreased risk to diseases exposure, this has not seen any increase in interest of dairy products consumption (Peng *et al*., 2006). Whether the choice or preference is between the type of milk in terms of which livestock it originates from, different milk processed products or between milk and another product (Abdullahi, 2014). This phenomenon between each individual in a population affects the consumption of milk both positively and negatively. If it affects milk consumption positively the choice or preference is for milk consumption and via versus if the response given is negative another item is in preference or of choice (Liu, 2009). However if the choice or preference is between milk produced by different livestock breeds this phenomenon affects the consumption patterns of both the forgone and selected. The forgone choice will be affected negatively and the selected positively both in terms of consumption patterns (Hatirli *et al*., 2004).

Furthermore, lifestyle factors have also influenced the habitual food choices of the consumer and some others studies have illustrated that membership of social category such as gender, age, education, occupational status and ethnicity may influence food selection behaviours and the attitudes and believes on which they depend on (Hatirli *et al*., 2004).

2.9.8 Religion and customary beliefs

Within the communal areas there is a diverse population of people this also mean that there is a variation and of different customary beliefs and religions. These different beliefs and customs each have their taboos in terms of the type of food they eat or condone (Trung *et al*., 2012). If a custom or religion condones the consumption of milk therefore the levels of consumption are affected as well (Liu, 2009). However if this factor is in reverse were milk is pivotal in the diet of that religion or custom the consumption of the milk will be affected positively in terms of

levels of consumption (Oni and Fashogbon, 2012). Several experiments have confirmed that beliefs and attitudes towards particular food products, gives an outcome on the consumption that is more important to other lifestyle factors (Hatirli *et al*., 2004; Celik *et al*., 2006).

2.10 Milk utilisation in communal areas

Although milk plays a vital role in food security, poverty alleviation and is nutritious there is little, if any, information available on how it is utilised in communal areas in South Africa (Chimonyo *et al*., 2000). Milk utilisation can be categorised into basically household use, marketing and sales (Trung *et al*., 2012). Chimonyo *et al*. (2000) revealed that milk production is one of the major reasons for communal households to keep cattle but according to Mapiye *et al*. (2009) there is little information on its utilisation in communal areas.

2.10.1 Household level use

Although not all household consume or utilise the milk from their lactating livestock it is used for other purpose in the household to supplement costs of other inputs that could cause unnecessary expenditure (Lentes *et al*., 2010). Milk can be used to feed pets like dogs and cats in communal areas. At household level basically the utilisation patterns mapped using factors like age, sex, activity dominance and how they interact in the why products are utilised in a household according to the household head upbringing (Nelson, 1970; Abdullah *et al*., 1985)

2.10.2 Processing for household consumption and community charity

Traditional milk processing is a common practice of all smallholder farmers who own lactating cows (Mursik *et al*., 2014). Milk in communal areas is obtained in its raw state of which it is consumed most at this stage (Abdullah *et al*., 1985; Mursik *et al*., 2014). The raw milk with time if not in abundance is processed into products like sour milk, cheese and butter (Nelson, 1970). This activity is mostly done by the women and young girls in the families and the milking mostly done by the men or young boys (Mutukumira, 1996). In South Africa like in

Zimbabwe, a thick cured milk coagulate called *amasi* which is naturally soured forms an important part of the traditional diet and is often eaten with *Umphokoqo* (African salad) and *Sadza* (thick maize porridge) (Chimonyo *et al*., 1999). In South Africa fresh milk is either seldom drunk alone or mixed with sour mix and *umphokoqo* (Ngongoni *et al*., 2006) but in Zimbabwe it is seldom drunk alone. Households which produce milk in abidance and can process or utilising enough for their household can give away to friends, family and neighbours (Dar, 2014). This can also be classified as a way of milk utilisation in the communal areas (Mapekula, 2012; Bereda *et al*., 2013)

2.10.3 Strategic feeding livestock, marketing and sales

Many of the communal framers practice a mixed livestock framing system were they keep different types of livestock in one household (Trail, 1981). For example some of these farmers that keep cattle most likely also have small stock like sheep or goats (Lentes *et al.,* 2010). This practice of keeping a mixed livestock system can be linked with spreading risk in the event of any losses that take place (Mngomezulu, 2010). This integrated system can be used in the event that a goat kid is offend milk for a cow can be used to strategically feed and raise the kid till weaning stage (Dar, 2014). The marketing and trading of milk in the communal areas can also be classified as a factor affecting milk utilisation (Bereda *et al*., 2013). As previously stated not all communal household own lactating livestock and as a result to have milk as a part of their diet, it has to be purchased (Mapekula, 2012). If marketing of milk is the major source of household revenue, this affects the milk utilisation within that community (Dar, 2014).

2.11 Conclusion

In the communal livestock production system of land lease, all land that is not put aside for households or cropping is present as well as grazing areas to all community members. Generally, communal areas don't have boundaries on livestock populations, accessible nutritional resources are rigorously, scarce limited and all animals in this scheme are possibly performing as well as the available nutritional resources permit. At a biological perception, the major restriction to more effective animal production in the communal farming system is insufficient nutrition. From the sociological perception, the labour restrictions discussed above linked directly from the point that livestock must be herded for sizeable distances in order to obtain satisfactory nutrients from the overgrazed pasture ecosystem. Communal households rear livestock for multiple purposes (Trail, 1981). They do rely on livestock for income, horns meat, hides and milk (Chimonyo *et al*., 1999; Dovie *et al*., 2006). Compiled together, these facts specify that animal science research is not possible to have much influence within the communal system, and that the sociological characteristics of communal land lease represents the most important issue that needs to be dealt with.

2.12 References

Abdullahi, M.K. 2014. Consumption Preferences for Dairy Products in an Urban Setting : A Study of Sokoto Metropolis Abstract : *Innovative Research and Development*, **3 (11):** 308–314.

Aharoni, Y.brosh, a. ezra, E. 1999. Effects of heat load and photoperiod on milk yield and composition in three dairy herds in Israel. *Animal Science*, **69**:37–47.

Alden, D.L., Steenkamp, J.B.E.M. and Batra, R. 2007. Consumer attitudes towards market place globalization: Structure, antecedents and consequences. *International Journal of Research Marketing,* **23:** 227-239.

Amaresekera, S.K. 1998. Animal recording in smallholder farming systems, the Sri Lankan experience. *Journal of American Diethetic Association*, **10 (1):**118–26.

Bailey, K. 2005. Evaluating the economic impacts of regional milk pricing authorities: The case of dairy compacts. *Agricultural and Resource Economics* Review, **29 (2):**208-219.

Banga, C. 1998. Dairy herd improvement services in Zimbabwe: past, present, future. In *proceedings of International Workshop on Animal Recording for Smallholders in Developing Countries.* Anad, India. Pp 173-179.

Beede, D.K., 2006. Evaluation of Water Quality and Nutrition for Dairy Cattle. PhD Thesis, Michigan State University, East Lansing, USA.

Bembridge, T. 1984. A systems approach study of agriculture development problems in Transkei. PhD Thesis, University of Stellenbosch, South Africa.

Bereda, A., Yilma, Z., and Nurfeta, A. 2013. Handling , processing and utilisation of milk and milk products in Ezha district of the Gurage zone. Southern Ethiopia. *Wudpecker Journal of Agricultural Research,* **1(11):** 459.

Bester, J., Matjuda, L.E., Rust, J.M. and Fourie, H.J. 2003. The Nguni: A case study. In FAO. Community-based management of animal genetic resources. In: *Proceedings of the workshop held in Mbabane*, Swaziland, pp, 45-68.

Brouček, J. and Šoch, M. 2009. Effect of high temperature on milk production of cows from free-stall housing with natural ventIlation. *Animal Production*, **2 (4):**167–173.

Bobe, G., Lindberg, G, L.; Young, J; and Beitz, D, C. 2008 "Changes in Milk Protein and Amino Acid Composition of Dairy Cows in Response to Fatty Liver and Intravenous Glucagon," *Animal Industry Report*: AS 654, ASL R2308. Available at: http://lib.dr.iastate.edu/ans_air/vol654/iss1/57

Cannas, A., Nudda, A. and Pulina, G. 2002. Nutritional strategies to improve lactation persistency in dairy ewes. In: *Proceedings of the 8th Great Lakes Dairy Sheep Symposium*. Cornell University, Ithaca, New York, 17-59.

Chepkoech, B. 2010. Milk quality control and regulation in dairy production : a case of dairy producers in kikuyu division , kabete district , central province - Kenya By. *In*: *Proceedings of the Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference,* Cape Town, South Africa.

Chilliard, Y., Ferlay, A., Rouel, J., and Lamberet, G. 2003. A Review of Nutritional and Physiological Factors Affecting Goat Milk Lipid Synthesis and Lipolysis 1. *Dairy Science*, **86**:1751–1770.

Chimonyo M, Kusina N T, H.H. and N.O. 1999. A survey on land use and usage of cattle for draught in a smallholder farming area of Zimbabwe. *Journal of Applied Sciences in Southern Africa*, **5:**111–121.

Chimonyo M, Kusina N T. and Hamudikuwanda H, N.O. 2000. Effects of dietary supplementation and work stress on ovarian activity in non-lactating Mashona cows in a smallholder farming area of Zimbabwe. *Animal Science*, **70:**317–323.

Chinogaramombe, G.N.C., Muchenje, V., Mapiye, C., Ndlovu, T., Chimonyo, M. and Musemwa, L. 2008. Challenges for improving smallholder dairy production in the semi-arid areas of Zimbabwe. *Livestock Research for Rural Development*, **20 (3)**.

Chimonyo, M., Kusina, N.T., Hamudikuwanda, H., Nyoni, O. and Ncube, I. 2000. Effects of dietary supplementation and work stress on ovarian activity in non-lactating Mashona cows in a smallholder farming area of Zimbabwe. *Animal Science*, **70(2):** 317-323

Coetzee, L., Montshwe, B.D. and Jooste, A. 2004. The Marketing of Livestock on communal lands in the Eastern Cape Province: constraints, challenges and implications for the Extension Services. *South African Journal of Agricultural and Extension*, **34 (1):** 81–103.

Comerford, J.W., Bertrand, J.K., Benyshek, L.L. and Johnson, M.H., 1987. Reproductive Rates, Birth Weight, Calving Ease and 24-h Calf Survival in a Four-Breed Diallel among Simmental, Limousin, Polled Hereford and Brahman Beef Cattle. *Journal of Animal Science,* **64:**65-76.

Dar, B. 2014. Small-scale milk processing , utilisation and marketing of traditional dairy products in bahir dar zuria and mecha districts , northwestern ethiopia, *Journal of food Technology Reserch,* **1(3):**122-132.

Darshan, L, A, L. and Narayanan, K, M. 1989. Effect of lactation number of the animal on the fat and solids-not-fat contents of milk. *Indian Journal of Animal. Science*. **54 (9):** 835-839.

Davis, M. S., MaDer, T. L. and Holt, S.M.P.S.M. 2003. Strategies to reduce feedlot cattle heat stress: Effects on tympanic temperature. *Jounal of Animal Science*, **81**:649–661.

Devendra, C. 2001. Smallholder Dairy Production Systems in Developing Countries : Characteristics, Potential and Opportunities for Improvement - Review. *Asian-Australasian Journal of Animal Sciences*, **14 (1):** 104-113

Diwyanto, K., Angraeni, A. and Djajanegara, A. 1998 Practical experiences in milk recording in Indonesia. In: *Proceedings of International Workshop on Animal Recording for Smallholders in Developing Countries.* Indonesia, 89-120.

http://dad.fao.org/en/refer/library/reports/anand.pdf

Dovie, D.B.K., Shackleton, C.M. and Witkowski, E.T.F. 2006. Valuation of communal area livestock benefits, rural livelihoods and related policy issues. *Animal Sciences*, **23** :260–271.

Dugmore, T.J., Oosthuizen, P. A. and Toit, J.F. 2004. Strategies for dairy production in rural areas. *South African Journal of Animal Scieance*, **5:**45–47.

Enb, A. and Donia, M.A. 2009. Chemical composition of raw milk and heavy metals behaviour during processing of milk products. *Global Veterinaria*, **3 (3):**268–275

Ensley, S. M. 2000. Relationships of drinking water quality to production and reproduction in dairy herds. PhD. Thesis. Iowa State University. Ames, Iowa, United States of America

Findlay, N. 2006. *Newsletter of the Grassland Society of Southern Africa*, In : proceeding of the Future of Dairy Farmers in South Africa Conference.Pretoria, South Africa, pp. 5–6.

Foster, C., Green, K., Bleda, M., Dewick, P., Evan, B., Flynn A., Mylan, J. 2006. Environmental Impacts of Food Production and Consumption A research report completed for the Department for Environment , Food and Rural Nelson 1970Kkkkkk, et al 2000. Manchester Business School. Defra, London, United Kingdom. pp.44-47

Food and Agricultural Organisation 2001 Mixed crop-livestock farming: A review of traditional technologies based on literature and field experience. Traditional technologies for animal production, Chapter 5http://www.fao.org/DOCREP/004/Y0501E/y0501e06.htm

Gurmessa, J. and Melaku, A. 2012. Effect of Lactation Stage , Pregnancy , Parity and Age on Yield and Major Components of Raw Milk in Bred Cross Holstein Friesian Cows. World *Journal of Dairy Food Science*, **7 (2):**146–149.

Grunert, K. G., Hartvig Larsen, H., Madsen, T. K. and Baadsgaard, A. 1996. Market orientation in food and agriculture. Boston: Kluwer Academic Publisher, Massachusetts, United States.

Grobler, S.M., Scholtz, M.M., Bester, J., Mamabolo, J.M. & Ramsay, K.A. 2008. Dairy production systems in the emerging and communal sectors of South Africa: Results from a structured survey. *Applied Animal Husbandry and Rural Development*. **1:** 25-30.

Hartog, A.P., Staveren, W.A.V. and Brouwer, I.D. 2006. Food habits and consumption in developing countries: Manual for field studies. Wageningen Publishing The Netherlands.

Hanyani-Mlambo, B.T., Sibanda, S. and Østergaard, V. 1998. Socio-economic aspects of smallholder dairying in Zimbabwe. *Livestock Research for Rural Development*, **10 (2):**56–70.

Hatirli, S.A., Ozkan, B., Aktas, A.R. 2004 Factors affecting fluid milk purchasing sources in Turkey. *Food Qual*ity *Prefer*ence, **15**, 509–515

Heinrichs, J., Jones, C. and Bailey, K. 1997. Milk Components: Understanding the Causes and Importance of Milk Fat and Protein Variation in Your Dairy Herd. *Dairy and Animal Science*, **5 (97) :** 1–8.

Hoffman, P. C., Mertens, D. R., Larson, J., Coblentz, W. K., Shaver, R. D. 2012. A query for effective mean particle size of dry and high moisture corns. *Journal of Dairy Science*, **95:**3467– 3477.

Holland, C. and Kezar, W. 1990. Pioneer forage manual - a nutrition guide. In *Proceedings of Pioneer Hi-Bred International*. Des Moines, Mexico. pp 55.

Hoyer, W.D. and MacInnis, D.J. 1997. Consumer behaviour. Boston: Houghton Mifflin

Huber, J. T. 1996. Amelioration of heat stress in dairy cattle. In: *Progress of Dairy Science intanational,* Wallingford, United Kingdom. pp 211–243.

Jansen, H. G. P. 1992. Consumption of dairy products in Northern Nigeria. Dairy marketing in Sub-Saharan Africa. In: *proceedings of the 1992 symposium held at International Livestock Centre for Africa*, Addis Ababa, Ethiopia.
http://www.ilri.org/InfoServ/Webpub/Fulldocs/dairymkt/dairy.pdf

Kasulo, V. 2012. The perceived impact of climate change and variability on smallholder dairy production in northern Malawi. *African Journal of Agricultural Reseearch*, **7 (4):** 72–78.

Kiplagat, S.K., Limo, M.K., and Kosgey, I.S. 2012. Genetic Improvement of Livestock for Milk Production. Milk Production Advanced Genetic Traits, Celular Mechanism, *Animal Management and Health*, **11 (4):** 77–96.

Leng, R.A. 1990. Factors affecting the utilisation of 'poor quality' forages by ruminant animals particularly under tropical conditions. *Nutrition Research Reviews,* **3:**277–303.

Lentes, P., Holmann, F., Peters, M., and White, D. 2010. Constraints , feeding strategies and opportunities to improve productivity and income in milk production systems in Olancho , Honduras, Honduras. *Tropical Grasslands,* **44 (1):**33–46

Linn, J. and Raeth-knight, M. 2001. Water Quality and Quantity for Dairy Cattle, In : *Proceedings anembe (Spanish Veterinary Medical Association,* Madrid, Spain. pp, 1–5.

Liu M., W.G. and W.H. 2009. Propensity analysis on consumption expenditure of rural residents in Hebei province - China. *Asian Agricultural Research*, **1 (8):**20–23.

Looper, M. 2012. Factors Affecting Milk Composition of Lactating Cows. *Nutrition Journal*, **12 (1):**103.

Luginbuhl, J.M.L., Poore, M.H. and Muller, J.P. 2002. Managing body condition: A key to successful [online]. *www.cals.ncsu.edu/an_SCI/extension/anim*.

Meissner H.H. 2013. Sustainability of the South African Livestock Sector towards 2050 Part 2: Challenges, changes and required implementations. *South Africa Journal of Animal Science,* **43:** 298-319.

MacDonald, D, Greenhalgh, J.F.D and Edwards, P. 2005. Animal nutrition. 4th edition, : Longman Publishers. Cambridge,United Kingdom.

Mahanjana, a. M. and Cronjé, P.B. 2000. Factors affecting goat production in a communal farming system in the Eastern Cape region of South Africa. *South African Journal of Animal Sciences*, **30 (2):**149–154.

Maiwashe, A., Nengovhela, N.B., Nephawe, K.A., Sebei, J., and Netshilema, T. 2013. Estimates of lactation curve parameters for Bonsmara and Nguni cattle using the weigh-suckle-weigh technique, *South African Journal of Animal Science*, **43 (5):** 12-16

Mapekula, M., Chimonyo, M., Mapiye, C., and Dzama, K. 2009. Milk production and calf rearing practices in the smallholder areas in the Eastern Cape Province of South Africa. *Tropical Animal Health and Production*, **41:**1475–1485.

Mapiye, C. Chimonyo, M., Muchenje, V., Dzama, K., Munyaradzi, C., and Raats, J.G. 2007. Potential for value-addition of Nguni cattle products in the communal areas of South Africa : a review. *Journal of Agricultural Research*, **2:**488–495.

Mapiye, C., Mwale, M., Mupangwa, J. F., Mugabe, P.H., Poshiwa, X., and Chikumba, N.2007 Utilisation of ley legumes as livestock feed in Zimbabwe. *Tropical Grasslands,* **41:**84-91

Marten, G.C. 1985. Factors influencing feeding value and effective utilisation of forages for animal production. *In*: *Proceedings of the 15 International Grassland Congress. Kyoto, Japan*.

Masikati, P. 2010. Improving the water productivity of integrated crop-livestock systems in the semi-arid tropics of Zimbabwe : an ex-ante analysis using simulation modeling. In: *Proceedings at International Crops Research Institute for the Semi-arid Tropics (ICRISAT)*, Bulawayo, Zimbabwe Retrieved January 17, 2015, from

http://www.zef.de/fileadmin/webfiles/downloads/zefc_ecology_development/eds_78_masikati_text.pd

Melnik, B.C., John, S.M., and Schmitz, G. 2013. Milk is not just food but most likely a genetic transfection system activating mTORC1 signaling for postnatal growth. *Nutrition Journal*, **12 (1):**103.

Mngomezulu, S. 2010. Formal Marketing of Cattle by Communal Farmers in the Eastern Cape Province of South Africa. MSc Thesis (Animal Science), Wageningen University, Netherlands.

Mosavi, G.H.R., Fatahnia, F., Mirzaei Alamouti, H.R., Mehrabi, A. A. and Darmani Kohi, H. 2012. Effect of dietary starch source on milk production and composition of lactating Holstein cows. *South African Journal of Animal Sciences*, **42 (3):**201–209.

Muehlhoff, E., Bennett, A. and McMahon, D. 2013. Milk and dairy products in human nutrition. *International Journal of Dairy Technology,* **2 (67):**303-304.

Muchenje, V., Chimedza-Graham, R., Sikhosana, J.L.N., Assan, N., Dzama, K. and Chimonyo, M. 2007. Milk yield of Jersey × Nguni and Jersey × Tuli F1 and F2 cows reared under smallholder farming conditions. *South African Journal of Animal Science* **8:** 7-10.

Mursik, M., Episodes, D., Preschool, A., and Kirui, E. 2014. Factors influencing consumption of traditionally fermented milk (mursik) and diarrhoea episodes among preschool children (1-5 years old) in kapseret location -uasin gishu county, Kenya. *Nutrition Journal*, **13 (1):**103.

Mutibvu, T., Maburutse, B.E., Mbiriri, D.T., and Kashangura, M.T. 2012. Constraints and opportunities for increased livestock production in communal areas : A case study of Simbe , Zimbabwe., *Livestock Research for Rural Development*.**24 (9):**561–756.

Mutukumira, A. N., 1996. Investigation of some prospects for the development of starter culture for industrial production of traditional fermented milk in Zimbabwe. Doctor Scientiarum Thesis. Department of Food Science. Agriculture University of Norway, Norway

National Department of Agriculture (NDA) 2004. Directorate: Agricultural Statistics of the National Department of Agriculture, Republic of South Africa. 58-73. http://www.nda.agric.za/ docs/Abstract 08.pdf. Accessed 19 September 2015.

National Department of Agriculture (NDA) 2001. Directorate: Agricultural Statistics of the National Department of Agriculture, Republic of South Africa. 73-78. http://www.nda.agric.za/ docs/Abstract 08.pdf. Accessed 19 September 2015.

National Department of Agriculture (NDA) 2008. Directorate: Agricultural Statistics of the national Department of Agriculture, Republic of South Africa, pp. 58-73. http://www.nda.agric.za/docs/Abstract_08.pdf. Accessed 16 July 2008.

Ngongoni, N.T., Mapiye, C., Mwale, M., and Mupeta, B. 2006. Factors affecting milk production in the smallholder dairy sector of Zimbabwe. *Livestock Research for Rural Development*, **18 (5).**

Njarui, D.M.G., Gatheru, M., Wambua, J.M., Nguluu, S.N., Mwangi, D.M., and Keya, G.A. 2011. Consumption Patterns and Preference of Milk and Milk Products among Rural and Urban Consumers in Semi-Arid Kenya Consumption Patterns and Preference of Milk and Milk Products among Rural and Urban Consumers in Semi-Arid Kenya. *Ecology of Food and Nutrition*, **(50):**240–262.

Nyoni L, Titterton M, Hamudikuwanda H and Mutisi C 2001 Body Condition Score and lactation responses in indigenous and cross bred cows in smallholder dairying systems in a Semi-Arid area of Zimbabwe. In: Sustaining livestock in challenging dry season environments:

strategies for small-scale livestock farmers. *In: Proceedings of the 3rd workshop on livestock production programme projects.* Ingwe Lodge and ICRISAT, Matobo, Zimbabwe, pp. 90-96.

Oni, O. and Fashogbon, A.E. 2012. Rural household consumption of milk and products in nigeria. *ARPN Journal of Agricultural and Biological Science*, **7 (12):**1062–1069.

Ouédraogo, G. A, Millogo, V. and Kanwé, B. A. 2008. Relationship between somatic cell counts , dairy cattle milk yield and composition in Burkina Faso. *African Journal of Biochemistry Research*, **2** (2):56–60.

Ozrenk, E. and Inci, S. 2008. The effect of seasonal variation on the composition of cow milk in Van Province. *Pakistan Journal of Nutrition*, **7 (1):**161–164.

Palmquist, D.L. 2009. Milk fat: Origin of fatty acids and influence of nutritional factors thereon. *Advanced Dairy Chemistry*, **2:**43–92.

Pandey and Voskuil. 2011. Smallholder dairy farming: a tool for HIV/AIDS mitigation and food in-security. [Electronic] Africa Forum 2006; The dual epidemics of HIV/AIDS and food insecurity, Lusaka, Zambia, pp 34

Pedersen, C. and Madsen, J. 2000. Contraints and opportunities for improved milk production and calf rearing in Sanyati communal farming area, Zimbabwe. *Livestock Research for Rural Development,***10 (1)**.

Peden, D., Taddesse, G. and Haileslassie, A. 2009. Livestock water productivity: Implications for sub-Saharan Africa. *The Rangeland Journal,* **37:**187-193.

Pedersen, C., and Madsen, J. 1998. Constraints and opportunity for improved milk production and calf rearing in Senyati communal farming area, Zimbabwe. *Livestock Research for Rural Development*, **10 (1)**.

Petit, H. V. 2010. Review: Feed intake, milk production and milk composition of dairy cows fed flaxseed. *Canadian Journal of Animal Science*, **90 (1032):**115–127.

Phuong, N.V. & Marcus M. 2013 Meat consumption patterns in Vietnam: Effects of household characteristics on pork and poultry consumption, In: *Proceedings of a poster presentation at the 53rd Annual Conference of the German Society of Economic and Social Sciences in Agriculture (GEWISOLA): How much market and how much regulation does sustainable agricultural development need?,* Berlin, Germany pp, 25-27.

Ruiz-Sanchez, R., Blake, R.W. Castro-Gamez, H.M.A., Sanchez, F., Montaldo, H.H. and Castillo-Juarez, H., 2007. Short Communication: Changes in the Association Between Milk Yield and Age at First Calving in Holstein Cows with Herd Environment level for Milk Yield. *Journal of Dairy Science*, **90 (10):** 4830–4834.

Sarakul, M., Koonawootrittriron, S., Elzo, M. A, and Suwanasopee, T. 2011. Factors Influencing Genetic Change for Milk Yield within Farms in Central Thailand. *Asian-Aust Journal of Animal Science*, **24 (8):** 1031-1040

Schlink, A.C., Nguyen, M., and Viljoen, G.J. 2010. Water requirements for livestock production : Water requirements for livestock, *Revue scientifique et technique (International Office of Epizootics),* **29 (3):**603–619.

Scholtz, M.M. 2000. Selection possibilities of hardy beef breeds in Africa: the Nguni example. *In*: Pro *3rd World Congress. Sheep and cattle Breeding*, Paris, France.

Schroeder, J.W. and Specialist, D. 2012. Dairy Cow Nutrition Affects Milk Composition, (July).**Sileshi Z, Tegegne AG, Tekle T.** 2003. Water resources for livestock in Ethiopia: implication for research and development. Nairobi (Kenya): ILRI, Addis Ababa, Ethiopia.

Smith, J.F., Brouk, M.J., Iii, J.P.H., and Dhuyvetter, K.C. 2006. Issues with Dairy Facilities Located in the High Plains. In : *Proceeding of the High Plains Dairy Conference* Anand, India, pp. 1–14.

Tapson, D.R. and Rose, C.J. 1984. *An Investigation into the Kwa Zulu Cattle Industry. Agricultural and Rural Development Research Institute*, Fort Hare 2/84

Thorpe, D.R. and W. 2001. Smallholder dairy production and marketing — Opportunities and constraints. In: *Proceedings of 2001 South–South workshop held at National Dairy Development Board (NDDB)* Anand, India.

Toluić, Z., Mijić, P. and Toluić, M. 2009. Importance of Standardizing Raw Milk Quality for the Enhancement of Croatian Market Competitiveness. *Journal of International Food & Agribusiness Marketing*, **21:**207–213.

Trail. 1981. Sahiwal cattle. An evaluation of their potential contribution to milk and beef production in Africa. *Tropical Animal Health and Production*, **41:**1475–1485.

Trung, T.Q., Giam, D.Q., Hai, V.T., Thao, L.P., Thi, N., Hang, T., Thi, L., Son, K., Thi, B., and Linh, M. 2012. Factors Influencing Milk Consumption of Rural Households in. *Greener Journal of Business and Management Studies*, **4 (2):**031–040.

Uzunoz, M and Akeay, Y. 2012. "A case study of Probit Model Analysis of Factors Affecting Consumption of Unpacked Milk in Turkey,." *Economic Research International*, **10:**1155.

Vigne, P. and Whiteside, M. 1997. Encouraging sustainable smallholder agriculture in Namibia, In *Proceedings of work report 2*, Windhock, pp,59.

Vuuren, J. V. 2006. *The smallholder dairyman ' s role in Africa. Dairy Mail Africa: Publication for the Dairy Industry in Africa,* **4 (1):** 20-21.

Walshe, M.J. 2002. Dairy Development in Sub-Sahara Africa: A study of Issues and options case. World Bank Technical Paper, Africa Technical Department Series, Amazon.

SAS, 2015. Statistical Analysis Systems user's guide SAS Institute Inc., Cary, North Carolina, USA.

Waldner, D.N. and Looper, M.L. 2002. Water for Dairy Cattle, New Mexico State University, Cooperative Extension Service, 160 www.cah.nmsu.edu (F-4275, Oklahoma State University, Cooperative Extension 161 Service, http://www.osuextra.com, 1-4.

Wallberg, L. and Wallberg, L. 2011. *Milk production in dairy cows and goats – a case study in the Nyando district in South-Western Kenya*, MSc Thesis, Swedish University of Agricultural Sciences, Sweden.

Webb, E.C. and Mamabolo, M.J. 2004. Production and reproduction characteristics of South African indigenous goats in communal farming systems. *South African Journal of Animal Sciences*, **34:**236–239.

Webb, E.C., Mamabolo, M.J., Du Preez, E.R. and Morris, S.D. 1999. Reproductive status of goats in communal systems in South Africa. In: Research and Training Strategies for Goat Production Systems in South Africa, Proceedings of a Workshop held on 22–26 November, 1998 Eastern Cape Province, South Africa. Pp 79–85.

Weston, R.H. 1996. Some aspects of constraint to forage consumption by ruminants. *Australian Journal of Agricultural Research*, **47 (2):**175–197.

Winks, L., O'Rourke, P.K., Venamore, P.C. and Tyler, R. 1978. Factors affecting birth weight and performance to weaning of beef calves in the dry tropics of north Queensland. *Australian Journal of Experimental Agriculture and Animal Husbandry*, **18(93):** 494-499.

CHAPTER 3: The production of livestock milk in the communal sector of the Eastern Cape Province, South Africa

Abstract.

The objective of the study was to characterize the communal livestock milk production patterns and dynamics in the communal areas in the Eastern Cape Province of South Africa. A total of 500 randomly selected households were interviewed using a semi-structured questionnaire with key informants and personal observations. On average, pasture land size of the sampled households was 1 ha, with a range of 0.25-1.5 ha. The numbers of animals per species found in the studied province was highest for sheep (310) followed by cattle (227) and goat (87). The average livestock holding per household in the study area was 9.85 TLU (Tropical Livestock Unit) with an average of 1-3 milking animals dominant. The indigenous cross breed within sheep, cattle and goat was the predominant breed found within all milk producing livestock, milk production was mainly from cattle (43%) followed by goats (32%) and least sheep (29%). The majority of the livestock milking practices was done predominantly once a day (37%), followed by twice daily (2%). The daily milk production recorded was between 2-5 litre in cattle, 0-1litre in goats and 0-1liter in sheep per producing household with in the province. The highest cattle milk production was recoded in Alfred Nzo district producing 6.0% of milk between 10-20 litres of milk per day. Chris Hani district recorded at 5% the lowest milk production between 1-3 litres per day. Consumption is the predominant reason for milk production recorded at 27% and preference at 14% is the main reason for not producing milk across the province. It was concluded that milk production livestock management is poor, milk production is generally low and varied across the province.

Key words: Tropical Livestock Unit, Indigenous cross breed

3.1 Introduction

It is estimated that 12 to 14 percent (750-900 million people) of the world population and almost 150 million farm households' (approximately 750 million people), are engaged in milk production worldwide (FAO, 2010). The majority of these people are from developing countries either living on dairy farms or within milk producing households that are estimated to produce one million litres of milk per year and creating approximately 200 on farm jobs (FAO, 2010). The milk industry in South Africa is characterised by a wide range of farm sizes (measured in terms of production of milk per annum) and substantial geographic diversity (Dugmore, 2004).In the past years the total production of raw milk in South Africa has increased from 2.2 billion litres in 2004 to 2.6 billion litres in 2011 (SA, 2012). As of 2014, commercial dairy sector produced about 2.8 billion litres. Although the total volume of the production of raw milk in South Africa is increasing, the number of production farm units is decreasing. According to Dugmore (2004), milk production in South Africa from communal livestock is estimated to be only a quarter of that in commercial farming due to low levels of nutrition and management in communal grazing areas

The Eastern Cape livestock numbers are considered, the most important province in the Republic of South Africa (Mapekula *et al*., 2009). The province presents a distribution of more than 8.1 million sheep (36%), 2.9 million cattle and 3.1 million goats, of which 66% and 60% respectively are found mostly in the communal farming areas (National Department of Agriculture, 2004). Eastern Cape contributed 27% of the total milk produced in South Africa followed by Western Cape which took up 26%, Kwa Zulu–Natal took 25%; Free State contributed 10%; Gauteng 3%; Mpumalanga 3%; North West contributed 5% each, Northern Cape and Limpopo provinces shared less than 2% (SA, 2012). However these statistics, disregard milk production from the communal farm households sector is not well documented.

Mapekula *et al.* (2009) reported that the amount of milk produced in communal farm households sector has no evident records and its contribution to national economies is largely unknown.

According to Kabirizi *et al*. (2004) household livestock milk production promotes regular monetary earnings to people who access cash once a season after they sell their harvested crops. It was further stated that, regular monthly monetary earnings from the sale of milk and milk products have favourable effects on the cash flow charts of rural households and assist in improving the lifestyles of the rural people. Communal livestock milk production also helps people to get involved in the mainstream cash economy and poverty alleviation ventures of their countries (Ngongoni *et al*., 2007, Mapekula *et al*., 2009)). It increases the milk production base of the country, improves household nutrition, and empowers women and youths in income generation ventures and overall agricultural development (Somda *et al*., 2005). Ngongoni *et al*. (2006) also reported that household livestock milk production assists farmer households to diversify, spread farming risks and creates opportunity for some idling resources like crop residues to enter the human food chain hence utilising marginal form of resources. The objective of the current study was to characterise production patterns of livestock milk in the communal sector of the Eastern Cape Province, South Africa. The hypothesis tested was there is no difference in milk production among the communal livestock farmers in the Eastern Cape Province.

3.2 Material and Methods

3.2.1 Study area and selection of farmers.

The Eastern Cape (Figure 3.1) is the country's second-largest province after the Northern Cape, taking up 13.9% of South Africa's land area and with a population of around 6.5-million people (Statistics South Africa, 2011). It is lying on the south eastern coast of South Africa, it is a region of rugged cliffs, rough seas and dense green bush of the stretch known as the Wild Coast. The province's diverse climates and landscapes range from the dry and desolate Great Karoo to the lush forests of the Wild Coast and the Keiskamma Valley (Kakembo, 2001). District municipalities in the province are Alfred Nzo, Amathole, Cacadu, Chris Hani, Nelson Mandela Bay Metropolitan and 37 local municipalities and two metropolitan municipalities (Cocks *et al*., 2003).

Climate is highly varied. The west is dry with sparse rain during winter or summer, with frosty winters and hot summers. Mean annual precipitation is <500 mm while potential evaporation is >2000 mm (Kakembo, 2011). Coastal rainfall (600-1000mm) decreases inland to 450-750mm on the central plateau, and increases on the seaward facing scarps and mountains. The winters temperature averages between 7 and 20º C (April and August) and summers temperatures range from 16 to 26º C (November and April) (Cundill, 2005) (Table 3.1) . Convective mid-summer precipitation in the north-east is contrasted with winter rains in the west Kakembo, (2011). The interior can become very cold in winter with temperatures of 7ºC, with heavy snowfalls occasionally occurring in the mountainous regions between Molteno and Rhodes (Britz *et al.,* 2001).

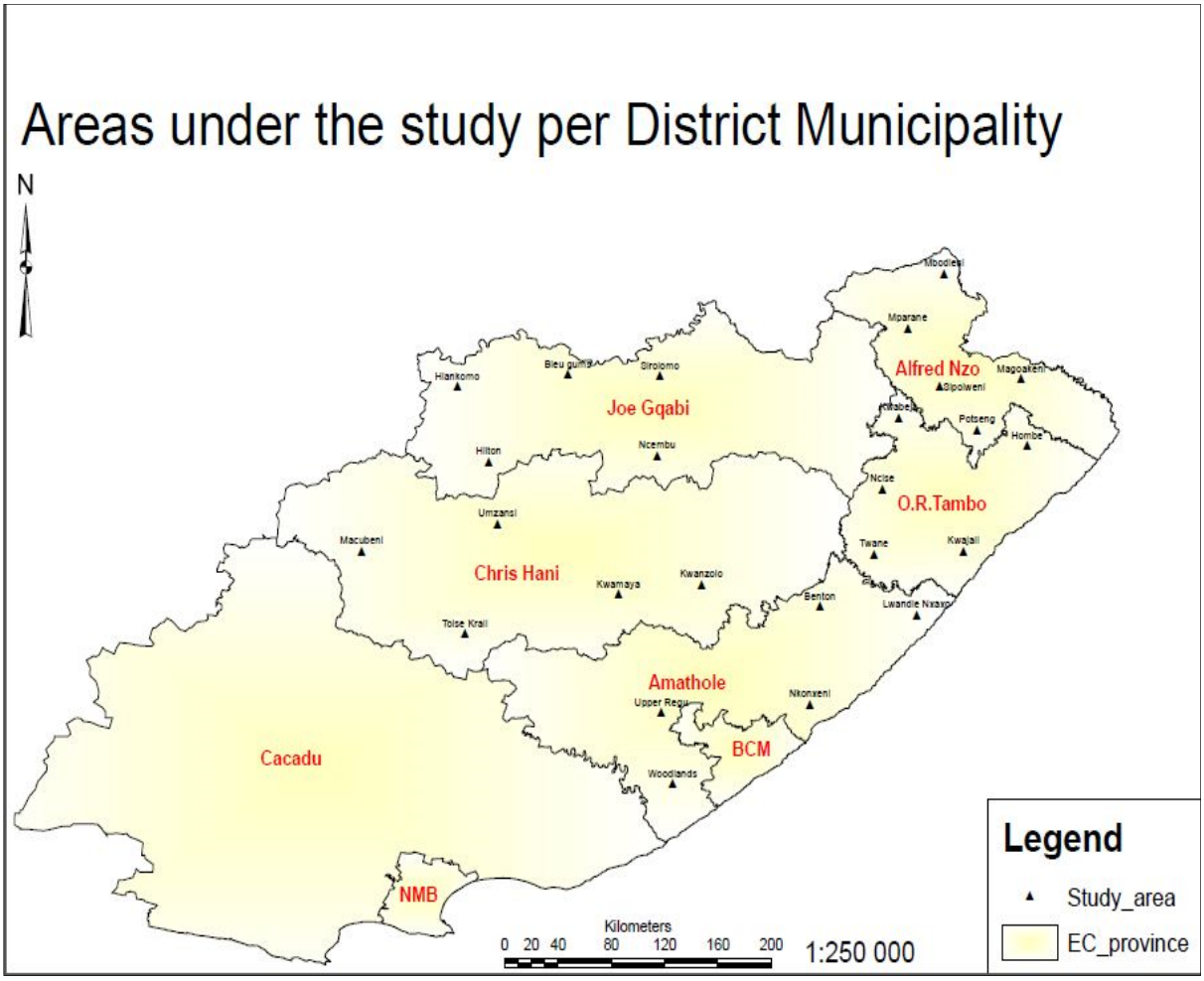

Figure 3.1 Map of area under study per community surveyed and district municipality

Source: South Africa National Biodiversity Institute (SANBI) (2015).

General characteristics of study site.

Table 3.1 Mean rainfall, temperature and veld type.

District	Community	RF (mm)	T (°C)	Veld type
Amathole	Woodlands	85	15	Great fish thicket
	Upper Regu	85	15	Buffels thicket
	Benton	85	15	Mthatha moist grassland
	Nkonxeni	85	15	Bhisho Thiornveld
	Lwandle Nxaxo	85	15	Bhisho Thiornveld
Chris Hani	Toise Krall	85	12	Eastern Cape Escarpment thicket
	Macubeni	85	12	Eastern Cape upper Karoo
	Umzansi	85	12	Eastern Cape upper Karoo
	Kwanzolo	85	12	Mthatha moist grassland
	Kwamaya	85	12	Mthatha moist grassland
Alfred Nzo	Pontseng	200	17	Eastern Valley Bushveld
	Sipolweni	200	17	Mthatha moist grassland
	Mparane	200	17	Mthatha moist grassland
	Mbodleni	200	17	Southern Drankensberg Highland grassland
	Magoakeni	200	17	Midlands Mistbelt grassland
Oliver Tambo	Twane	150	20	Mthatha moist grassland
	Ncise	150	20	Mthatha moist grassland
	Kwabeja	150	20	Eastern Griqualand grassland
	Hombe	150	20	Eastern Griqualand grassland
	Kwajali	150	20	Bhisho thornveld
Joe Qabi	Blue gums	100	20	Eastern Upper Karoo
	Sirolomo	100	18	Aliwal North Dry Grassland
	Hlankomo	100	18	Eastern Upper Karoo
	Ncembu	100	18	Stomberg Plataeu grassland
	Hilton	100	18	Eastern Upper Karoo

Source: South Africa National Biodiversity Institute (2015)

The distribution of veld types in the province can be described briefly as follows: (Kakembo *et al*, 2001, Dovie *et al*, 2008) firstly, Coastal Tropical forest, which occurs from Alexandria to the south- western border of the Eastern Cape near the Knysna area; secondly, False Bushveld, which can be found between the Kei and Keiskamma river valleys (Simnkonda., *et al* 2009), while Karoo and Karroid vegetation covers most of the interior of the region; and finally, Grassveld, which can be found only north of the Great Fish river basin (Cundill, 2005).(Figure 3.2). Soil types there are laterite (red, leached, iron-bearing soil) Kakembo, *et al* (2001), unleached subtropical soils, and gley like (bluish gray, sticky, and compact) podzolic soils (highly leached soils that are low in iron and lime) as described in the Eastern Cape State of the Environment Report (2004).

3.2.2 Study sampling procedure.

A multi – stage area probability sample (Iyoke, 2006) was used between June 2014 and May 2015. The respondents were man and women of 18 years and above spread across the communal district areas of the Eastern Cape. They represent different age groups, education status, and socio-economic profile. This type of sample was chosen because sampling is done sequentially across to or more hierarchical levels. Typical with this survey the first level was the province, then the second level was the delineated district areas and subsequent smaller administrative areas such as wards with the ultimate household level. Although randomly selected the choice of these districts was driven with the intension to give a full detailed description of the Eastern Cape Province as a whole in terms of livestock milk production and communal household milk and milk product consumption patterns.

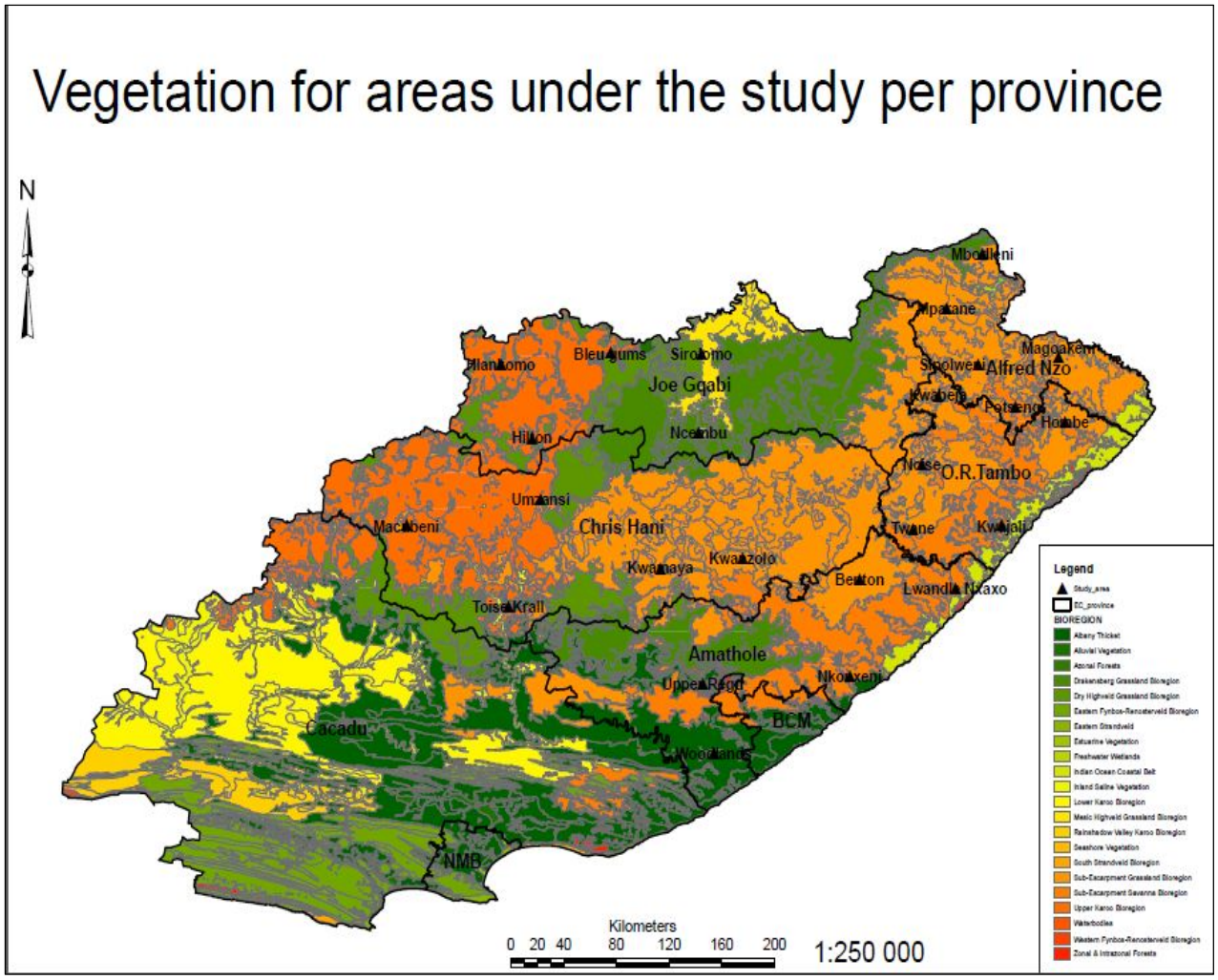

Figure 3.2 Vegetation map of areas under study per community surveyed and district municipality

Source: South Africa National Biodiversity Institute (SANBI) (2015).

3.2.3. Household sampling size procedure.

The household sample size was calculated using a statistical methodology through a fixed formulary and based on a rural population size of 4410000, a confidence level of 95% and a confidence interval of 5%. It was calculated that a sample size of at least 500 would be sufficient for a survey of this nature (Rao soft, 2004). To arrive at a figure of 500, was decided by sampling 20 households in 5 communities within five different communal districts of Eastern Cape. The districts were selected according to their proximity to the University of Fort Hare and financial constraints. Communities were randomly grouped into different agro-ecological zones within each district and feature randomly chosen across each district to insure different agro-ecological zones are covered. The only qualification criteria for selected households is that they should be actively engaged in livestock farming with animals that have a capacity for household or small-scale commercial milk production and that they should have a recent history of milk production. However, this will only give a representative picture on the communal household milk producers and not for non-producers. Therefore half the total sample size was used to represent the number of non-milk producing households (250) to get a true reflection on consumption profiles for non-producers. There was no qualification criteria for selected households surveyed for consumption profiles of non-producers.

3.2.4 Data collection

Pre-tested semi-structured questionnaire was used to collect data through a single visit survey. Trained enumerators collected data from 500 respondents at household level. The questionnaire (See Appendix 2) was prepared in English and translated in local languages (Xhosa and Swati) during interviews. Administration of questionnaire involved key informants such as headman, chiefs, district livestock and health officials, council members and randomly selected community households in all the study sites. Data from the survey was collected from May

2014 to June 2015. Collected data included aspects like: socio-demographic characteristics, milk and milk product: consumption, price, preferences and purchase behaviour, livestock milk production practices and management of milk producing livestock.

3.2.5 Code of ethics.

The researcher will be guided by the HSC code of ethics (HSRC, 1997).

3.2.6 Statistical analysis

Data was analysed using the IBM, Statistical Package for Social Sciences (SPSS) version 22. Descriptive statistics were generated to represent respondents' opinions on various aspects of livestock milk production and these include frequencies, means and standard deviations. Significance differences among treatments means were separated using Tukey HSD at $P<0.05$.

The model used for the analysis of data was:

$$Yijk = \mu + W_i + P_k + e_{ijk}$$

Where,

$Yijk$ = the observed value of a dependent variable (Milk yield)

μ = overall mean

W_i = the effect of the i_{th} district

P_j = the effect of the j_{th} community

e_{ijk} = random error

3.3 Results

3.3.1 Characteristics of milk producing households

3.3.1.1 Household Social demographics

Forty-three per cent of the households were above 60-80 years of age. The highest percentage observed in the study was in Alfred Nzo (38 %) 1.17±1.74, followed by Amathole (33 %) 2.21±1.07, Joe Qabi (27%) 1.08±0.83, Chris Hani (26%) 2.21±1.05 and Oliver Tambo (23 %) 1.46±0.91 between the ages of 60-80 years. About 9 % of the households in province were in the active age group (20-40 years), as shown in Table (3.2). However, the overall mean age for all the districts in the province was 60-80 (± 2.45) years. About 56 % of farmers were male. Most of the households (56%) were married couples, while widows' accounted for 25 %. Majority of the female farmer's husbands worked and lived elsewhere. The majority (46 %) of the households comprised of 5-10 members. The highest percentage observed in the study was in Chris Hani (35%) 2.01±1.30, Alfred Nzo (21%) 1.87±1.02 followed by 30 % (2.11±1.32) in Amathole, Oliver Tambo (1.79±1.11) and Joe Qabi (1.21±1.01) between the ages of 14-20 members. All the households were literate, with the majority (41 %) having completed at least primary school education. The highest leave of literacy (tertiary education) in the province was recorded at 47% (1.10±0.72) in the Joe Qabi district, followed by Oliver Tambo (32%) 1.24±0.69, Amathole (31%) 2.04±1.03, Alfred Nzo (30%) 1.12±0.08 and Chris Hani (27%) 2.17±1.12.The lowest level of literacy in the province was recorded in Alfred Nzo at 22% (1.09±0.60).

Table 3.2 Household size, age category and educational status per district in the study area (n = 500)

Demographics	District									
	Amathole		Alfred Nzo		Chris Hani		Oliver Tambo		Joe Qabi	
	Mean ± SD and Percentages									
Household size										
1-5 members	0.85±0.21	19.0	1.03±0.48	20.0	0.79±0.41	12.0	1.02±0.91	11.0	0.82±0.39	11.0
6-10 members	1.21±0.53	24.0	1.42±0.61	32.0	0.89±0.26	14.0	1.12±0.61	23.0	1.08±0.58	30.0
11-14 members	1.28±0.36	7.0	0.88±0.29	7.0	1.01±0.46	2.0	0.89±0.46	5.0	0.91±0.39	9.0
15-20 members	2.11±1.32	30.0	1.87±1.02	21.0	2.01±1.30	35.0	1.79±1.11	30.0	1.21±1.01	30.0
21-30 members	1.27±0.89	20.0	1.26±1.02	20.0	2.27±0.98	37.0	1.29±0.99	31	0.89±0.71	20.0
P value	0.32		0.25		0.43		0.33		0.11	
Household age Categories										
<20 year of age	0.96±0.44	11.0	1.11±0.58	21.0	0.86±0.50	9.0	1.21±0.91	22.0	0.91±0.46	13.0
20-40 year of age	1.41±0.66	20.0	1.60±0.70	11.0	1.07±0.62	10.0	1.23±0.87	23.0	1.21±0.62	28.0
41-60 year of age	1.58±0.97	21.0	0.96±0.44	9.0	1.12±0.52	21.0	0.70±0.57	14.0	0.98±0.48	18.0
61-80 year of age	2.21±1.07	33.0	1.17±1.74	38.0	2.21±1.05	26.0	1.46±0.91	23.0	1.08±0.84	27.0
81-100 year of age	1.47±0.99	16.0	1.06±0.73	21.0	2.41±1.31	34.0	1.06±0.87	18.0	0.99±0.64	14.0
P value	0.02		0.01		0.010		0.00		0.00	
Educational status of household heads										
Illiterate	0.76±0.38	11.0	1.09±0.60	22.0	0.80±0.42	15.0	1.02±0.67	17.0	0.82±0.53	13.0
Primary	1.01±0.56	25.0	1.23±0.52	33.0	1.01±0.52	29.0	1.12±0.63	35.0	1.03±0.61	31.0
Secondary	1.21±0.83	33.0	0.87±0.38	15.0	1.03±0.60	29.0	0.83±0.49	16.0	0.93±0.50	19.0
Tertiary	2.04±1.00	31.0	1.12±0.08	30.0	2.17±1.12	27.0	1.24±0.69	32.0	1.10±0.72	47.0
P value	0.00		0.01		0.02		0.01		0.00	

N= Number; %= Percentage; SD=Standard deviation

3.3.1.2 Arable land holding and land use

3.3.1.2.1 Arable land available

The results from the survey indicates (Table 3.3) that the majority (48 %) of the household heads had arable land which are between 0- 0.5hectare. Amathole district had the highest respondents at 39%, in this category (0.5- 1 hectare). Only about 3 % of the households have crop land between 7 - 10 hectares. Among this category, Joe Qabi district had the highest at only 2% of the respondents stating they had arable land of this size. On the other hand Oliver Tambo district showed the lowest arable land holding at 35% between 0-0.5 hectares of land. There was a significant $P \leq 0.05$ difference among the five districts in arable land holding by household heads. Table 3.3 also indicates that there was significant ($P \leq 0.05$) difference on holdings of arable land size between households headed by male and female.

3.3.1.2.2 Grazing holding lands

The majority of the households interviewed fed there livestock on communal grazing land. Grazing lands between 30-40 hectares was recorded at 3 % in the Amathole district. Only 3% of the respondent's stated grazing land owned per household were between 5-10 hectares to be the most dominant grazing holding lands. Amathole district at 36% (1.68±0.73) recorded the highest response in all districts with households owning grazing land between 5-10 hectares. There are significant ($P \leq 0.05$) differences at among different districts in the size of the grazing lands across the province (Table 3.4). There was a significant ($P \leq 0.05$) difference on grazing holdings land size between households headed by male and female.

Table 3.3 Arable land available per district in the study area (n = 500)

Size arable land	District									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	Mean ± SD and Percentages (%)									
0-0.5hectare	3.63±1.15	39.0	3.63±1.15	37.0	4.58±2.75	35.0	3.47±2.21	37.0	3.63±1.55	38.0
0.5-1hectare	3.00±.75	31.0	4.00±2.25	35.0	5.00±2.15	38.0	4.00±2.15	31.0	3.00±1.21	31.0
1-2hectare	4.73±2.15	6.0	1.73±.13	10.0	1.66±.85	7.0	1.66±.55	9.0	0.73±.14	6.0
2-4hectare	2.11±.55	7.0	1.11±.21	5.0	0.416±.19	3.0	0.52±.14	6.0	0.81±.19	8.0
5-6hectare	1.50±.35	1.0	1.50±.11	2.0	0.707±.12	3.0	0.85±.11	1.0	0.50±.17	3.0
7-10hectare	1.00±.45	1.0	0.00±.00	0.0	0.414±.10	1.0	0.71±.13	1.0	0.30±.12	2.0
Mean and SD	2.29±1.62		2.01±1.02		2.45±1.89		2.29±1.62		2.56±1.36	
P value	0.00		0.02		0.03		0.00		0.02	

N= Number; %= Percentage; SD=Standard deviation

Table 3.4 Grazing holding lands per district in the study area (n = 500)

Land size	District									
	Amathole		Alfred Nzo		Chris Hani		Oliver Tambo		Joe Qabi	
	Mean ± SD and Percentages									
0-5hectares	0.83±0.24	2.0	-	-	0.71±0.28	1.0	1.01±0.42	7.0	0.45±0.50	2.0
5-10hectares	1.68±0.73	36.0	-	-	0.60±0.20	1.0	-	-	0.37±0.49	2.0
10-15hectares	-	-	-	-	-	-	-	-	-	-
20-30hectares	-	-	-	-	-	-	-	-	0.31±0.02	1.0
30-40hectares	-	-	0.20±0.011	2.0	-	-	-	-	0.57±0.54	3.0
P value	0.08		0.84		0.46		0.67		0.90	

N= Number; %= Percentage; SD=Standard deviation

3.3.1.2.3 Cultivated land use.

The major (13%) use of land across the province is shown in Table3.5 to be predominated by combination of cultivated crops (maize, sorghum, barley and wheat) and vegetables. However, cultivated crops recorded the highest (12%) preference followed by vegetables at 12% in terms of land cultivation preference. Joe Qabi district at 20% showed the highest level in cultivated crops (maize, sorghum, barley and wheat) and Chris Hani district in at 17% the highest vegetable cultivation in the province. There is a significant at ($P \leq 0.05$) between household size and cultivated land. Households with larger family sizes had more cultivated land compared to family with less household members. Table 3.5 also indicates that there was significant ($P \leq 0.05$) difference in cultivated land use between households headed by male and female. There is a significant ($P \leq 0.05$) differences among different districts in grazing holding lands across the province (Table 3.5).

3.3.2 Livestock holding

3.3.2.1 Livestock Herd Size

The livestock herd size per district is indicated in table 3.6. The average livestock holding per household in the study area was 9.85 TLU (Tropical Livestock Unit). The major livestock species kept by farmers in the study area were sheep, followed by cattle and goats. Livestock milk producing numbers were recorded with sheep being the highest at 310 (50 %), followed by cattle at 227 (36 %) and goat at 87 (13 %) across the province. Oliver Tambo district had the highest 61% (4.71±2.12) cattle and 81% (4.47±3.11) sheep ownership, followed by 26% (5.25±1.89) highest goat ownership in Joe Qabi district. There was a significant ($P \leq 0.05$) variation among districts for different species holding. There was significant ($P \leq 0.05$) difference on livestock herd size and ownership numbers between households headed by male and female. There was a positive correlation ($r=0.54$) between livestock herd size and education of level of household head.

Table 3.5 Arable Land use per district in the study area (n = 500)

Use of land	Districts									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	Mean ± SD and Percentages (%)									
Cultivated Crop (maize, sorghum, bali and wheat)	1.21±.56	19.0	2.11±1.03	21.0	1.10±.38	15.0	.87±.37	13.0	2.65±1.43	20.0
Vegetable	.53±.24	7.0	1.03±.99	10.0	1.58±.75	12.0	1.47±.89	17.0	.63±.45	8.0
Crop + Vegetables	5.22±2.82	44.0	4.10±1.76	37.0	5.30±2.89	45.0	4.54±2.55	48.0	3.87±2.21	39.0
Crop + Horticulture + Veg	1.01±.39	8.0	1.31±.29	11.0	.416±.37	6.0	.59±.54	5.0	1.81±.69	10.0
Crop + Horticulture	.30±.11	1.0	.50±.15	4.0	.61±.13	2.0	.75±.21	1.0	.50±.13	2.0
Mean and SD	3.03±2.73		3.45±2.81		2.98±1.76		3.13±2.65		3.11±2.66	
P value	0.05		0.00		0.02		0.13		0.00	

N= Number; %= Percentage; SD=Standard deviation; Veg= Vegetable

Table 3.6 Livestock Herd Size and ownership numbers per district in the study area (n = 500)

Herd size	Districts									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Cattle Herd Size										
Size	40	40.0	55	55.0	61	61.0	38	38.0	33	33.0
M±SD	3.83±2.75		4.23±2.73		4.71±2.12		3.22±2.26		3.02±2.04	
P value	0.01		0.02		0.04		0.01		0.00	
Goat Herd Size										
Size	14	14.0	21	21.0	11	11.0	15	15.0	26	26.0
M±SD	5.25±1.89		5.25±1.89		5.25±1.89		5.25±1.89		5.25±1.89	
P value	0.03		0.37		0.01		0.31		0.01	
Sheep Herd Size										
Size	49	49.0	55	55.0	81	81.0	64	64.0	61	61.0
M±SD	3.17±2.92		3.24±2.08		4.47±3.11		3.57±2.92		3.34±2.68	
P value	0.00		0.04		0.14		0.03		0.11	

N= Number; %= Percentage; M=Mean; SD=Standard deviation;

3.3.2.2 Livestock herd breed composition

The indigenous cross breed was the predominant breed found within all milk producing livestock across the province. It recorded a high of 26% in milking goats, 59% in milking cows and 31% in milking sheep. There is positive significant at ($P \leq 0.05$) among the districts and livestock breed types. The Jersey breed was the second highest breed found in the province with Alfred Nzo district at 4% (1.03±0.36). On the other hand, the Mbusi and Saana goat breeds were recorded as 18% and 22% across the province. The Mbusi is also the second highest goat breed across the province with Alfred Nzo district having the highest 32% (3.91±1.98) of the goat breed (Table 3.7). Amathole at 12% had the highest Boer goat breed. The second predominant breeds used for sheep milk production were crosses between commercial breeds like the Merino and Nguni indigenous breeds. Alfred Nzo at 46% recorded the highest use of crossbred for sheep milk production. Table 3.7 also indicates that there was significant ($P \leq 0.05$) difference between livestock herd breed composition and households headed by male and female. There is a correlation between household gender ($r=0.63$) and livestock herd breed composition.

3.3.3 Animal husbandry practices among the milk producing households within the districts of the Eastern Cape Province, South Africa.

3.3.3.1 Milking frequency of milk producing livestock

The majority of the livestock milking practices was done (37%) predominantly once a day, followed by twice daily (2%) across the province (Table 3.8). The highest milking frequency in cattle production of once day was recorded at 4% between Amathole (1.01±0.72), Oliver Tambo (1.23±0.71) and Alfred Nzo (2.00±0.91) districts. The highest milking frequency at 6%, once daily was recorded for goat milk production in Chris Hani (1.25±0.92) and sheep milk production in Amathole (1.21±0.81) and Chris Hani (1.35±0.84).

Table 3.7 Livestock herd breed composition per district in the study area (n = 500)

Livestock Breed	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Cattle Breed Composition										
Holstein dairy cross	0	0.0	2	2.0	2	2.0	0	0.0	0	0.0
Holstein	0	0.0	1	1.0	0	0.0	0	0.0	0	0.0
Jersey	1	1.0	4	4.0	3	3.0	0	1.0	1	1.0
Indig Cross	62	62.0	59	59.0	61	61.0	42	42.0	62	62.0
Brahman indig cross	0	0.0	1	0.0	4	4.0	0	0.0	0	0.0
Mean± SD	1.03±0.36		1.05±0.60		1.08±0.56		1.13±0.69		1.11±0.37	
P value	0.01		0.00		0.00		0.01		0.00	
Goat Breed Composition										
Mbusi	18	18.0	12	12.0	32	32.0	10	10.0	21	21.0
Mbusi cross	62	62.0	71	71.0	55	55.0	40	40.0	70	70.0
Boer	12	12.0	4	11.0	3	3.0	10	10.0	5	5.0
Saanen	8	8.0	59	6.0	10	10.0	12	12.0	4	4.0
Mean± SD	3.76±2.11		3.91±1.98		3.69±1.29		4.26±2.10		4.55±2.45	
P value	0.01		0.03		0.10		0.01		0.29	
Sheep Breed Composition										
Nguni Breed	11	11.0	9	9.0	7	7.0	15	15.0	15	15.0
Indig Cross	55	55.0	45	45.0	33	33.0	39	39.0	49	49.0
Indig + com cross	33	33.0	46	46.0	45	45.0	39	39.0	29	29.0
Mean± SD	4.02±1.88		3.85±1.27		4.21±2.09		3.88±1.37		3.09±1.86	
P value	0.19		0.07		0.21		1.02		0.90	

N= Number; %= Percentage; SD=Standard deviation; Indig=Indigenous; Com=Commercial

Table 3.8 Milking frequency per district in the study area (n = 500)

Frequency of milking	Districts									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Cattle Herd										
Once	4	4.0	4	4.0	4	4.0	3	3.0	3	3.0
Twice	1	1.0	1	1.0	0	0.0	3	3.0	0	0.0
Thrice	1	1.0	0	0.0	0	0.0	1	1.0	0	0.0
Mean SD	1.01±0.72		2.00±0.91		1.23±0.71		1.15±0.81		1.36±0.81	
P value	0.65		0.39		0.09		0.65		0.57	
Goat Herd										
Once	3	3.0	4	4.0	5	5.0	6	6.0	4	40
Twice	2	2.0	2	2.0	1	1.0	0	0.0	1	1.0
Thrice	0	0.0	0	0.0	1	1.0	1	1.0	0	0.0
Mean SD	1.11±0.61		1.80±0.54		1.33±0.84		1.25±0.92		1.25±0.69	
P value	0.00		0.01		0.03		0.01		0.01	
Sheep Herd										
Once	6	6.0	5	5.0	3	3.0	6	6.0	4	4.0
Twice	1	1.0	1	1.0	1	1.0	2	2.0	1	1.0
Thrice	0	0.0	1	1.0	1	1.0	1	1.0	0	0.0
Mean SD	1.21±0.81		1.70±0.65		1.61±0.86		1.35±0.84		1.21±0.70	
P value	0.01		0.01		0.00		0.01		0.01	

N= Number; %= Percentage; SD=Standard deviation.

There is a positive correlation between household composition (r=0.38), household labour source (r=0.51), household gender (r=0.62), herd size (r=0.29), herd breed composition (r=0.15), household head and milking frequency of milk producing livestock.

3.3.3.2 Time factor in milking practices

3.3.3.3 1 Time when milking is done

Table 3.9 indicates that morning milking practice is the major milking time (36%) preferred by the respondents across the province. Chris Hani district recorded the highest 42% (1.13±0.74) cattle and 22% (1.20±0.88) goat milking preference at this time. Sheep milking practices were also predominantly done in the morning and highest 25% (1.06±0.78) was recorded in the Joe Qabi district. It is also the dominant livestock to be milked at lunch (12%) across the province, with Joe Qabi recording the 10% highest milking practice at this time. Joe Qabi also recorded the highest time of milking combinations being morning and evening with 16% cattle, 10% goat and 9% sheep being milked at this time. There is no significant ($P > 0.05$) difference among the districts and time of milking livestock.

3.3.3.3 2 Time spent on milking livestock

In general from the study it is noted that majority (38%) of the respondents across the province indicated 0-5mints as the time it takes to milk most milk producing livestock. Amathole district at 0-5mints recorded 91% (0.33±1.17) in cattle and 96% (1.32±1.21) in goats being the highest time take to milk livestock (Table 3.10). Joe Qabi district also recorded 81% (1.36± 1.62) being the highest time spent in sheep milking at 0-5mints. However at 16% Chris Hani district, followed by Oliver Tambo district at 14% cattle and 11% sheep also recorded an averagely high response in time spent on milking between 5-10mints among the surveyed population across the province. There were no ($P > 0.05$) differences among the districts and time spent milking livestock.

Table 3.9 Time when milking is done per district in the study area (n = 500)

Frequency of milking	District									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Cattle Milking										
Morning	3	3.0	9	9.0	18	18.0	42	42.0	21	21.0
Noon/Lunch	0	0.0	1	1.0	1	1.0	2	2.0	1	1.0
Evening	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Morn/Evening	0	0.0	1	1.0	0	0.0	3	3.0	16	16.0
Mean SD	1.01±0.17		1.40±0.53		1.05±0.63		1.13±0.74		1.24±0.81	
P value	0.32		0.09		0.33		0.05		0.62	
Goat Milking										
Morning	3	3.0	11	11.0	15	15.0	22	22.0	18	18.0
Noon/Lunch	2	2.0	0	1.0	0	0.0	1	1.0	6	6.0
Supper	0	0.0	0	0.0	0	0.0	1	1.0	1	1.0
Morn/Evening	2	2.0	2	2.0	0	0.0	3	3.0	10	10.0
Mean SD	1.22±0.95		1.30±0.73		1.13±0.89		1.20±0.88		1.10±0.79	
P value	0.52		0.01		0.19		0.09		0.72	
Sheep Milking										
Morning	3	3.0	10	10.0	13	13.0	22	22.0	25	25.0
Noon/Lunch	1	1.0	2	2.0	2	2.0	2	2.0	10	10.0
Evening	0	0.0	1	1.0	0	0.0	0	0.0	0	0.0
Morn/Evening	1	1.0	9	9.0	1	1.0	3	3.0	9	9.0
Mean SD.	0.99±0.09		1.02±.62		1.10±0.65		0.95±0.48		1.06±0.78	
P value	0.14		0.02		0.01		0.01		0.01	

N= Number; %= Percentage; SD=Standard deviation; Morn= Morning

Table 3.10 Time spent on milking per district in the study area (n = 500)

Time spent milking of livestock	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Cattle Time spent on milking										
0-5mins	91	91.0	80	80.0	33	33.0	48	48.0	74	74.0
6-10mins	1	1.0	0	0.0	14	14.0	11	11.0	6	6.0
11-19mins	2	2.0	2	2.0	17	17.0	4	4.0	6	6.0
21-25mins	0	0.0	0	0.0	1	1.0	1	1.0	1	1.0
26-30mins	4	4.0	1	1.0	9	9.0	2	2.0	0	0.0
31min-1h	2	2.0	0	0.0	0	0.0	0	0.0	0	0.0
Mean SD	0.33±1.16		1.10±2.29		2.18±2.062		2.08±2.41		1.00±2.05	
P value	0.01		0.00		0.00		0.00		0.00	
Goat Time spent on milking										
0-5mins	96	96.0	72	72.0	54	54.0	39	39.0	76	76.0
6-10mins	1	1.0	2	2.0	11	11.0	16	16.0	8	8.0
11-19mins	2	2.0	3	3.0	12	12.0	9	9.0	11	11.0
20-25mins	0	0.0	0	0.0	1	1.0	1	1.0	2	2.0
26-30mins	1	1.0	1	1.0	2	2.0	2	2.0	0	0.0
31mins-1h	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Mean SD	1.32±1.21		1.40±1.31		1.23±1.70		1.54±1.82		1.36±1.72	
P value	0.01		0.02		0.00		0.05		0.32	
Sheep Time spent on milking										
0-5mins	82	82.0	83	83.0	48	48.0	61	61.0	81	81.0
6-10mins	8	8.0	4	4.0	11	11.0	11	11.0	3	3.0
11-19mins	3	3.0	2	2.0	9	9.0	3	3.0	1	1.0
21-25mins	1	1.0	0	0.0	3	3.0	7	7.0	1	1.0
26-30mins	1	1.0	2	2.0	2	2.0	2	2.0	1	1.0
31mins-1h	1	1.0	0	0.0	1	1.0	1	1.0	1	1.0
Mean SD	1.45±1.751		2.32±1.611		1.53±1.621		1.61±1.511		1.36± 1.621	
P value	0.07		0.05		0.08		0.04		0.05	

N= Number; %= Percentage; SD=Standard deviation; Min=Mints; h=Hour

3.3.4 Different livestock species utilized for milk production among the districts of the Eastern Cape Province, South Africa.

3.3.4.1 Reasons for household milk production

Consumption is the predominant reason for milk production recorded at 27% across the province. Joe Qabi district recorded consumption at 64% as the highest reason for milk production among all districts. Pet food 2%, high milk production 10%, feeding other livestock 6% and donation 1%, are the other major reasons for milk production in order of response across the province. Oliver Tambo district (0.57±0.04) at 15%, 12% and 9% recorded the highest levels of reasons for milk production to other districts as pet food, high milk production, feeding other livestock and donation respectively. There is a correlation between household composition (r=0.22), household labour source (r=0.31), household gender (r=0.43), Herd size (r=0.37), herd breed composition (r=0.55), household head and reasons for milk production.

Table 3.11 The reasons for household milk production per district in the study area (n = 500)

Reason	District									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	Mean ± SD and Percentages (%)									
Consumption	4.85±2.25	41.0	4.03±2.48	42.0	5.79±1.71	57.0	2.02±.914	27.0	5.82±3.37	62.0
Pet food	0.91±.52	6.0	1.42±.61	12.0	2.89±1.56	15.0	1.02±.612	18.0	0.88±.51	6.0
Donation/Charity	0.88±.36	4.0	0.88±.28	1.0	1.01±0.63	9.0	0.89±.22	2.0	0.00±.00	0.0
High Production	0.71±.32	2.0	0.17±.15	3.0	2.01±1.02	12.0	1.09±.19	9.0	0.71±.31	11.0
Feed other Animals	0.57±.12	3.0	0.56±.32	2.0	1.27±0.92	9.0	1.99±.92	3.0	0.49±.11	1.0
Mean SD	1.02±0.32		2.36±1.03		0.57±0.04		1.82±0.52		1.84±0.55	
P value	0.03		0.01		0.01		0.05		0.01	

N= Number; %= Percentage; SD=Standard deviation.

3.3.4.2 Daily milk production per milk producing household

Milk production is 43% most preferred in cattle followed by 32% in goat and 29% in sheep across the province. There is a significant ($P \leq 0.05$) difference between milk production and districts. Daily cow milk production per household is recorded at 2-5 litre (0.446±1.072) per house hold producing with in the province. .The highest cattle milk production was recoded in Alfred Nzo district producing 6.0% of milk between 10-20liters of milk per day (Figure 4.3). Alfred Nzo district also recorded the highest least producing households at 5.0% between 1-3liters per day. Chris Huni at 5.0%, Oliver Tambo at 3.0% and Joe Qabi and Amathole districts both at 5.0% all followed between 1-3liters per daily. The highest level of cattle milk produced between 2-5liters was recorded in Oliver Tambo district at 4.0%. Amathole and Alfred Nzo districts recorded the lowest cattle milk production at 2.0%. Alfred Nzo Oliver Tambo and Chris Hani districts at 3.0% were all recording the highest milk production between 5-10liters of milk per day. There was a correlation between household composition (r=0.21), household labour source (r=0.24), household gender (r=0.36), Herd size (r=0.25), herd breed composition (r=0.36), household head and daily cattle milk production within the province. .

Daily goat milk production was between 0-1liters (4.86±0.81) per household across the province. The highest goat milk production was recorded in the Amathole and Alfred Nzo districts at 7.0 and 9.0%, respectively, with yield of between 0-5liters produced daily. This was followed by Amathole district also having the highest milk production at 8.0% and least at 1.0% in the Alfred Nzo district between the 2-5liters of milk per day (Figure 4.4). At 11.0% Amathole, Alfred Nzo, Oliver Tambo and Joe Qabi districts all recorded the highest milk production between 1-2liters of milk per household per day**.** There is a correlation between household composition (r=0.33), household labour source (r=0.28), household gender (r=0.33), Herd size (r=0.26), herd breed composition (r=0.55), household head and daily goat milk production within the province. .

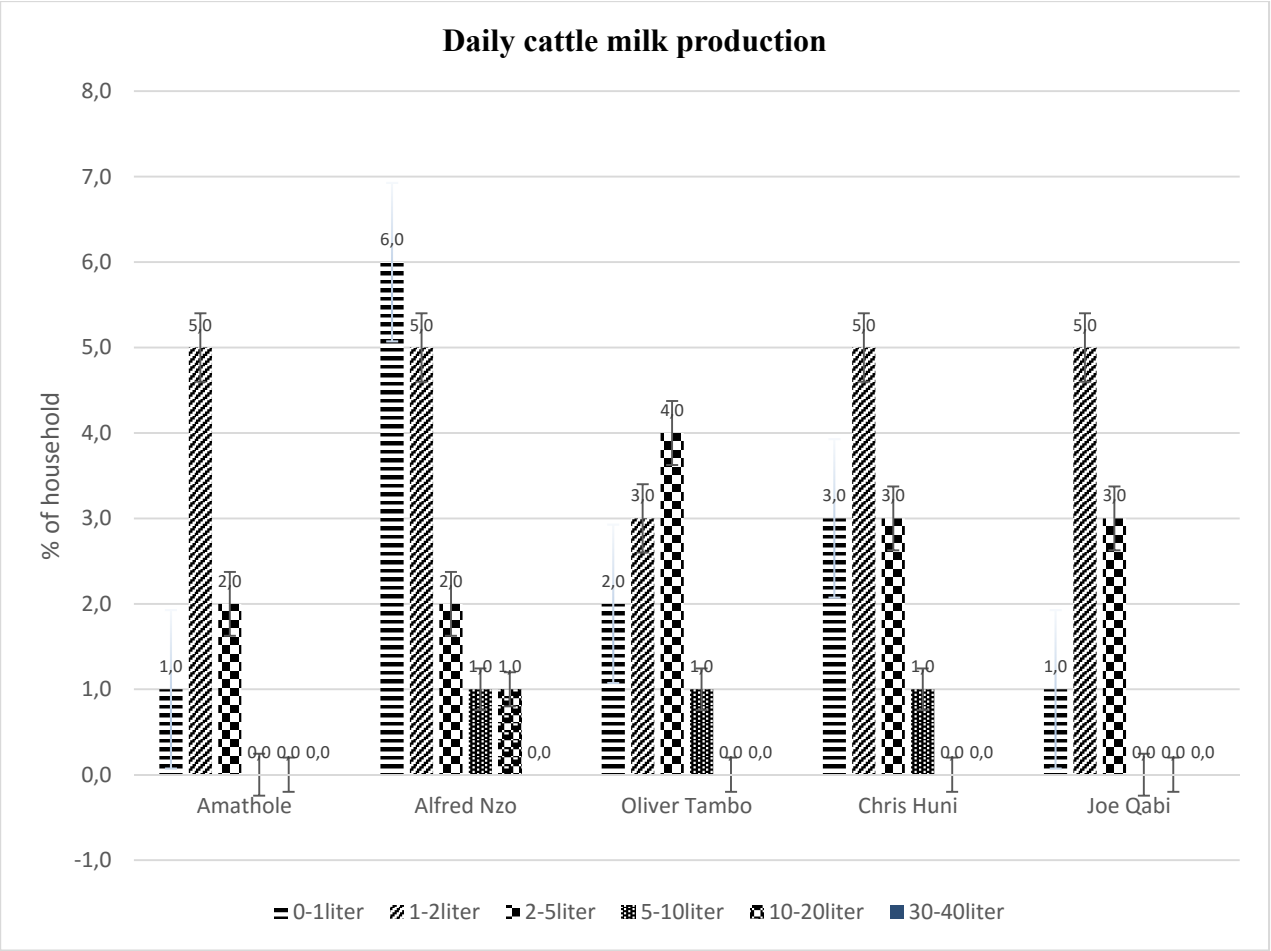

Figure 3.3 Average daily cow milk production within the Eastern Cape Province

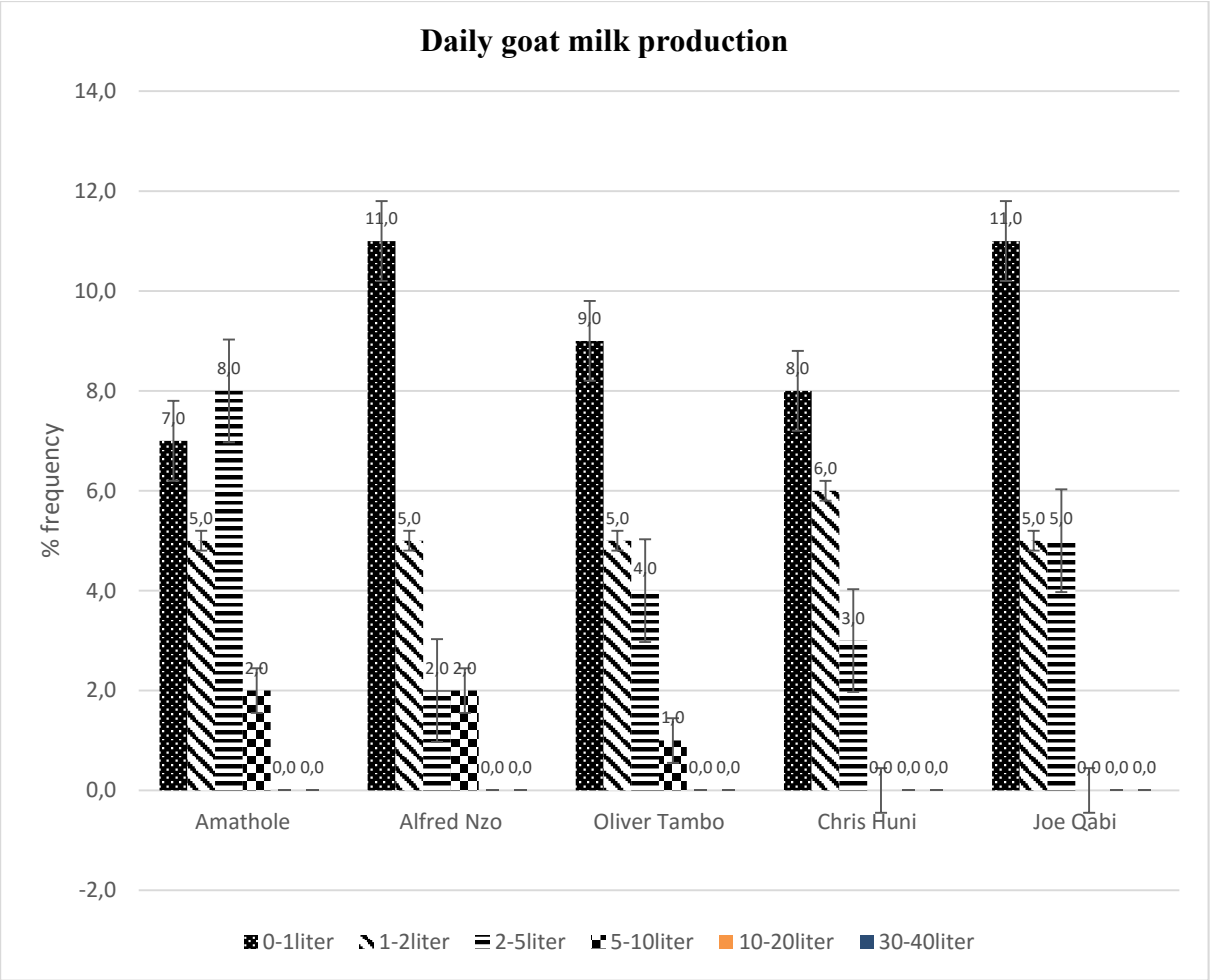

Figure 3.4 Average daily goat milk production within the Eastern Cape Province

The major daily sheep milk production was recorded at 12.0% between 0-1 litres (4.864±0.784) of milk per household per day. Only Amathole district at 4.0% and Alfred Nzo district at 2.0% recorded milk production at the highest level between 8-12liters per house hold daily in the province. The lowest sheep milk production was recorded at 6.0% in the Joe Qabi district between 0-1liters of sheep milk per household daily. Amathole district also recorded the highest daily milk production at 6.0% between 1-2liters, 2.0% between 2-5liters and at 1.0% between 5-10liters (Figure 4.5). The lowest at 2.0% between 2-5liters was recorded in Alfred Nzo district and at 1.0% between 5-10liters in Alfred Nzo and Oliver Tambo. There is a correlation between household composition (r=0.12), household labour source (r=0.22), household gender (r=0.27), Herd size (r=0.33), herd breed composition (r=0.55), household head and daily goat milk production within the province. .

3.3.4.3 Number of milk producing animals

The predominant milking livestock numbers, according to the respondents were between 1-3 animals milking per household in the province (Table 3.12). Generally milking livestock numbers are 18% cows, 2% goats and 7% sheep per household between 1-3 animals in the province. There is positive significant ($P \leq 0.05$) effect between the number of milk producing animals per household and the district in which the animals are found. Alfred Nzo district at 5% (1.23±0.46) has the highest milk producing cows per household being between 11-15animals. The highest goat livestock milk producing numbers were also between 11-15 animals and recorded at 1% in Chris Hani (0.11±0.01) and Alfred Nzo (1.87±0.71) districts. There are more cow milking numbers between 4-6 animals per household compared to other milking livestock. There is a correlation between household composition (r=0.22), household labour source (r=0.32), household gender (r=0.24), Herd size (r=0.33), herd breed composition (r=0.55), household head and number of milk producing animals per household.

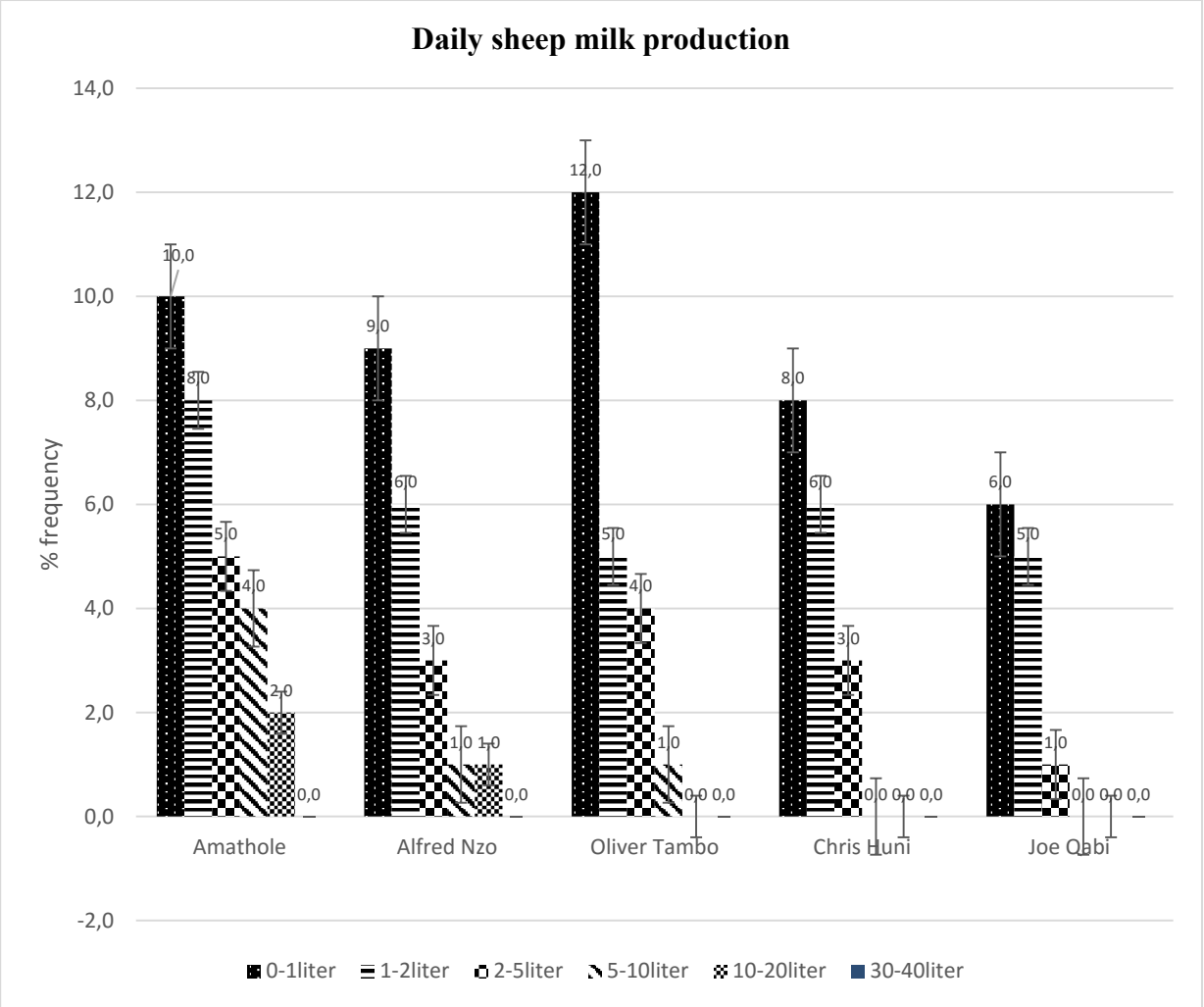

Figure 3.5 Average daily sheep milk production within the Eastern Cape Province

Table 3.12 The number of milking animals per district in the study area (n = 500)

Number of milking animals	District									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Number of milking Cattle										
1-3	80	80.0	69	69.0	82	82.0	80	80.0	70	70.0
4-6	18	18.0	15	15.0	11	11.0	15	15.0	28	28.0
7-9	2	2.0	10	10.0	5	5.0	2	2.0	1	1.0
10-12	0	0.0	2	2.0	1	1.0	0	0.0	1	1.0
11-15	0	0.0	5	5.0	1	1.0	1	1.0	0	0.0
Mean SD	2.01±0.78		1.23±0.46		1.01±0.21		0.11±0.01		0.87±0.31	
P value	0.03		0.09		0.04		0.07		0.01	
Number of milking Goat										
1-3	86	83.0	89	89.0	80	80.0	81	81.0	80	80.0
4-6	11	11.0	10	10.0	13	13.0	16	16.0	8	8.0
7-9	3	3.0	1	1.0	6	6.0	2	2.0	8	7.0
10-12	0	0.0	0	2.0	1	1.0	0	0.0	3	3.0
11-15	0	0.0	0	0.0	0	0.0	1	1.0	1	1.0
Mean SD	2.11±0.78		1.03±0.46		1.11±0.21		1.11±0.61		1.87±0.71	
P value	0.01		0.00		0.03		0.00		0.00	
Number of milking Sheep										
1-3	78	78.0	81	81.0	80	80.0	83	83.0	80	80.0
4-6	15	15.0	14	14.0	10	10.0	12	12.0	18	18.0
7-9	5	5.0	3	3.0	7	7.0	4	4.0	1	1.0
10-12	1	1.0	2	2.0	2	2.0	0	0.0	1	1.0
13-15	1	1.0	0	0.0	1	1.0	1	1.0	0	0.0
Mean SD	2.01±1.78		1.23±0.76		1.21±0.41		1.11±0.51		1.87±0.81	
P value	0.02		0.03		0.01		0.02		0.00	

N= Number; %= Percentage; SD=Standard deviation

3.3.4.4 Source of labour for milk production

The survey indicated there is a high predominance of child labour as the main source for milking producing livestock across the province. There is a significant ($P \leq 0.05$) difference between source of labour allocated for milking livestock and type of livestock milked. Olives Tambo district recorded 17% the highest level of child labour in goat milk production (Table 3.13). Alfred Nzo district followed 16% in sheep and 15% in cow child labour used for milk production. Oliver Tambo district also recorded 5% the highest external family sources of labour in cow milking. Table 3.13 also indicates that there was significant ($P \leq 0.05$) difference between sources of labour and livestock milk production between households headed by male and female. Male headed households had larger 12.8% participation in in milking practices than female headed household heads 8.6%. Only 1% of family friends were used as source of labour was recorded in Amathole district for sheep milk production and Alfred Nzo in cow milking production. There is a correlation between household composition (r=0.25), household gender (r=0.44), Herd size (r=0.34), herd breed composition (r=0.55), milking frequency (r=0.36), milk production and source of labour for milk production per household.

Table 3.13 Source of labour for milk production per district in the study area (n = 500)

Number of milking animals	District									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Cattle milking										
Father	8	8.0	10	10.0	18	18.0	12	12.0	16	16.0
Mother	1	1.0	21	21.0	7	7.0	8	8.0	6	6.0
Children	11	11.0	15	15.0	13	13.0	6	6.0	14	14.0
Ext.Fmly	2	2.0	4	4.0	5	5.0	1	1.0	3	3.0
Mean SD	0.68±0.24		0.21±0.03		0.71±0.13		0.11±0.01		0.16±0.01	
P value	0.01		0.01		0.01		0.05		0.06	
Goat milking										
Father	5	5.0	13	13.0	15	15.0	11	11.0	12	12.0
Mother	3	3.0	5	5.0	11	11.0	4	4.0	3	3.0
Children	9	9.0	10	10.0	17	17.0	9	9.0	10	10.0
Ext.Fmly	1	1.0	2	2.0	1	1.0	0	0.0	1	1.0
Mean SD	0.56±0.12		1.34±0.45		0.58±0.22		3.76±1.28		1.25±0.61	
P value	0.04		0.84		0.84		0.22		0.32	
Sheep milking										
Father	7	7.0	14	14.0	21	21.0	15	15.0	11	11.0
Mother	3	3.0	7	7.0	5	5.0	4	4.0	3	3.0
Children	12	12.0	11	11.0	16	16.0	11	11.0	11	11.0
Ext.Fmly	2	2.0	2	2.0	2	2.0	0	0.0	1	1.0
Mean SD	0.45±0.04		0.81±0.07		0.69±0.11		1.01±0.29		0.12±0.01	
P value	0.06		0.00		0.00		0.13		0.03	

N= Number; %= Percentage; SD=Standard deviation; Ext.Fmly=Extended family

3.3.5 Feed management practises among the milk producing households within the districts of the Eastern Cape Province, South Africa.

3.3.5.1 Livestock feed supplementation

The majority of the livestock feed supplementation in the province was done using natural forage. Amathole district had the highest natural forage supplementation in cattle (98%) and goat's supplementation at 97%. In sheep production Oliver Tambo district had the highest natural forage supplementation at 87%. Amathole had the highest commercial feed supplementation in goats (97%) and sheep (89%). Commercial sheep fed supplementation was generally high (21%) across the province with Alfred Nzo district recording the highest district level of supplementation at 32% (Table 3.14). Most (22%) respondents used supplementation combination were cultivated crop feed mixed with natural forage across the province. The combination of cultivated crop feed mixed with natural forage was most used in goat feeding within the Alfred Nzo district at 88% (0.18±0.04). Sheep supplementation at 76% (0.32±0.07) followed in Joe Qabi district and lastly in Chris Hani at 26% (0.61±0.05) in cattle natural forage supplementation. The use of commercial feed mixed with cultivated crop feed was not commonly used in the province with Oliver Tambo district recording the highest usage at 76% in goat supplementation feeding (Table 3.15). There is a highly positive significance between livestock feed supplementation and household arable land size. Table 3.14 shows the major used mineral supplement to be commercial mineral licks at 48% across all livestock milking species.

Table 3.14 Livestock feed supplementation for milk producing livestock per district in the study area (n = 500)

Veterinary practices	District									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Cattle feed supplementation										
CF	9	9.0	32	32.0	6	6.0	29	29.0	6	6.0
CCF	2	2.0	9	9.0	5	5.0	35	35.0	20	20.0
NF	89	89.0	56	56.0	81	81.0	2	2.0	69	69.0
CCF+NF	0	0.0	1	1.0	2	2.0	26	26.0	2	2.0
CF+CCF	0	0.0	2	2.0	6	6.0	2	2.0	3	3.0
Mean SD	0.23±0.13		0.18±0.03		0.19±0.03		0.61±0.05		0.82±0.03	
P value	0.00		0.00		0.02		0.01		0.00	
Goat feed supplementation										
CF	89	89.0	3	3.0	1	1.0	8	8.0	2	2.0
CCF	0	0.0	6	6.0	17	17.0	32	32.0	20	20.0
NF	2	2.0	3	3.0	1	1.0	3	3.0	69	69.0
CCF+NF	1	1.0	88	88.0	5	5.0	28	28.0	3	3.0
CF+CCF	0	0.0	0	0.0	76	76.0	7	7.0	6	6.0
Mean SD	0.23±0.11		0.18±0.04		0.19±0.02		0.21±0.05		0.32±0.07	
P value	0.00		0.01		0.03		0.01		0.00	
Sheep feed supplementation										
CF	97	97.0	1	1.0	4	4.0	2	2.0	4	4.0
CCF	0	0.0	6	6.0	4	4.0	26	26.0	10	10.0
NF	2	2.0	69	69.0	87	87.0	2	2.0	2	2.0
CCF+NF	0	0.0	2	2.0	5	5.0	46	46.0	76	76.0
CF+CCF	0	0.0	22	22.0	0	0.0	7	7.0	2	2.0
Mean SD.	0.23±0.11		0.18±0.04		0.19±0.02		0.21±0.05		0.32±0.07	
P value	0.00		0.01		0.03		0.01		0.00	

N= Number; %= Percentage; SD=Standard deviation; CF= Commercial feed; NF= Natural forage; CCF= Cultivated crop feed; CCF+NF= Cultivated crop feed +Natural forage; CF+CCF= Commercial feed+ Cultivated crop feed

Table 3.15 Livestock mineral supplementation for milk producing livestock per district in the study area (n = 500)

Veterinary practices	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Cattle mineral supplementation										
CML	10	10.0	6	6.0	15	15.0	9	9.0	10	10.0
C. Salt	1	1.0	67	67.0	6	6.0	16	16.0	4	4.0
Mean SD	1.03±0.36		1.05±0.60		1.08±0.56		1.13±0.69		1.11±0.37	
P value	0.01		0.00		0.01		0.08		0.00	
Goat mineral supplementation										
CML	99	99.0	5	5.0	2	2.0	57	57.0	83	83.0
C. Salt	1	1.0	3	3.0	0	0.0	8	8.0	10	10.0
Mean SD	1.13±0.66		1.35±0.70		1.28±0.66		1.23±0.75		1.11±0.47	
P value	0.00		0.000		0.01		0.03		0.01	
Sheep mineral supplementation										
CML	100	100.0	76	76.0	94	94.0	68	68.0	83	83.0
C. Salt	0	0.0	2	2.0	5	5.0	9	9.0	9	9.0
Mean SD.	2.29±1.616		2.01±1.02		2.45±1.89		2.29±1.62		2.56±1.36	
P value	0.00		0.02		0.03		0.00		0.00	

N= Number; %= Percentage; SD=Standard deviation; CML= Commercial mineral lick; C. Salt= Course salt

3.3.6 Animal health practises among the milk producing households within the districts of the Eastern Cape Province, South Africa

3.3.6.1 Disease prevalence in milk producing livestock

The highest disease recorded in milk producing cows was 8% gall sickness, 2.4% foot rot, 3.6% red water 1.5% abscess 1.9% Quarter evil and 2% three day stiffness across the province (Table 3.16). The dominant disease gall sickness was highest at 10.5% in the Oliver Tambo district. The highest disease prevalence in the province were recorded as red water at 3.9% in the Amathole district, heart water at 2% in the Alfred Nzo district and Quarter evil at 2.3% in the Chris Hani district.

The highest disease recorded in milk producing goats was 6.2% gall sickness, 1.5% mange, 1.2%% foot rot, 1.2% nasal worms and 1% contagious abortion across the province (Table 3.17. The dominant disease was gall sickness which recorded the highest at 8.3% in the Oliver Tambo district. The highest disease prevalence in the province were recorded as mange at 1.9% in the Alfred Nzo district, contagious abortion at 1.3% in the Joe Qabi district, warts at 1.1% in the Amathole district and Mal-kop at 1% in the Chris Hani district. Predators at 3% and unspecified diseases at 2.2% also had a noticeable high prevalence in the Oliver Tambo district.

The most dominant disease prevalent in milk producing sheep was 4.5% nasal worms, 2.9% mange, 2.9% gall sickness and 1.8% blue tongue across the province. The highest disease prevalence in the province were recorded as nasal worms at 5.1% in the Alfred Nzo district, Mal kop at 2.9% in the Oliver Tambo district, mange at 1.1% in the Amathole district and Mal-kop at 1% in the Chris Hani district. Table 3.18 shows there is a positive significant ($P \leq 0.05$) between livestock species and diseases prevalence in each different livestock species.

Table 3.16 Cattle disease prevalence per district in the study area (n = 500)

Disease	District									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Foot rot	12	2.2	17	2.5	21	2.9	18	2.5	10	1.9
Mange	5	0.9	4	1.1	10	1.9	9	0.7	4	0.7
Abscess	7	1.3	8	1.5	5	1.1	11	1.7	10	1.8
Heart water	6	1.1	11	2.0	7	1.4	2	0.7	2	0.5
Lumpy skin	8	1.5	10	1.8	11	1.9	4	0.9	6	0.8
Gall sickness	44	8.1	60	10.1	53	10.4	39	7.1	32	5.9
Red water	21	3.9	25	4.5	20	3.2	23	3.7	17	2.6
Warts	3	0.6	5	.9	7	1.3	4	0.7	1	0.2
Mal kop	1	0.2	2	.5	4	0.5	5	1.1	1	0.2
Quarter evil	10	1.8	8	1.5	16	2.3	14	2.3	8	1.4
Sudden death	1	0.2	2	0.5	3	0.6	1	0.2	1	0.2
Liver sickness	1	0.2	1	0.2	2	0.5	3	0.7	1	0.2
Contagious Abortion	2	0.4	3	0.7	6	0.9	1	0.2	1	0.2
One day stiffness	5	0.9	7	1.2	3	0.7	6	0.9	3	0.7
Three day stiffness	11	2.0	13	2.3	15	2.9	15	2.4	5	0.7
Mean SD	2.29±1.62		2.01±1.02		2.45±1.89		2.29±1.62		2.56±1.36	
P value	0.004		0.021		0.028		0.000		0.002	

N= Number; %= Percentage; SD=Standard deviation

Table 3.17 Goat disease prevalence per district in the study area (n = 500)

Number of milking animals	District									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Gall sickness	33	6.1	35	6.5	41	8.3	30	6.0	31	6.1
Mange	9	1.7	11	1.9	12	1.9	7	1.4	6	1.1
Worms	8	1.5	5	1.2	10	1.7	5	0.9	5	0.9
Mal kop	1	0.2	3	.5	3	.5	2	0.5	2	0.5
Abortion	6	1.1	7	1.3	4	.7	4	0.7	7	1.3
Predator	12	2.2	15	2.7	18	3.0	9	1.7	8	1.5
Warts	6	1.1	3	1.0	5	0.8	4	0.7	5	0.9
Black leg	3	.6	4	0.8	4	0.7	2	0.5	4	0.7
Blue tongue	1	.2	2	0.5	1	0.2	1	0.2	2	0.5
Foot rot	7	1.3	9	1.5	9	1.7	5	0.9	5	0.9
Unspecified	8	1.5	10	1.9	12	2.2	4	0.7	5	0.7
Off	5	0.9	2	0.3	8	1.1	3	0.6	2	0.5
Mal kop	3	0.6	6	0.9	1	0.2	2	0.5	1	0.2
Three day stiffness	1	0.2	2	0.5	2	0.5	1	0.2	2	0.5
Mean SD	3.03±2.73		3.45±2.81		2.98±1.76		3.13±2.65		3.11±2.66	
P value	0.05		0.01		0.02		0.13		0.01	

N= Number; %= Percentage; SD=Standard deviation

Table 3.18 Sheep disease prevalence per district in the study area (n = 500)

Number of milking animals	District									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Nasal Worms	26	4.8	30	5.1	23	4.2	25	4.5	22	4.0
Mange	18	3.3	20	3.9	15	2.9	14	2.3	16	2.4
Red water	3	0.6	5	0.9	8	1.2	1	0.2	4	0.8
Pulpy Kidney	4	0.7	2	0.3	10	1.7	5	0.9	3	0.7
Foot Rot	3	0.6	7	1.1	5	.9	2	0.5	2	0.5
Mal kop	12	2.2	15	2.7	17	2.9	10	2.1	13	1.5
Gall sickness	18	3.3	20	3.8	20	3.8	12	2.3	14	1.7
Black leg	2	0.4	3	0.5	5	1.0	4	0.7	5	0.9
off	2	0.4	5	0.8	3	0.7	5	0.9	1	0.2
Blue tongue	11	2.0	14	2.7	9	1.4	10	1.7	8	1.2
Scabs	3	0.6	1	0.2	5	0.9	2	0.5	4	0.8
Pink eye	2	0.4	2	0.5	2	0.5	3	0.7	2	0.5
Internal Parasites	2	0.4	3	0.7	1	0.2	2	0.5	1	0.2
Mean SD	3.17±2.924		3.24±2.084		4.47±3.112		3.57±2.921		3.34±2.675	
P value	0.000		0.038		0.136		0.029		0.105	

N= Number; %= Percentage; SD=Standard deviation

3.3.3.6.2 Veterinary procedures performed in milk producing livestock

The majority of veterinary procedure were done in sheep at 35.8%, followed by goats at 32.9% and cattle at 31.3% across the province. Dosing practices in milk producing livestock was highest in sheep at 67% followed by goats at 62% and cattle at 55% (Table 3.19). The highest dosing practices were done in Amathole district at 86% in sheep production, 70% in the Oliver Tambo district for goat production and 66% in the Alfred Nzo district for cattle production. Oliver Tambo district recorded the lowest practise in dosing goat at 59% followed by Chris Hani district recording 28% in cattle and 49% in sheep production.

Vaccination practises were highest in sheep production at 66.6%, followed by 63.4% in goat and 55.6% in cattle production. Amathole district at 85% recorded the highest level of sheep vaccination practises followed by Oliver Tambo district at 70% in cattle production and Alfred Nzo district at 66% in goat production. The lowest vaccination practices were recorded at 29% in cattle and 49% in sheep production under the Chris Hani district and 60% in goat production under the Oliver Tambo district.

Livestock dipping practices across the province were recorded at 63.8% in sheep, 61.8% in cattle and 55.8% in goat production. Cattle production had the highest dipping practises at 82% in Amathole district, followed by Oliver Tambo district recording the highest dipping practises in goats at 72%. Alfred Nzo district recorded the highest dipping practise in sheep production at 67%. Chris Hani district at 29% in goat production, 40% in cattle production and 60% in sheep production recorded the lowest dipping practises .Table 3.16 shows there is a positive significant ($P \leq 0.05$) between dosing, dipping and vaccination practises in livestock and different districts in the province.

Table 3.19 Veterinary procedures performed in milk producing livestock per district in the study area (n = 500)

Veterinary practices	Amathole		Alfred Nzo		Oliver Tambo		Chris Hani		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Dosing practices										
Cattle	62	62.0	58	58.0	70	70.0	28	28.0	57	57.0
Goat	63	63.0	66	66.0	59	59.0	61	61.0	64	64.0
Sheep	86	86.0	54	54.0	78	78.0	49	49.0	68	68.0
Mean SD	1.29±0.0982		1.22±0.621		1.30±0.751		1.15±0.581		1.16±0.578	
P value	0.125		0.014		0.000		0.013		0.004	
Vaccination practises										
Cattle	60	60.0	59	59.0	70	70.0	29	29.0	60	60.0
Goat	65	65.0	66	66.0	60	60.0	61	61.0	63	63.0
Sheep	85	85.0	54	54.0	78	78.0	49	49.0	67	67.0
Mean SD	1.99±0.0772		1.02±.421		2.10±0.951		1.95±0.981		1.16±0.778	
P value	0.044		0.037		0.001		0.040		0.003	
Dipping practises										
Cattle	82	82.0	49	49.0	79	79.0	40	40.0	59	59.0
Goat	61	61.0	58	58.0	72	72.0	29	29.0	59	59.0
Sheep	65	65.0	67	67.0	60	60.0	61	61.0	66	66.0
Mean SD.	0.99±0.0872		1.02±.621		1.10±0.651		0.95±0.481		1.06±0.778	
P value	0.137		0.017		0.007		0.010		0.006	

N= Number; %= Percentage; SD=Standard deviation;

3.3.7 Constraints in livestock milk production among the milk producing households within the districts of the Eastern Cape Province, South Africa

3.3.3.7.1 Challenges leading to reasons for not milking livestock

The majority (14%) of the respondent's in the study stated preference as the main challenge leading to reasons for not milking livestock across the province (Table 3.20). Oliver Tambo district at 17% (1.45±0.997) recorded the highest reason for not producing milk being preference. Alfred Nzo district at 15% records cultural reasons and 13% recorded poor animal productivity as the other major reason for not milking livestock. There is a positive significant ($P \leq 0.05$) difference among reasons for not milking livestock and districts. There was also a significant ($P \leq 0.05$) difference on reasons for not milking livestock between households headed by male and female.

Table 3.20 Challenges leading to reasons for not milking livestock per district in the study area (n = 500)

Reasons	District									
	Amathole		Alfred Nzo		Oliver Tambo		Chris Huni		Joe Qabi	
	N	%	N	%	N	%	N	%	N	%
Poor Animal Productivity	6	6.0	13	13.0	9	9.0	2	2.0	6	6.0
Nutrition level	1	1.0	5	5.0	6	6.0	0	0.0	3	3.0
Cultural Reasons	5	5.0	15	15.0	11	11.0	7	7.0	9	9.0
Labour Availability	2	2.0	4	4.0	0	0.0	4	4.0	0	0.0
Preference	14	14.0	14	14.0	17	17.0	15	15.0	11	11.0
Poor Animal Productivity+ Labour	7	7.0	9	9.0	3	3.0	5	5.0	5	5.0
Production + Labour	3	3.0	1	1.0	0	0.0	7	7.0	5	5.0
Mean SD	2.10±1.008		1.91±1.302		1.45±0.997		1.29±1.241		2.65±1.921	
P value	0.453		0.618		0.274		0.621		0.321	

N= Number; %= Percentage; SD=Standard deviation;

3.4 Discussion

The majority (40%) of the households with a mean age of 9 (± 0.6) were recorded to be above 60-80 years of age. Mutisi *et al,* (1994) recorded comparable range of age at 58 years within households in the Chinamhora communal area in Zimbabwe. About 50 % of the households in province recorded the active age group to be between 20-40 years. The majority (77 %) of the households comprised of 14-20 members with a mean of 9 (± 0.6) members/family. Studies done by Bartlett (1980) were in line with these findings were it was states that family size has been asserted to being the most important determinant of labour investment for livestock producing households. He feature gives these as the main reason most livestock producing households have averagely high family size. Also in agreement to these results are the results of Mutisi *et al.* (1994) who indicated that a larger family size strongly correlate positively to the availability of labour in agricultural producing households for herding and cropping.

Generally majority of the households in the province were literate, with the majority (54 %) having completed at least primary school education. This level of education could be linked to the fact that most of the household heads are males. The male child within communal areas is the most encouraged child within a household to reach high levels of education. According to Kerealem (2005) it is believed that in normal circumstances men are the household heads and for that reason the role of education of a household head was linked to higher household income and as a whole the socio-economic status of the family. Nyangito (1986) in agreement with this also linked a positive correlation of household head level of education with the adoption of new and improved technologies in agriculture. The highest level of literacy (tertiary education) in the province was recorded at 47% in the Joe Qabi district. This could be linked to the highest 28% active age group with that district.

Farm sizes are generally small and used first and foremost for food crop production in order to ensure household food security. Results from the survey indicates (Table 3.3) that the majority (47 %) of the household heads had arable land which was in the range of 0.5- 1 hectare this is in line with the report of Delali *et al*. (2006). Cultivar crops (maize, sorghum, barley and wheat) recorded the highest (21%) preference followed by vegetables at 12% in terms of land cultivation preference. The province is shown in Table3.5 to be predominated by combination of cultivar crops and vegetation. There is a significant between household size and cultivated land. Households with larger family sizes had more cultivated land compared to family with less household members. There was also a significant difference in cultivated land use between households headed by male and female noted. This could be most likely linked to traditional culture were male children inheriting land is more common hence male household heads owning larger cultivated land.

The communal grazing lands were reported by the respondents to be the dominant source of feed for livestock in the province. In all the season, wet and dry, animals were allowed to graze entirely on natural pasture on communal grazing land. This was in line with findings reported by Nicholson *et al*. (2004) who reported that livestock farmers in East Africa exchanged genetic material freely. On the other hand management of land under a traditional system with no title deed to land results in overstocking and overgrazing leading to limited herbage production throughout the year. Studies by Moyo *et al.* (2008) in Amathole, Chris Hani and Joe Qabi districts in the Eastern Cape Province indicated the complexity of communal grazing strategies with socio-economic, ecological and institutional factors at play. Studies by Mapiye *et al*. (2009) and Hanyani-Mlambo *et al*. (1998) are in agreement with these results and also reported that efficiency of utilisation of communal rangelands is difficult due to the scarcity of information on the effect of seasonal changes in management and herd dynamics. Out of the

total households interviewed only 33 % of the households had planted pasture. Findings from previous studies (Dlamini, 1990; Ogwang, 1993; Pedersen, 1998; Dlamini and Khumalo, 2000) show that the major limitations to pasture improvement and fodder management was lack of land, knowledge, capital, expertise, equipment and water availability. As observed in the study lack of planted pastures and poor quality grazing and is in line agrees with the findings of Dlamini and Khumalo (2000) went on to state that these constraints are feather exacerbated by livestock grazing is communal area, without proper management and control over livestock numbers.

Indicated in Table 3.4 there is a significant difference on grazing holdings land size between households headed by male and female. Some (12%) of the respondents stated that they owned grazing land owned per household ranges from 5-10 hectares. This could be as a result of tradition were in communal areas land inheritance is usually given to male children therefor resulting in male headed households having access to private grazing lands. Mapiye *et al.* (2009) report was in line with these results were he stated that these large private livestock grazing lands owned by individual households are most likely land benefiters from the land resettlement established by the government in 1890.

The major livestock species kept by farmers in the study area were cattle, followed by sheep and goats. A case study conducted by Masiteng and van der Westhuizen (2001) in the North-eastern Free State in South Africa noted that majority of the communal farmers kept a variety of indigenous livestock breeds, ranging from beef breeds through to exotic and cross bred dairy breeds. The average livestock holding per household in the study area was 9.85 TLU (Tropical Livestock Unit). The major livestock species kept by farmers in the study area were sheep, followed by cattle and goats. Livestock milk producing numbers were recorded with sheep

being the highest at 310 (50 %), followed by cattle at 227 (36 %) and goat at 87 (13 %) across the province. The result agrees with reports form Solomon *et al.*, (1991) that usually show large herds or flocks are positively correlated to large household sizes

The indigenous cross breeds were the predominant breed found within all milk producing livestock across the province. This could be linked to the fact that livestock is allowed to freely breed during herding and dipping practices. These poor breeding practices have the effect of regressing the milk production potential of the resulting generations since the animals are either inbred, reducing their genetic variation or crossbred with non-dairy breeds. As far as cattle milking breeds are concerned, the jersey was the breed with the highest numbers in the province. However, Mostageer *et al.* (1987) studies stated that the problem and constraints with exotic cows in the communal environment are feed and management. Several authors (Pedersen and Madsen, 1998; Masiteng and van der Westhuizen, 2001; Bebe *et al.,* 2003; Weldeselasie, 2003; Kahi *et al*., 2004) reported that majority of livestock farmers in developing countries support the cross breeding of indigenous and exotic dairy breeds in an effort to harness the positive traits of the different breeds On the other hand the Mbusi goat breeds was recorded as the predominant breed across the province. The other predominant breeds used for sheep milk production were crosses between commercial breeds and indigenous breeds. Weldeselasie (2003) and Kahi *et al*. (2004) agreed with the results stating the reason being that the indigenous breeds are known to be well adjusted to their environmental conditions. Kahi *et al.* (2004) further goes on to state that indigenous breeds adjust by being either tolerant or resistant to most of the prevalent livestock diseases and pests making them generally hardy breeds.

The survey indicated there is a high predominance of child labour as the main source for milking livestock across the province. Similarly, studies done in Boran cattle households herding farmers who also involved male and female family members between 6 to 25 years of age (Coppock, 1994). This finding is also in line with the report of Grandin *et al.* (1991) were 92% respondents in Maasai Kenya indicated that the kids and lambs herding started between 3 or 4 years of age. However, herding of larger and considered more important livestock like calves started between 8 or 9 years of age. Therefore, those reports indicate that herding is the major activity for children in lowlands. There is a significant difference between milked livestock species and source of labour allocated for milking them. Household members are participating in various dairy animal managements in the studied area and this was dependent not only on the sex and age of the family members, but also on the type of livestock. Grandin *et al*. (1991) also noted that to overcome labour shortage communal farmers strategically allocated labour in terms of different age and sex to different tasks. Fratkin (1987) findings are also in agreement with the results.

The frequency of milking per day ranged between once daily to twice a day among the milk producing households at the time the study was conducted. Most livestock farmers milking practices were done (37%) predominantly once a day, followed by twice daily (2%) across the province Most respondents highlighted that most milking practises were done in the morning. There was positive significant among the districts and milking frequency of milk producing livestock. This is in agreement with reports from Prosser and Davis (1992) and Bar-Peled *et al.* (1995) who both highlight that increased milk yields can be achieved through increased milking frequency. Amos *et al.* (1985) was also in line with the results reported stating that cows milked 3 times a day in comparison to those milked twice a day had higher milk yields and lactation persistency.

Generally milk production in the study area was low. These results are in agreement with reports from other authors (Shackleton *et al*., 1999; Grobbler *et al*., 2008 and Delali *et al*., 2006) who observed that milk yield in commercial production systems was higher compared to yields in communal systems. The daily milk production recorded was between 2-5 litre in cattle, 0-1litre in goats and 0-1liter in sheep per producing household with in the province. Similarly, results by South Africa Trial and Gregory (1981) and Prinsloo and Keller (2002) research reported low milk yields findings of 7.6 to 10.6 1itres per household in communal areas. Ngongoni *et al*. (2006), Muchenje *et al*. (2007) and Chinogaramombe *et al*., (2008) reported similar findings of low milk yields of below 10kg/day in the communal areas of Zimbabwe. However, Azage *et al*. (2009) reported a similar range to the present study results to be 2±0.13 litters as an average daily milk yield from cattle in the Amhara region in North Gondar. Milk production in all livestock varied across the province. The highest cattle milk production was recoded in Alfred Nzo district producing 6.0% of milk between 10-20 litres of milk per day. There is positive significant among the districts and milk production in milk producing livestock. The observed differences between regions on milk yield could be attributed to difference in lactating cow numbers, management, nutrition and agro-ecological factors.

Milk production is 43% most preferred in cattle followed by 32% in goat and 29% in sheep across the province. It was noted that majority of farmers indicated they were interested in producing more milk and incorporating breeds such as Jersey or dairy crossbreeds. However, these farmers mentioned that they wished to be capacitated with management of the dairy breeds and supplementary feeding to improve livestock performance, this is in line with findings from Israel and Pearson, (1998), Kennedy, (2005) and Scholtz, (2010). The findings in the study indicate that farmers need training in dairy livestock management agrees with Du

Toit Moolman and Burger (1992). The study also revealed that community members, especially in Chris Hani district preferred donating to neighbours than selling milk or processing for household consumption. Although farmers never give specific reasons for donating milk, it might be linked to reducing wastage and community strengthening of relationships. This is similar to findings by Mapekula (2009) were it was also stated that communal milk producers in Queenstown town in the Eastern Cape Province, South Africa preferred donating milk to neighbours than selling it so as to gain fame, strengthen community relationships and create socio political security

Milk producing livestock in the study area were not given any special treatment from all other livestock kept by the respondents. There is limited veterinary service in the study area with particular focus to milk producing livestock. Dipping followed by vaccination practices were reported to be the most common veterinary practices. This could be because the government through extension services provide subsidised dipping and selected vaccination products to communal farmers. Majority of the dipping is done in communal dip tanks constructed by government. A few households controlled ticks on the farm using knapsack sprayers. However, sometimes livestock spent long periods without being dipped due to either the unavailability of water or dipping chemicals, also reported by Mapiye *et al.* (2007). Vaccination and dosing practises are mostly done "when necessary" by private practices on commission from the communal livestock farmers. The household farmers indicated random and disorganised de-worming, unsystematic vaccination against diseases of economic importance like quarter evil and contagious abortion and showed little understanding of the common causes of death in their livestock. Gall sickness was the major disease noted to be dominant across all milk producing livestock species in the province. According to Suzuki (2005) diseases are affecting

livestock production in numerous ways such as early death, body weight loss and poor fertility and reduced milk yield.

There is limited cultivation of fodder for animals. The majority of the livestock feed supplementation in the province was done using natural forage One of the critical problems faced by the farmers was seasonal scarcity of livestock feed. Several authors (Lilius *et al*. 2003, Ngongoni *et al*. 2006, Mupangwa, 1994, Mapiye *et al*. 2009, Mapiye *et al*. 2006, Mapiye *et al*. 2006b).reported similar research work done in Zimbabwe in smallholder farmers based on seasonal feed variations. According to Mupangwa, (1994) the scarcity of communal grazing lands in communal areas and access to quality management, communal farmers are most likely to have high reliance on communal feed supplies and challenges in overcoming livestock feed shortages. Intensification of dairy production has limited potential under grazing systems. In addition to the restricted availability, Topps and Oliver (1993) reported that high cost of concentrates and the decreasing milk to concentrate price ratio makes it problematic to feed satisfactory concentrates causing low productivity in milk production.

The use of commercial feed mixed with cultivated crop feed was not commonly used in the province. Similarly, as indicated by Beruk (2000) the use of improved forage and supplementary feed was insignificant which made rangelands the preferred main feed sources of livestock Table 3.14 shows the major used mineral supplement to be commercial mineral licks at 48% across all livestock milking species. This type of feeding of salt was also reported by Ahmed (2002) in the Somali region were herders collected salt in potential salt rich areas to feed livestock. This report is also in line with the report of Abule (2004) in middle awash valley who stated the feeding of mineral salt increased milk production. There is a correlation between household head gender (r=0.55) and livestock feed and mineral supplementation per

household. This indicates that male headed households show the understanding in importance of supplementary mineral and feed practices.

3.5 Conclusion

The study showed that there is a low milk production at household level throughout the province. The findings also show that the milk producing households are mixed crop and livestock producers dominated by indigenous milk producing livestock. Livestock production is one of the main livelihood activities for subsistence and cash income within the provinces communal areas. Farmers do not benefit fully from these activities as there are a number of associated constraints. As a conclusion, from this study it was noted that the existing milk production systems is low and mainly extensive systems which are interwoven with many constraints related to diseases, feed shortages, poor livestock performance, labour availability, animal health, nutrition level and farmers preference.

3.6 References

Abule, E. 2004. Rangeland Evaluation in Relation to Pastoralists perceptions in the Middle Awash of Ethiopia. PhD Thesis, University of the Free State. Bloemfontein. South Africa. pp. 87-120.

Ahmed, P. K. and Rafique, M. 2002. Internal Marketing: Tool and concepts for customer focused-management, Butterworth Heinemann, Oxford, United Kingdom.

Amos, H. E., T. Kiser, and M. Loewenstein. 1985. Influence of milking frequency on productive and reproductive efficiencies of dairy cows. *Journal Dairy Science,* 68: 732-736

Azage, T., Tesfaye M., Tesfaye D., Worku T. and Eshete D. 2009 Transhumance cattle production system in North Gondar, Amhara Region, Ethiopia: *Is it sustainable? IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project. Working Paper No.14*. ILRI (International Livestock Research Institute), Nairobi, Kenya, 73.

Bar-Peled, U., Maltz, E., Bruckental, I., Folman, Y., Kail, K., Gacitua, H. and Lehrer, A, R. 1995. Relationship between frequency milking or suckling in early lactation and milk production of high producing dairy cows. *Journal Dairy Science*, **78**:2726-2736.

Bartlett, P. F. 1980. Cost benefit analysis: a test of alternative methodologies. In: Bartlett P F (editor) Agricultural decision making to Rural Development. Academic Press. Rando San Diego, New York, United Sates of America.

Bebe, B.O., Udo, H.M.J., Rowlands, G.J. and Thorpe, W. 2003. Smallholder dairy systems in the Kenya highlands: cattle population dynamics under increasing intensification. *Livestock Production Science*, **8 (22-3)**: 211-221.

Britz, P.J. 2007. A Study on the Status of Aquaculture Production and Trade in South Africa. In: Growth Potential of the South African Aquaculture Industry and Recommendations for Sector Development. A report for the Department of Trade and Industry produced by Environment Fish Africa, **2:**24

Chinogaramombe, G.N.C., Muchenje, V., Mapiye, C., Ndlovu, T., Chimonyo, M. and Musemwa, L. 2008. Challenges for improving smallholder dairy production in the semiarid areas of Zimbabwe. *Livestock Research for Rural Development*, **20 (3)**.

Cocks, M., Dold, T. and Wiersum, F. 2003. The Cost of Culture: the role of natural resources in maintaining Xhosa customs in the Eastern Cape. *Veld and Flora,* **89:** 146-149.

Coppock, D. L., Ellis, J. E., and Swift, D. M. 1988. Seasonal patterns of activity, travel and water intake for livestock in South Turkana, Kenya. *Journal of Arid Environments*, **14:** 319–331.

Cundill, G. 2005. Institutional Change and Ecosystem Dynamics in the Communal Areas around Mt Coke State Forest, Eastern Cape, South Africa. M.A. thesis, Rhodes University.

Delali, B.K., Dovie, D.B.K., Charlie, M., Shackleton, C.M. and Witkowski, E.T.F. 2006. Valuation of communal area livestock benefits, rural livelihoods and related policy issues. *Land Use Policy*, **23:** 260–271.

Dlamini, A. M. and Khumalo, G.Z. 2000. Evaluation of the performance of the small-scale dairy sector on Swazi nation Land. (University of Swaziland). A final project report commissioned by the Swaziland Farmer Development Foundation under the consortium of NGO's Drought mitigation programme (Sponsored by the EU).

Dlamini, S. M. 1990. The management practices on small-scale dairy farms in Swaziland. BSc Dissertation, Faculty of Agriculture, University of Swaziland, Swaziland.

Dovie D, Witkowski E and Shackleton C. 2008. Knowledge of plant resource use based on location, gender and generation. *Applied Geography*, **28**: 311-322.

Du Toit Moolman, L.A. and Burger, W.P. 1992. The New Agricultural Science. Hodder and Stoughton Educational Southern Africa, South Africa, 206 - 210

Dugmore, T.J., Oosthuizen, P. A, and Toit, J.F. 2004. Strategies for dairy production in rural areas. *South African Journal of Animal Scieance*, **5:**45–47.

Eastern Cape State of the Environment Report. 2004.

http://www.environment.gov.za/soer/ecape/download_report.htm

Food and Agricultural Organisation 2001 Mixed crop-livestock farming: A review of traditional technologies based on literature and field experience. Traditional technologies for animal production, Chapter 5http://www.fao.org/DOCREP/004/Y0501E/y0501e06.htm

Fratkin, E. 1987 Age-sets, households and the organisation of pastoral production: The Ariaal, Samburu and Rendille of Northern Kenya. *Research in Economic Anthropology* **8**: 295–314.

Grandin, B. E., Bekure, S., and Nestel, P. 1991. Livestock transactions, food consumption and household budgets. In Bekure, S., de Leeuw, P. N., Grandin, B. E., and Neate, P. J. H. (eds.), *Maasai Herding: An Analysis of the Livestock Production System of Maasai Pastoralists in Eastern Kajiado District, Kenya*. Addis Ababa, Ethiopia: International Livestock Centre for Africa, 103–114.

Grobler, S.M., Scholtz, M.M., Bester, J., Mamabolo, J.M. & Ramsay, K.A. 2008. Dairy production systems in the emerging and communal sectors of South Africa: Results from a structured survey. *Applied Animal Husbandry and Rural Development*. **1:** 25-30.

Hanyani-Mlambo, B.T., Sibanda, S. and Østergaard, V. 1998. Socio-economic aspect of smallholder dairying in Zimbabwe. *Livestock Research for Rural Development* **10(2).**

Israel, S.H. and Pearson, R.A. 2000. Strategies to improve the effectiveness of supplementary feeding of working cattle in semi-arid crop/livestock systems. Empowering farmers with animal traction. Proceedings of the workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA) held 20-24 September 1999, Mpumalanga, South Africa. http://ww.atnesa.org/Empowering99/Empowering99-Isreal/Pearson-

Iyoke, C.A. 2006 "Teachers' Attitude is Not an Impediment to Adolescent Sexuality Education in Enugu, Nigeria." *African Journal of Reproductive Health/La Revue Africaine de la Santé Reproductive* **10 (1)**: 81-90

Kabirizi, J., Mpairwe, D. and Mutetikka, D. 2004. Testing forage legume technologies with smallholder dairy farmers: a case study of Masaka district, Uganda. *Uganda Journal of Agricultural Sciences*, **9**: 914-921.

Kahi, A. K., Nitter, G. and Gall, C. F. 2004. Developing breeding schemes for pasture based dairy production systems in Kenya 11. Evaluation of alternative objectives and schemes using a two-tier nucleus and young bull system. *Livestock Production. Science*, **88**: 179-192

Kakembo, V. 2001. Trends in Vegetation Degradation in Relation to Land Tenure, Rainfall, and Population Changes in Peddie District, Eastern Cape, South Africa. *Environmental Management,* **28**: 39-46.

Kebede, T. and Lemma, T. 2007 Study of honey production systems in Adami Tulu Jido Kombolcha district in mid rift valley of Ethiopia. *Livestock Research for Rural Development*, **19:**11. http://www.lrrd.org/lrrd19/11/kebe19162.htm

Kennedy, J., Dillion, P., Delay, L., Faverdin, P., Stakelum, G. and Rath M. 2005. Effect of genetic merit and concentrate supplementation on grass intake and milk production with Holstein Friesian dairy cows. *Journal of Dairy Science,* **86:** 610-621

Llius, A.W. and O'Connor, T.G. 2000 Resource heterogeneity and ungulate population dynamics. *Oikos*, **89**:283–294.

Mapekula M, Chimonyo M, Dzama K. and Mapiye, C. 2009. Milk production and calf rearing in communal areas of the Eastern Cape Province of South Africa. *Tropical Animal Health Production*, **41**: 1475-1485.

Mapiye. C., Mupangwa, J. F., Mugabe, P. H., Chikumba, N., Poshiwa, X. and Foti, R. 2006 A review of forage legumes research for rangeland improvement in Zimbabwe, *Tropical Grasslands* **40**: 145-149

Mapiye C, Mwale M, Chikumba N, Poshiwa X, Mupangwa J F and Mugabe, PH 2006b A review of improved forage grasses in Zimbabwe. *Tropical and Subtropical Agro-ecosystems*, **6:**125-131.

Mapiye, C., Chimoyo, M., Muchenje, V., Dzama, K., Marufu, M.C. and Raats, J.G. 2007a. Potential for value-addition of Nguni cattle products in the communal areas of South Africa: a review. *Africa Journal of Agricultural Research*, **2 (10)**: 488-495

Mapiye, C., Chimonyo, M., Dzama, K., Raats, J.G. and Mapekula, M. 2009. Opportunities for improving Nguni cattle production in the smallholder farming systems of South Africa. *Livestock Science,* **124:**196 - 204.

Mejai, C.E., Preston, T.R. and Fajersson, P., 1998. Effects of restricted suckling versus artificial rearing on milk production, calf performance and reproductive efficiency of dual purpose Mpwapwa cattle in a semi-arid climate. *Livestock Research for Rural Development***, 10(1)**.

Mostageer A, Morsy M A and Nigm A, A. 1987. The performance of cattle breeds in adverse environments. *Journal of Animal Breeding and Genetics,* **104:** 206-212.

Moyo, B. and Masika, P. J. 2009. Tick control methods used by resource limited farmers and the effect of ticks on cattle in rural areas of the Eastern Cape Province, South Africa. *Tropical Animal Health and Production,* **41(4):** 517 - 523.

Muchenje, V., Chimedza-Graham, R., Sikhosana, J.L.N., Assan, N., Dzama, K. and Chimoyo, M. 2007. Milk yield of Jersey ^{X} Nguni and Jersey ^{X} Tuli F1 and F2 cows reared under smallholder farming conditions. *South African Journal of Animal Science* **8**: 7-10.

Mupangwa, J. F. 1994 Fodder production in small-scale and communal sectors of Zimbabwe. In: Proceedings of the Workshop on Integrated Livestock/Crop Production in the Small-Scale and Communal Farming Systems in Zimbabwe. Held at Faculty of Agriculture Hall, University of Zimbabwe. 26-28 January 1994

Mutisi C, Nyamangara M, Madsen J, Hvelplund T and Gomez M 1994 A study of crop-livestock system in Chinamhora communal area with emphasis on cattle nutrition. In: Mutisi

C, Madsen J, Hvlepund T and Gomez M (editors). Proceedings of the workshop on integrated livestock/crop production in the small-scale and communal farming systems in Zimbabwe. University of Zimbabwe. 26-28 January 1994. pp 148-161.

National Department of Agriculture (NDA) 2004. Directorate: Agricultural Statistics of the National Department of Agriculture, Republic of South Africa. 58-73. http://www.nda.agric.za/ docs/Abstract 08.pdf. Accessed 19 September 2015.

Ngongoni, N.T., Mapiye, C., Mwale, M. and Mupeta, B. 2007. Effect of supplementing a high-protein ram press sunflower cake concentrate on smallholder milk production in Zimbabwe. *Tropical Animal Health and Production*, **39 (4)**: 297-307.

Ngongoni, N.T., Mapiye, C., Mwale, M. and Mupeta, B. 2006. Factors affecting milk production in the smallholder dairy sector in Zimbabwe. *Livestock Research for Rural Development*, **18 (05).**

Nicholson, C. F., Thornton, P. K. and Muinga, R. W. 2004. Household level impacts of dairy cow ownership in Coastal Kenya. *Journal of Agricultural Economics,* **55** (2): 175-195.

Nyangito, H. Z. 1986 A socio-economic analysis of the factors that determine the effect of potato post-harvest practices and storage technologies on Kinangop, Kenya. A case study. MSc Thesis, University of Nairobi, Kenya.

Ogwang, B. H. 1993. Constraints to the development of improved pastures for small-scale dairy farmers in Swaziland. *Uniswa Journal of Agriculture*. **2**: 70-75.

Pedersen, C., and Madsen, J. 1998. Constraints and opportunity for improved milk production and calf rearing in Senyati communal farming area, Zimbabwe. *Livestock Research for Rural Development*, **10 (1)**.

Prinsloo, N.A., and Keller, J.J. 2000. A case study of the production of milk by rural farmers in the highlands of South Africa. In "*Small-Scale Milk Collection and Processing in Developing Countries*" conference held in South Africa.

http://www.fao.org/ag/aga/agap/ lps/dairy/ECS/Papers/pp_sa.htm. Accessed 19 September 2015.

Prosser, C.G. and Davis, S.R. 1992. Milking frequency alters the milk yield and mammary blood flow response to intra-mammary infusion of insulin-like growth factor-I in goat. *Journal of Endocrinology*, **135**: 311-316.

Rao soft Inc. 2004. Statistical software to calculate sample size of survey type experiments rearing in communal areas of the Eastern Cape Province of South Africa. Journal of River Catchment, Bushbuckridge, CSIR Environment Report No. ENV-P-C 99003,

Scholtz, M.M. and Theunissen, A. 2010. The use of indigenous cattle in terminal cross breeding to improve beef cattle production in Sub-Saharan Africa. *Animal Genetic Resources,* **46:** 33 – 39.

Scholtz, M.M. and Grobler, S.M., 2000 A systems approach to the South African dairy industry. *South African Journal of Animal. Science*. **39**:121-125.

Shackleton, C.M., Shackleton, S.E., Netshiluvhi, T.R., Mathabela, F.R. and Phiri, C. 1999. The direct use value of goods and services attributed to cattle and goats in the Sand River Catchment, Bushbuckridge, CSIR Environment, and Report No. ENV-P-C 99003, CSIR, Pretoria.

Solomon, G., Solomon, A. and Asfaw Negassa. 1991 Growth responses of Begait sheep to different level of maize and Noug Cake supplements. pp. 113-118. In: proceeding of the 4th National Livestock Improvement Conference (NLIC). 13-15 November 1991, IAR. Addis Ababa, Ethiopia.

Somda, J., Kamuanga, M. and Tollens, E. 2005. Characteristics and economic viability of milk production in the smallholder farming systems in The Gambia. *Agricultural Systems*, **85 (1)**: 42-48.

South Africa. 2012. Census 2011 Statistical release – P0301.4. Pretoria: Statistics South Africa.

SPSS 2002 Statistical Procedures for Social Sciences SPSS B1 survey tips Chicago: SPSS Inc. United States of America

Suzuki, T. 1993 Bovine embryo transfer and related techniques. *Molecular Reproduction. Development*, **36**:236–237.

Topps, J. H. and Oliver, J. 1993. Animal Foods of Central Africa. Rhodesia Agricultural Journal Technical Handbook No. 2, Harare, Zimbabwe, pp. 5–9.

Trail, J. C. M. and Gregory, K. E. 1981. Sahiwal cattle. An evaluation of their potential contribution to milk and beef production in Africa. International Centre for Africa, ILCA Monograph. 3. Addis Ababa, Ethiopia.

Weldeselasie, A. M. 2003. Dairy constraint analysis in Eritrea, with special emphasis on Asmara and surrounding dairy farms. MSc Thesis. University of Natal, Pietermaritzburg, South Africa.

CHAPTER 4: Consumption patterns, preference of milk and milk products in the communal livestock production sector of the Eastern Cape Province, South Africa

Abstract.

A survey was carried out between June 2014 and May 2015 using a pre-tested structured questionnaire to characterize the consumption pattern, preference and purchase behaviour of milk and milk products in the Eastern Cape Province, South Africa. Five hundred households were randomly selected for a face to face interview from five districts within the Eastern Cape Province (100 from each district). The data was analysed using the IBM, Statistical Package for Social Sciences (SPSS) version 22. Across the province the communal average family size was between 5-10 members with a monthly income of ZAR1340 per household. The monthly mean and standard deviation of raw milk consumption pattern provincially was (2.196± 1.423) 2-5 litres of cattle milk, (4.780±0.785) 2-5 litres of goat milk and (4.980±0.692) 2-5 litres of sheep milk per consuming household. Pasteurised milk was found to be the most regularly consumed and preferred milk product with an average consumption of 4.78±0.84 litres per consuming household each month across the province. Other monthly provincial cattle milk product consumption were 0.5 kg-1 kg of powdered milk and 2-5 litres of sour milk. Household composition and consumer preference were ($P<0.05$) significantly the primary reasons for the consumption of milk and milk products. The standard price ranges for milk and milk products were R8.50-R9.50 per litre of fresh milk, R7.50-R8.50 per litre of sour milk, R33.00-R35 kg of powdered milk and R11.50-R12.50 litre of pasteurised milk. Thus, this survey showed that there are differences in the consumption patterns, preferences and purchasing behaviour of milk and milk products at household level in the communal areas of the Eastern Cape Province.

Keywords: milk consumption, consumption level, consumption frequency, fresh milk.

4.1 Introduction.

Improving human nutrition plays an important role in achieving food security (Vabi *et al*., 1995). Nutrition is perhaps the most important challenge facing the poor people in the world today (Abdulai and Aubert, 2004). In spite of the progress made in improving nutrient availability in the last decade, a large proportion of poor households in developing countries still have inadequate access to sufficient food (Abdulai and Aubert, 2004). Milk is said to be the most complete food item because of its great biological value as it contains a variety of nutrients (Oni *et al*., 2012). It provides calcium necessary for strong bones, proteins needed for brain development and tissue growth, vitamin A for normal vision, and vitamin D for absorption of calcium (Murphy *et al.,* 1994; Black *et al*., 2002; Lonnerdal, 2003). These nutrients help make it nature's most nearly perfect food (Vabi *et al*., 1995). It is the first and the most only main stay food ingested for a considerable amount of time in human consumption (Olarinde *et al.*, 2005). Milk products have a unique contribution to nutritional status as well as health status of the smallholder household members (Melesse *et al*., 2009). Milk consumption in Africa is currently the lowest in the world (Dugmore *et al*., 2004), around 37 liters per capita annually, which is 67 liters below the world average of 104 liters per capita and only accounts for six percent of world consumption (Oni and Fashogbon, 2012).

South Africa's human population is growing at almost 1.3% per year (SAS, 2015). By 2016, the human population will be approximately 54 million and is projected to increase to 82 million by the year 2035 (ASA, 2008). Like most developing countries, South Africa's increasing human population, urbanization trends and rising household incomes are leading to a substantial increase in the demand for livestock products, particularly milk and meat (Uzunoz and Akca, 2012). Good nutrition is increasingly perceived as an investment in human capital

that yields returns today as well as in the future, such awareness has brought about consumer rational preference in communal households (Njarui, 2011).

There are several milk producing livestock species around the world. The main milk producing livestock species in the Eastern Cape Province communal are goat, sheep and cattle (Dugmore *et al*., 2004). Some 65% of the province's 6.9-million people live in rural areas (NDA, 2008). The Eastern Cape Province has great potential for production of milk and milk products (Grobbler *et al*., 2008) but there is limited documented information on consumption pattern, preference and purchase behaviour of milk and milk products.

The actual levels of consumption and purchase of milk and milk products in most of the communal districts is not well known. Therefore, it is vital to generate valuable information from such studies for domestic producers, traders and policy makers regarding the issues mentioned. The objective of the current study was to characterise the consumption patterns, preference and purchasing behaviour of milk and milk products in the communal livestock production sector of the Eastern Cape Province, South Africa. The hypothesis tested was that there is no difference in the consumption patterns, preferences and purchasing behaviour of milk and milk products at household level in the communal areas of the Eastern Cape Province.

4.2 Materials and Methods.

4.2.1 Study site

As described in chapter 3.2.1

4.2.2 Study sampling procedure

As described in Chapter 3.2.2

4.2.3 Household sampling

As described in Chapter 3.2.3

4.2.4 Data collection

As described in Chapter 3.2.4

4.2.5 Statistical analysis

The following nested design models were used during data analysis for household monthly income, consumer preference, consumption level for milk and milk products and price of milk and milk products.

$$Y_{ijkl} = \mu + W_i + L\, j_{(i)} + R_{k(ij)} + e_{l\,(ijk)}$$

Where:

Y_{ijkl} = the observed value of a dependent variable

μ = overall mean

W_i = the effect of district

$L_{i(J)}$ = the effect of community nested under district

$R_{k(ij)}$ = the effect of income group nested under district and community

$e_{l\,(ijk)}$ = random error

4.3 Results

4.3.1 Household social-economic demographics

4.3.1.1 Household age distribution.

The majority (60.8%) of the households in the Eastern Cape Province were observed to be headed by males and 39.2% of the households were found to be headed by females (Table 4.1). Of the male headed households, Chris Hani district had 81% while Oliver Tambo district had the lowest (52%) percentage of male headed households. The proportion of household heads (40-80 years of age) recorded the highest age distribution of 42.8% per household. Age distribution of male and female respondents were significantly different ($P<0.05$) among the households in each of the study location in Eastern Cape Province.

4.3.1.2 General educational status of household heads

The educational status of the household members was diverse; the majority of the household heads attended primary school only. At 55%, Amathole district recorded the highest population of household heads with at least primary school level education. Alfred Nzo district at 22% had the highest number of household heads who were illiterate, and do not read and write. The highest recorded level of educated household heads at 7% were from the Oliver Tambo and Joe Qabi districts as shown in Table 4.2. There was no significant difference ($P>0.05$) in the level of education of the respondents in Amathole and Oliver Tambo districts. However, Alfred Nzo district had significantly higher ($P<0.05$) level of education than that of Chris Hani and a significant difference ($P<0.05$) was observed in Joe Qabi district.

Table 4.1 The age and sex distribution of household heads in the study area (n=500)

Characteristic	Amathole		Alfred Nzo		Chris Hani		Oliver Tambo		Joe Qabi	
	Mean ± SD and Percentages (%)									
Age Group										
0-20	-	5	0.11±0.04	1	0.10±0.01	-	-	-	-	-
21-40	0.14±0.09	41	0.56±0.34	11	0.16±0.18	6	1.27±1.01	19	1.01±0.48	8
41-60	3.24±1.98	48	3.44±2.10	44	3.13±1.80	36	3.24±1.27	44	3.01±1.22	31
61-80	3.82±2.11	6	3.29±1.98	38	4.01±2.76	54	3.66±1.89	35	4.01±3.11	57
81-100	0.21±0.03	5	0.41±0.04	6	0.43±0.02	4	-	2	0.38±0.03	4
Gender										
Female	0.44±0.68	44	0.48±0.546	40	0.86±0.49	19	1.03±0.675	48	0.94±0.71	45
Male	0.70±0.55	56	0.84±0.435	60	1.22±0.67	81	1.11±0.567	50	0.81±0.56	55

n= Number of respondents; SD= Standard deviation

Table 4.2 The educational status of household heads in the study area (n=500)

Level of Education	Amathole		Alfred Nzo		Chris Hani		Oliver Tambo		Joe Qabi	
	Mean ± SD and Percentages (%)									
Illiterate	1.02±0.32	11	2.36±1.03	22	0.57±0.04	7	1.82±0.52	15	1.84±0.55	15
Primary	3.64±2.01	55	3.01±1.29	33	3.21±1.39	45	2.76±1.05	39	3.11±1.09	49
Secondary	3.26±1.01	33	3.67±1.52	45	3.78±2.02	46	3.24±1.89	39	2.67±1.11	29
Tertiary	0.45±0.04	1	-	-	0.87±0.21	2	1.09±0.76	7	1.11±0.89	7

n= Number of respondents; SD = Standard deviation

4.3.1.3 Household size

Family size for all districts surveyed is presented in Table 4.3. The majority of the district's 60.0% Joe Qabi, 54.0% Chris Hani, 49.0% Alfred Nzo and 44.0% Amathole recorded family household sizes between 5-10members. The mean household size was recorded as Amathole (3.76±2.11), Chris Hani (3.69±1.29), Alfred Nzo (3.91±1.98), Oliver Tambo (1.64±0.731) and Joe Qabi (4.55±2.45) per household within each district. There was no significant ($P>0.05$) difference between the household family size and the distribution of households in each of the locations.

4.3.1.4 Household head occupation and source of income.

In the districts surveyed 40% to 58% of the sampled household's heads were old age pension government receivers. The highest level of household head occupation at (2.01±0.78) 20.0% blue collar and second highest at (0.42±0.02) 5% white collar employment falls under the Amathole district. Alfred Nzo recorded (0.81±0.07) 12% the highest self-employed household heads across the province (Table 4.4). The mean household head occupation for Amathole (1.83±0.780), Chris Hani (1.66±0.695), Alfred Nzo (2.00±0.845), Oliver Tambo (2.02±0.819) and Joe Qabi (1.69±0.799) districts was recorded across the province. There was significant relationship ($P<0.05$) among the characteristics of household occupation and the study locations. There was higher significant (4.86) child grant income than alternative sources of income. Generally, there was no significant different ($P>0.05$) among the sources of income in all the study locations.

Table 4.3 The household family size in the study area (n=500)

Household Family size	Amathole		Alfred Nzo		Chris Hani		Oliver Tambo		Joe Qabi	
	Mean ± SD and Percentages (%)									
1-5 people	4.02±1.88	49	3.85±1.27	40	4.21±2.09	51	3.88±1.37	42	3.09±1.86	31
6- 10 people	3.76±2.11	44	3.91±1.98	49	3.69±1.29	43	4.26±2.10	54	4.55±2.45	60
11-15 people	1.09±0.21	7	1.07±0.32	7	1.01±0.11	5	0.12±0.01	1	1.11±0.32	9
16-20 people	-	-	0.43±0.12	4	0.11±0.01	1	0.14±0.02	3	-	-

n= Number of respondent, SD = Standard deviation

Table 4.4 Characteristics of household head occupation and alternative sources of income in the study area (n=500)

Characteristic	Amathole		Alfred Nzo		Chris Hani		Oliver Tambo		Joe Qabi	
	Mean ± SD and Percentages (%)									
Household head Occupation.										
Blue collar	2.01±0.78	20	1.23±0.46	12	1.01±0.21	9	0.11±0.01	1	0.87±0.31	10
White collar	0.42±0.02	5	0.13±0.01	2	-	-	0.12±0.01	2	0.14±0.01	3
Traditional leader	0.11±0.01	1	0.11±0.01	1	0.11±0.01	1	0.11±0.01	1	0.11±0.01	1
Chief	-	0	0.11±0.01	1	0.11±0.01	1	0.11±0.01	2	0.11±0.01	1
Self employed	0.45±0.04	7	0.81±0.07	12	0.69±0.11	6	1.01±0.29	9	0.12±0.01	2
Alternative sources of Income.										
Grant (old age)	3.12±1.01	44	3.02±0.98	40	3.16±1.02	40	4.11±1.34	56	4.01±2.01	58
Grant (child grant)	0.13±0.01	7	0.32±0.03	10	0.21±0.02	10	0.12±0.01	6	0.13±0.01	6
Pension + Child grant	0.11±0.01	4	0.10±0.01	2	-	0	0.13±0.01	5	0.11±0.01	1
Sick pensioner	0.11±0.01	1	0.11±0.01	2	0.13±0.02	4	0.11±0.01	1	-	0

n=Number of respondents, SD = Standard deviation

4.3.1Household income characteristics

Household income for all districts surveyed is presented in Table 4.5. The highest income range was R10000-R15000 and was only 3.0% being the highest recorded in Chris Hani. The mean monthly income per household head within the district was recorded as Amathole (2.54±1.16), Chris Hani (2.30±1.00), Alfred Nzo (2.81±1.30), Oliver Tambo (2.65±1.05) and Joe Qabi (2.19±1.01) per household within the districts. There was a highly significant difference ($P<0.05$) in the mean distribution of household monthly income among the study locations.

Table 4.5 Distribution of monthly income among the districts in the study area (n=500)

Income range	Amathole		Alfred Nzo		Chris Hani		Oliver Tambo		Joe Qabi	
	Mean ± SD and Percentages (%)									
R0-R500	0.56±0.12	12.0	1.34±0.45	26.0	0.58±0.22	13.0	3.76±1.28	46.0	1.25±0.61	18.0
R500-R2000	4.85±3.01	61.0	4.31±3.11	60.0	4.87±3.09	63.0	3.87±1.98	50.0	5.15±3.14	72.0
R2000-R5000	0.68±0.24	13.0	0.21±0.03	5.0	0.71±0.13	15.0	0.11±0.01	2.0	0.16±0.01	4.0
R5000-R7000	0/15±0.02	4.0	0.11±0.01	1.0	-	-	-	-	-	-
R7000-R10000	0.12±0.01	2.0	0.31±0.04	6.0	0.11±0.01	1.0	0.11±0.01	1.0	0.14±0.01	3.0
R10000-R15000	0.13±0.01	2.0	0.12±0.01	2.0	0.13±0.02	3.0	0.11±0.01	1.0	0.12±0.01	2.0

n= Number of respondents, SD = Standard deviation

4.3.2 Monthly consumption patterns of milk and milk products among the districts.

The monthly consumption frequency of milk and milk products is presented in Figures 4.8 through to Figure 4.12. Across the Eastern Cape Province consumption frequency patterns of milk and milk products showed significant variation caused by price changes within the different communal areas. The average consumption frequency patterns were 5-10 litres of pasteurised milk, 100g-500g powdered milk and 2-5 litres fresh and sour milk recorded monthly across the province. The daily mean consumption of milk and milk products was recorded as Amathole (3.50±1.07), Chris Hani (3.41±0.85), Alfred Nzo (3.71±1.18), Oliver Tambo (3.26±0.94) and Joe Qabi (3.80±0.94) per household within the districts. At 14% Chris Hani district recorded the highest amount of monthly consumed pasteurised milk of 15-25 litres. Alfred Nzo district recorded the highest consumed fresh milk, 8%, and sour milk (11%) with consumption values of 15-25 litres monthly. Joe Qabi district recorded the highest (94%) powdered milk consumption with a range of 4-6kgs monthly.

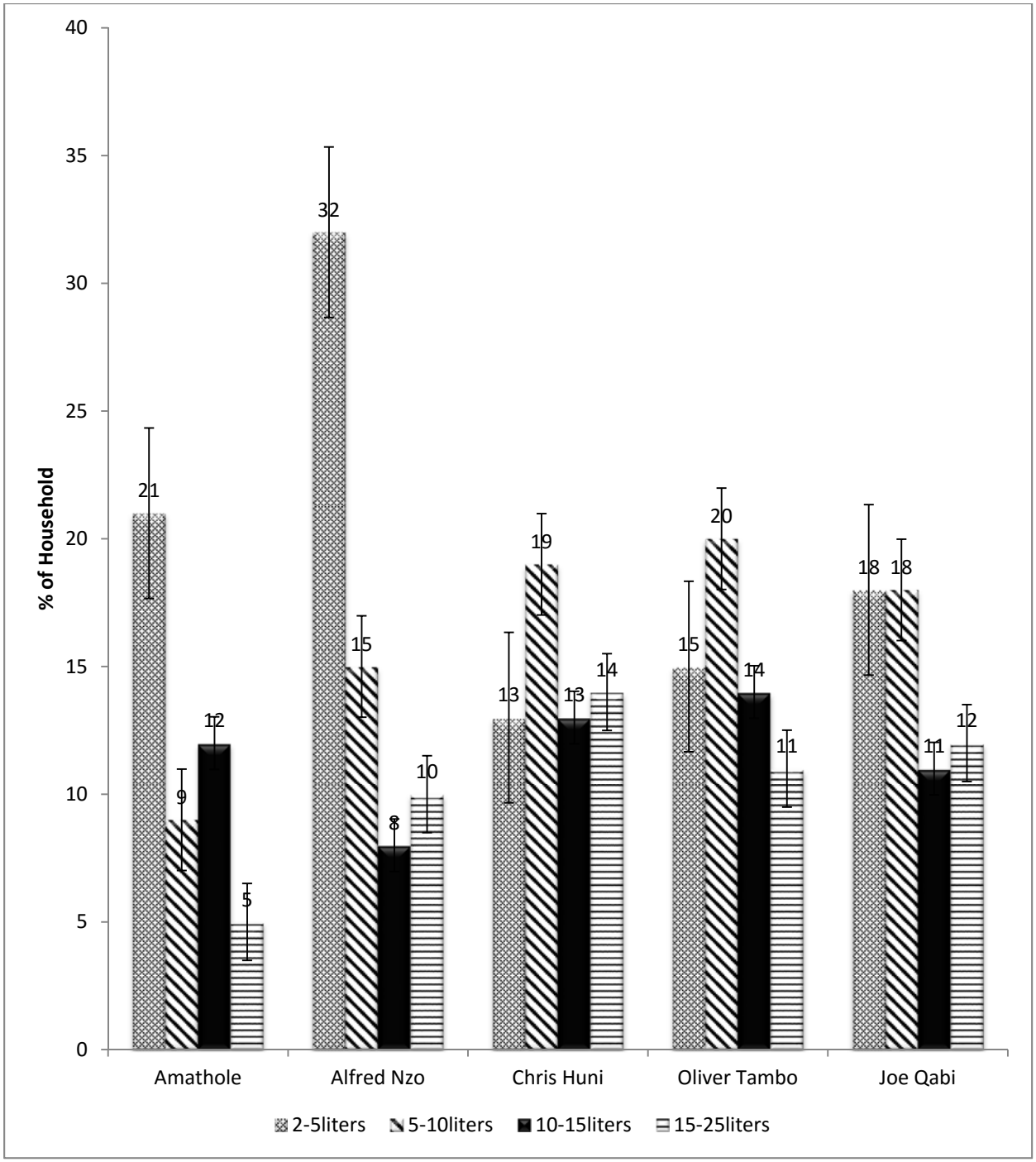

Figure 4.1: Monthly consumption patterns of pasteurised milk products among the consuming districts of the Eastern Cape Province, South Africa.

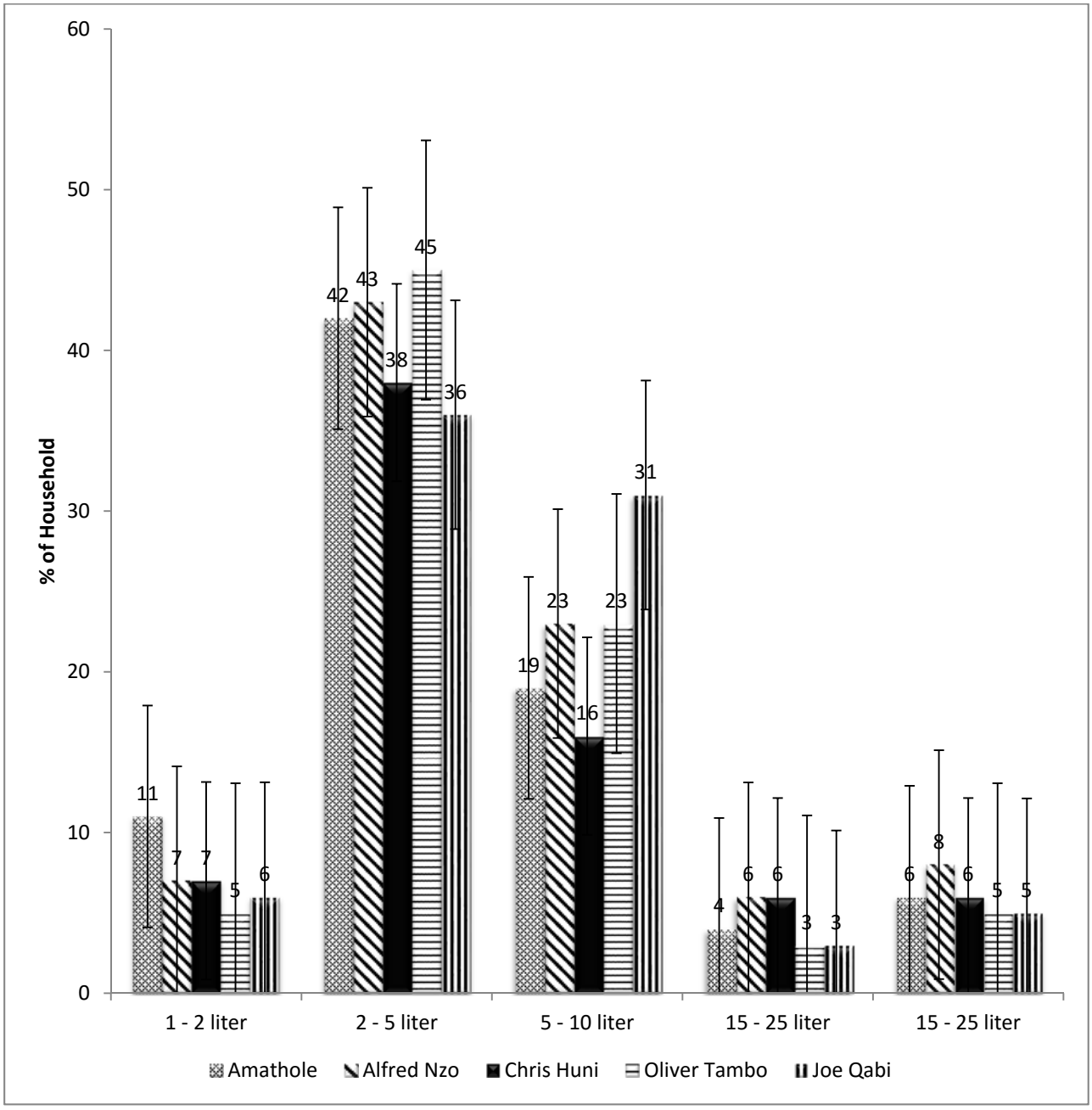

Figure 4.2: Monthly consumption patterns of fresh milk products among the consuming districts of the Eastern Cape Province, South Africa.

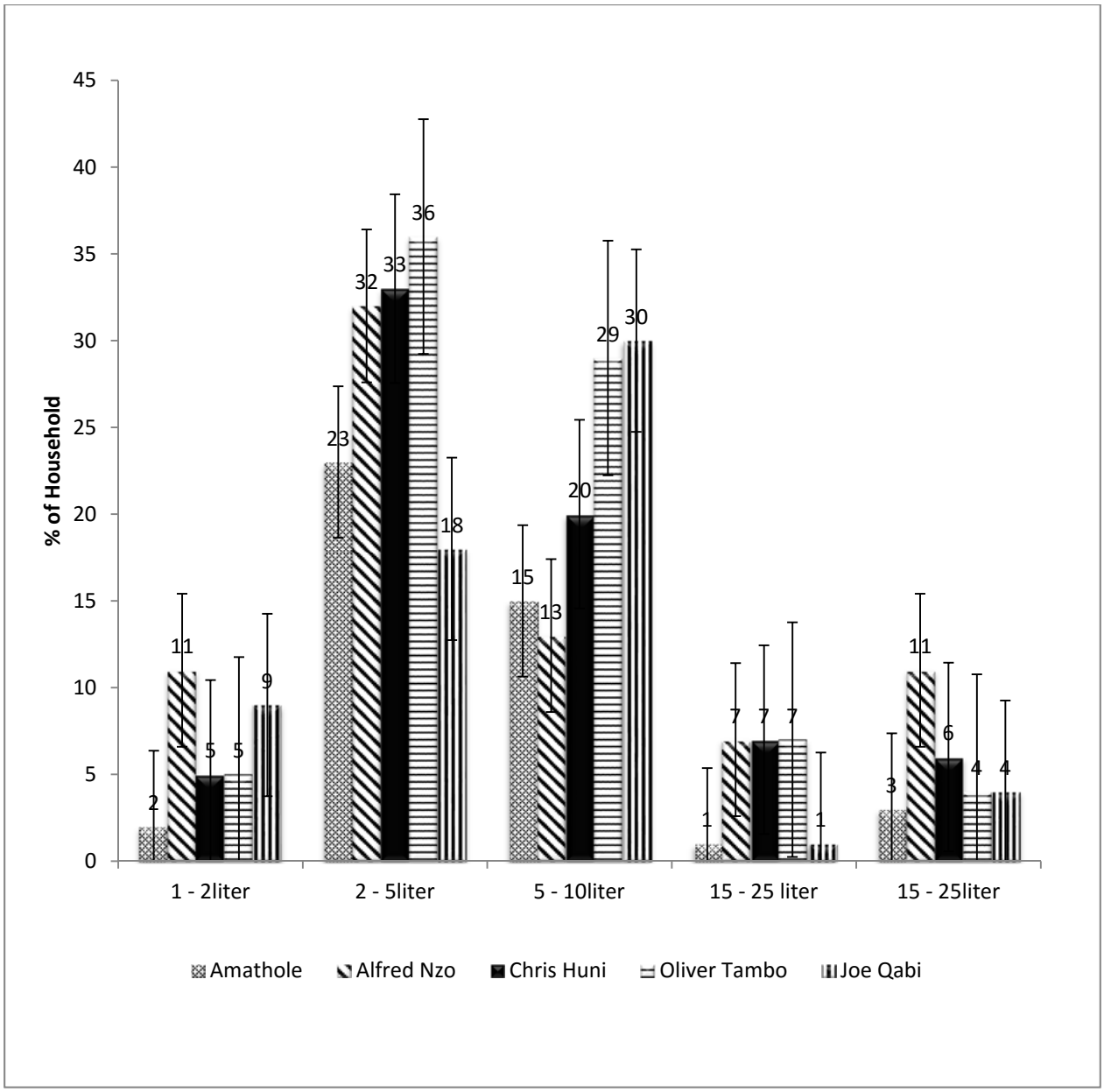

Figure 4.3: Monthly consumption patterns of sour milk products among the consuming districts of the Eastern Cape Province, South Africa

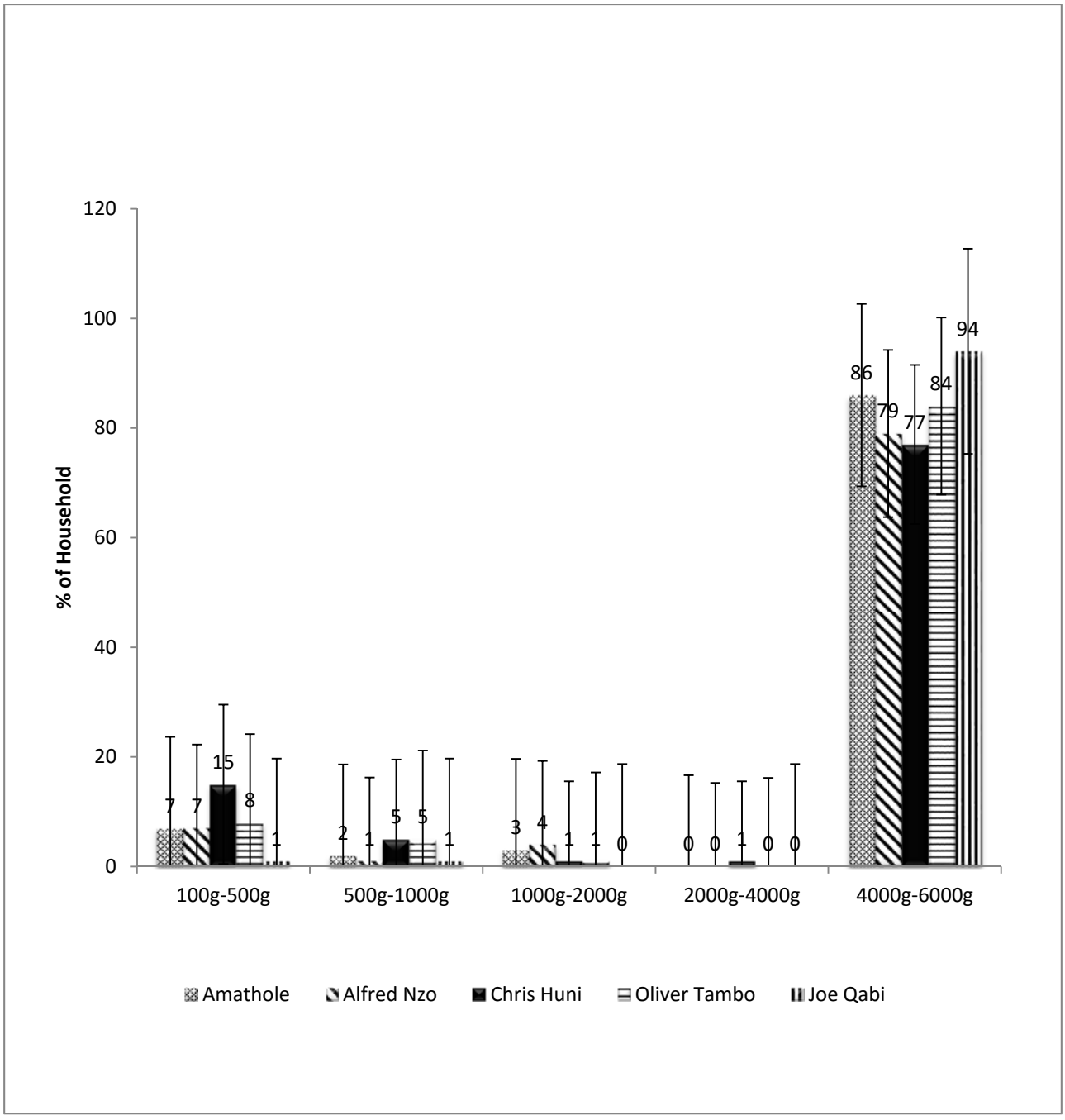

Figure 4.4: Monthly consumption patterns of powdered milk products among the consuming districts of the Eastern Cape Province, South Africa.

4.3.3 Consumer preference of milk and milk products among the districts

Residents of Oliver Tambo district showed the highest consumer preference (77%) towards milk compared to the other districts. Both sheep and goat milk were mostly preferred in Chris Hani district, with values of 25% and 15%, respectively (Figure 4.5). There was a significant difference ($P<0.05$) between the consumer preference of milk and milk products among the districts. Most districts preferred consuming a combination of fresh and sour milk to other milk products with Oliver Tambo district recording the highest preference of 64% among the three milk products (Figure 4.6). Sour milk had the highest consumer preference in Joe Qabi which recorded the highest preference at 16% followed by 6% in Amathole, 4% in Alfred Nzo and 3% in Chris Hani districts.

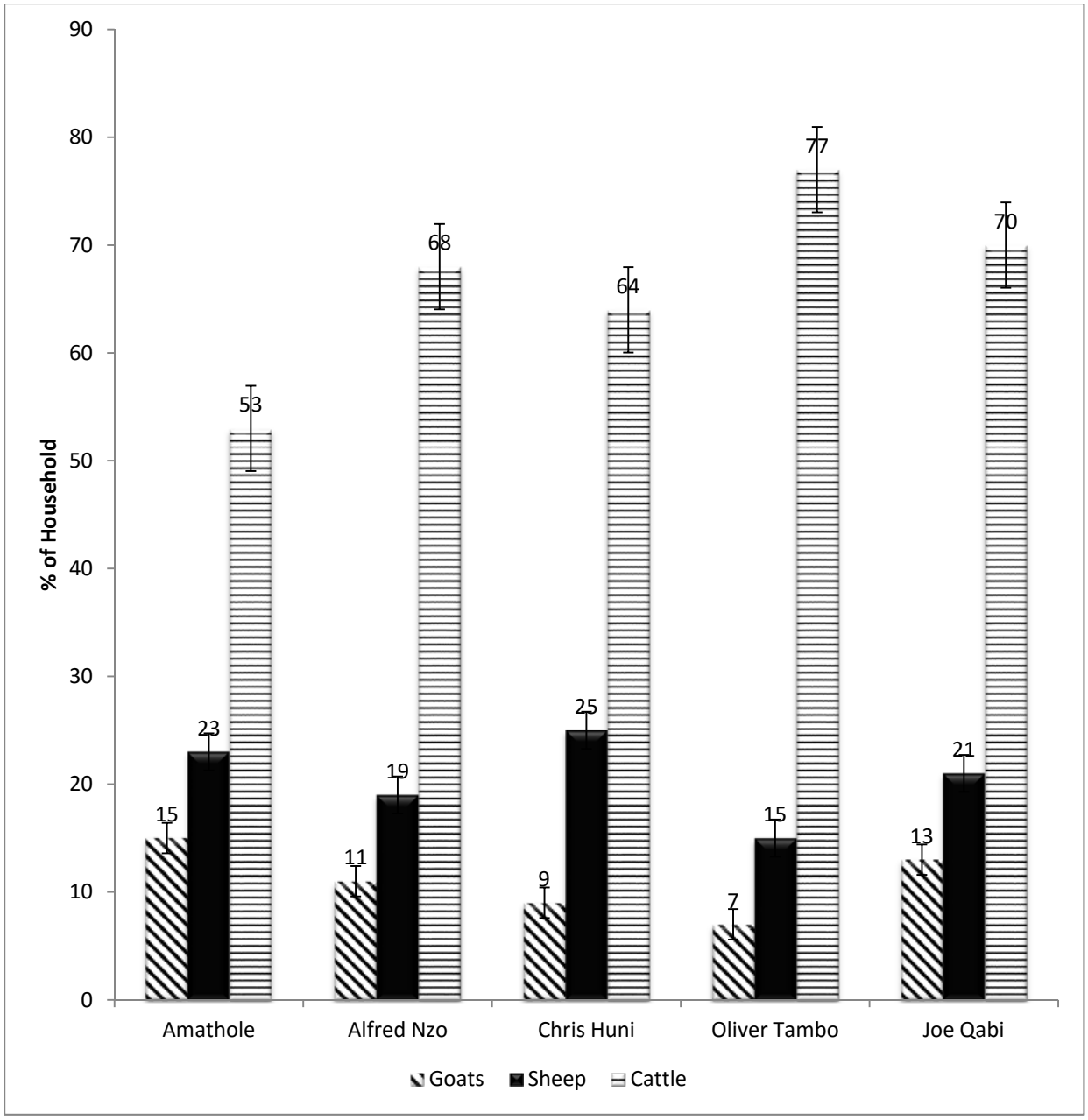

Figure 4.5: Milk preferences from different livestock species among the districts of the Eastern Cape Province, South Africa.

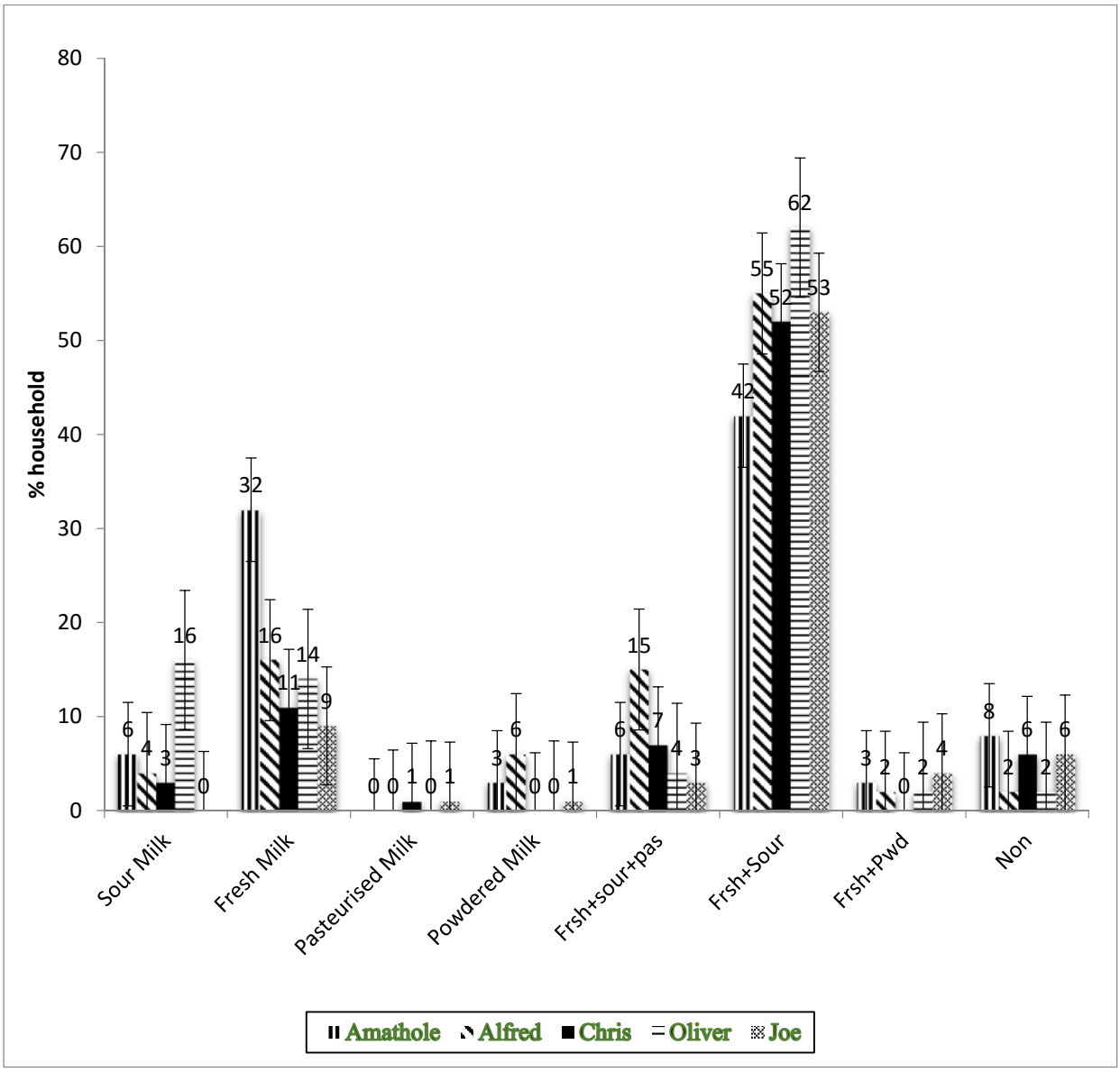

Figure 4.6: Consumer preference of milk products among the districts of the Eastern Cape Province, South Africa.

4.3.4 Consumer purchasing behaviour of selected milk and milk products

Amathole district recorded the highest consumer price preference of pasteurised milk and powdered milk respectively (Figure 4.7). The price for fresh milk varied between R7.50 to R8.50 across the surveyed area (Figure 4.8). However, Joe Qabi district recorded the highest (32%) fresh milk price between R9.50-R10.50. Alfred Nzo district also recorded the most expensive price preference of sour milk purchased at 33% between R9.50-R10.50 (Figure 4.8). and powdered milk at 55% between R50.00-R52.00 (Figure 4.10) The overall mean and standard deviation of milk prices observed were 0.13±2.98 per litre of pasteurised milk, 0.11±2.58 per litre of fresh milk, and 0.07±1.59 per kg of powdered milk and 0.04±0.82 per litre for sour milk (*Amasi*) across the province. There is a significant ($P>0.05$) difference between product price and consumer purchasing behaviour of selecting milk and milk products types.

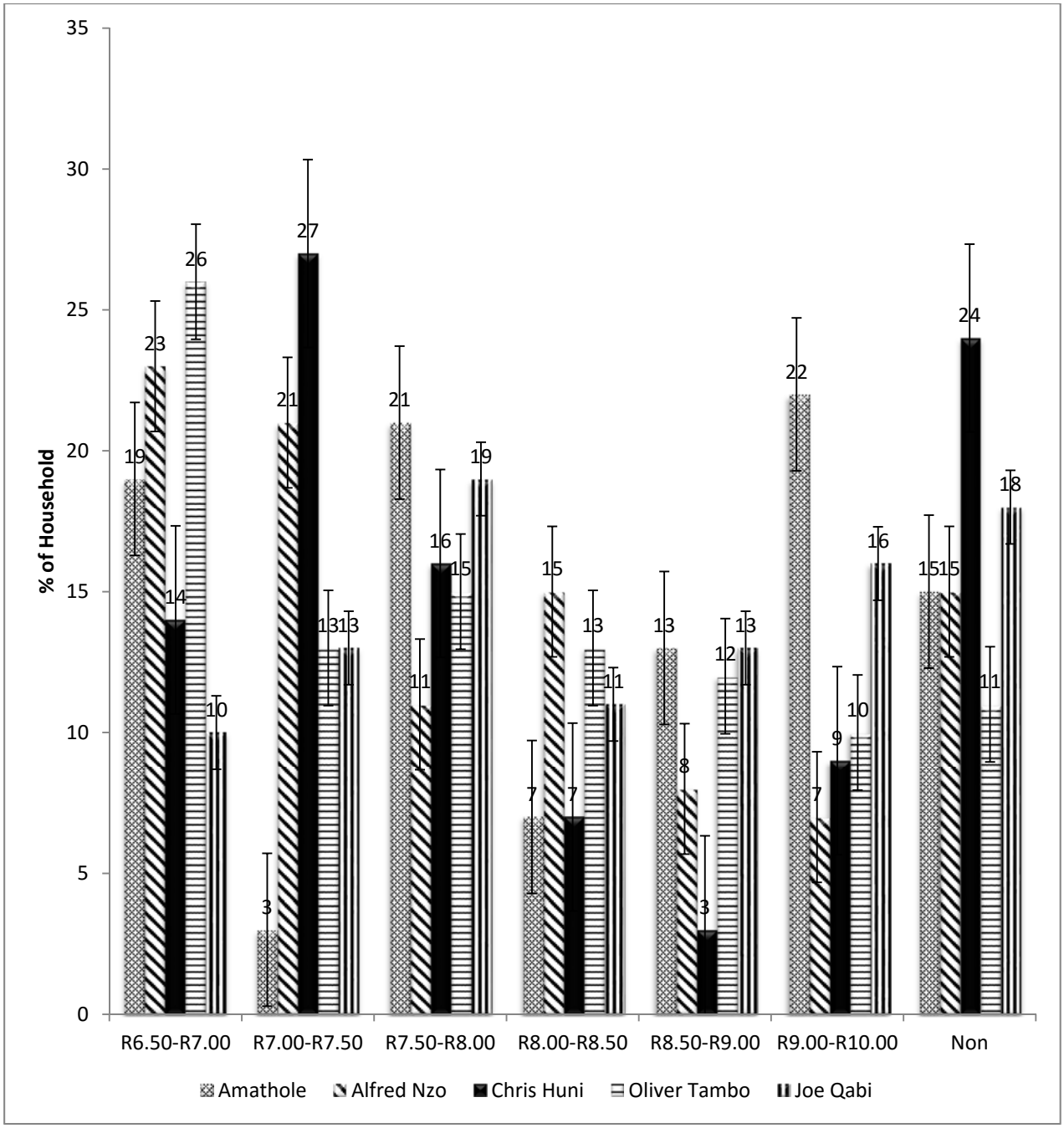

Figure 4.7: Purchasing price of selected pasteurised milk products purchase among the districts of the Eastern Cape Province, South Africa.

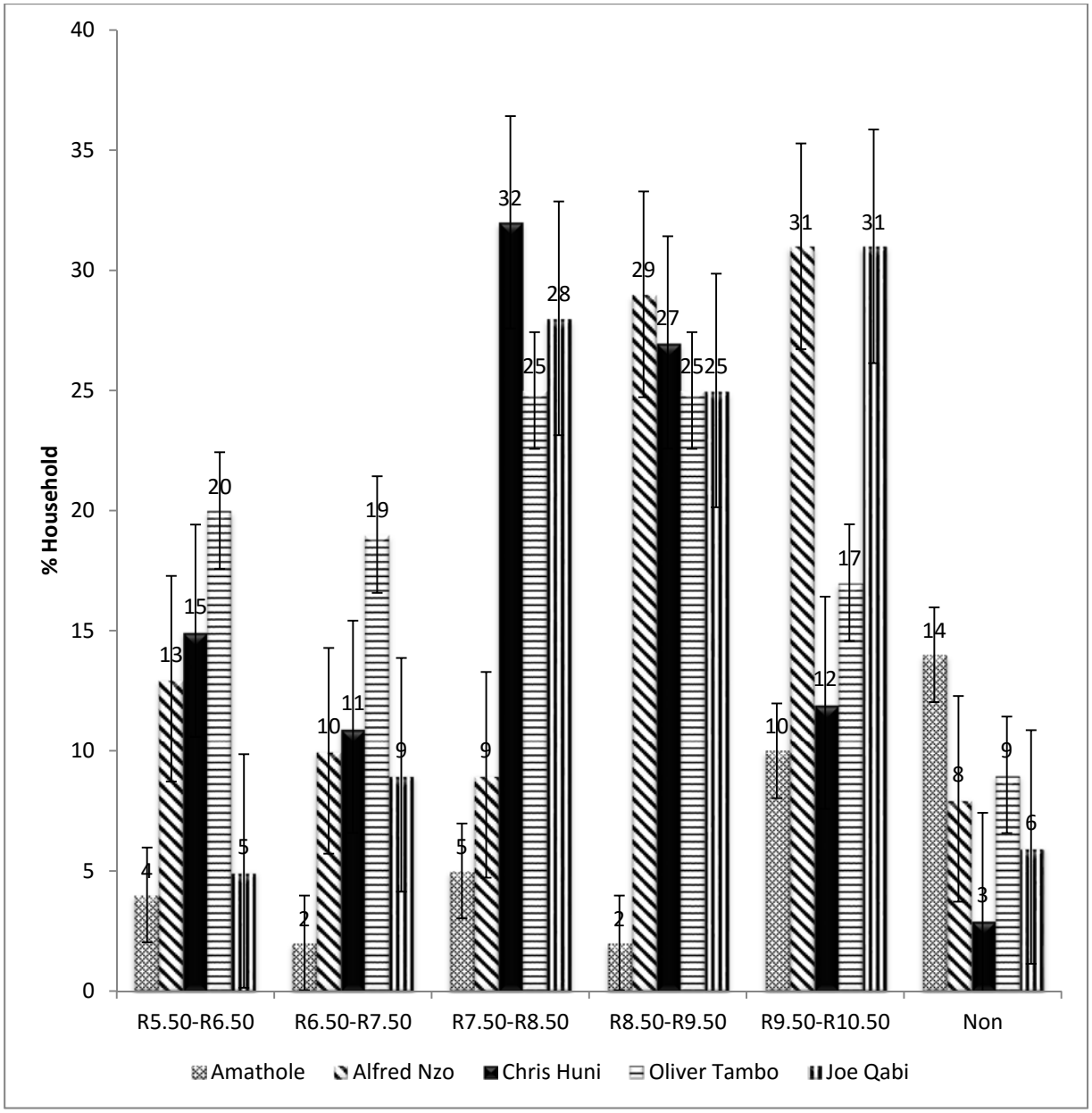

Figure 4.8: Purchasing price of selected fresh milk products among the districts of the Eastern Cape Province, South Africa.

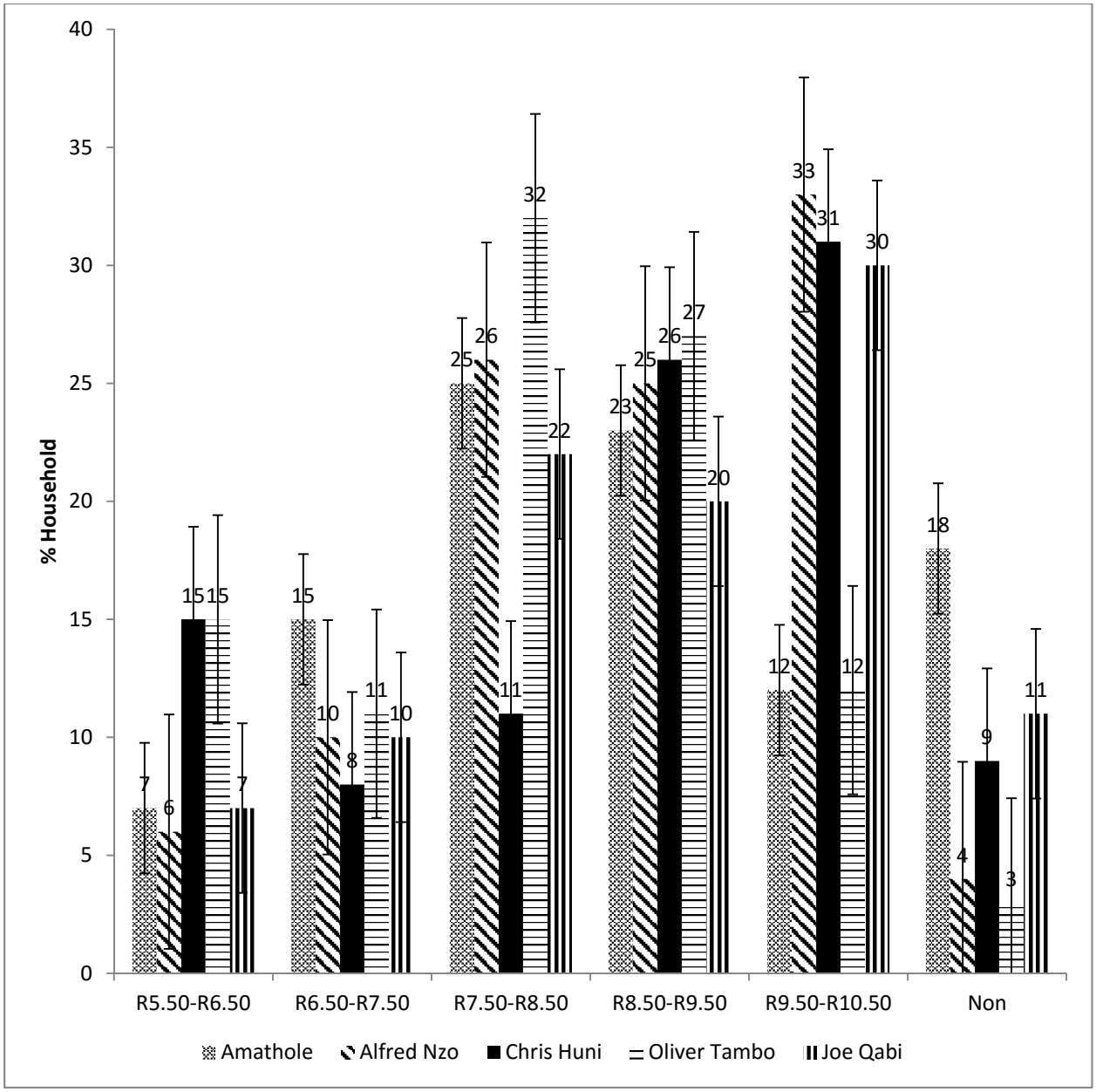

Figure 4.9: Purchasing price of selected sour milk products among the districts of the Eastern Cape Province, South Africa.

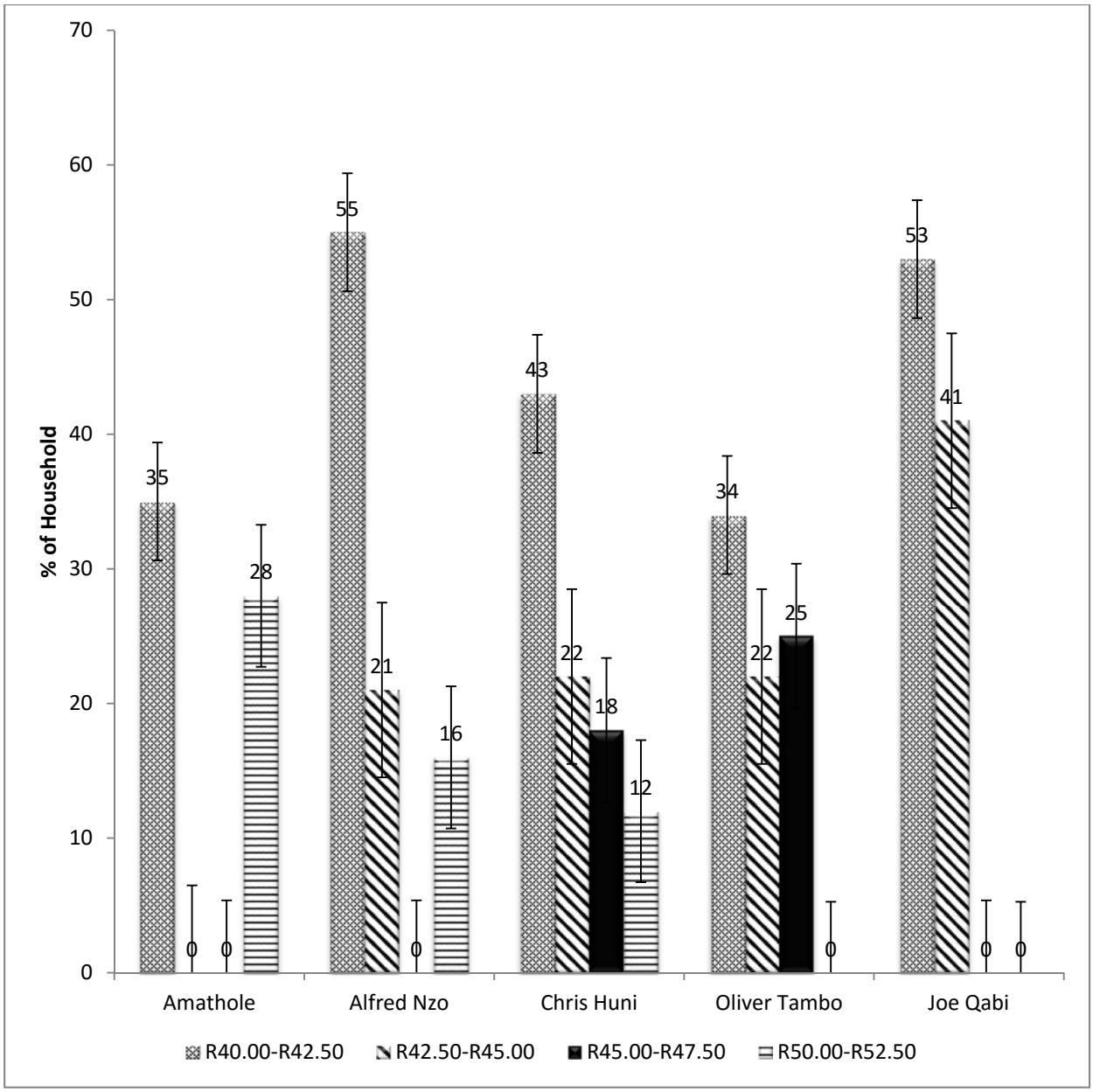

Figure 4.10: Purchasing price of selected powdered milk products among the districts of the Eastern Cape Province, South Africa.

4.3.4.1 Consumer preference rational for selected milk and milk products

The consumer purchasing behaviour of selected milk and milk products is greatly affected by the consumer rational of preference. Across the Eastern Cape Province consumers interviewed stated that household dynamics and preference are the most considered factors for rational choice of selected milk and milk product for purchase. Household dynamics at 45% recorded Joe Qabi district as the highest consumer rational preference for selected milk and milk products (Figure 4.11). In Chris Hani district 35% consumers stated choice and 15% consumers in Alfred Nzo district stated availability as the some of the main factors affecting their rational preferences used by consumers when purchasing milk and milk products. There was no significant difference ($P>0.05$) between the consumer rational preference for selected milk and the type of milk products purchased.

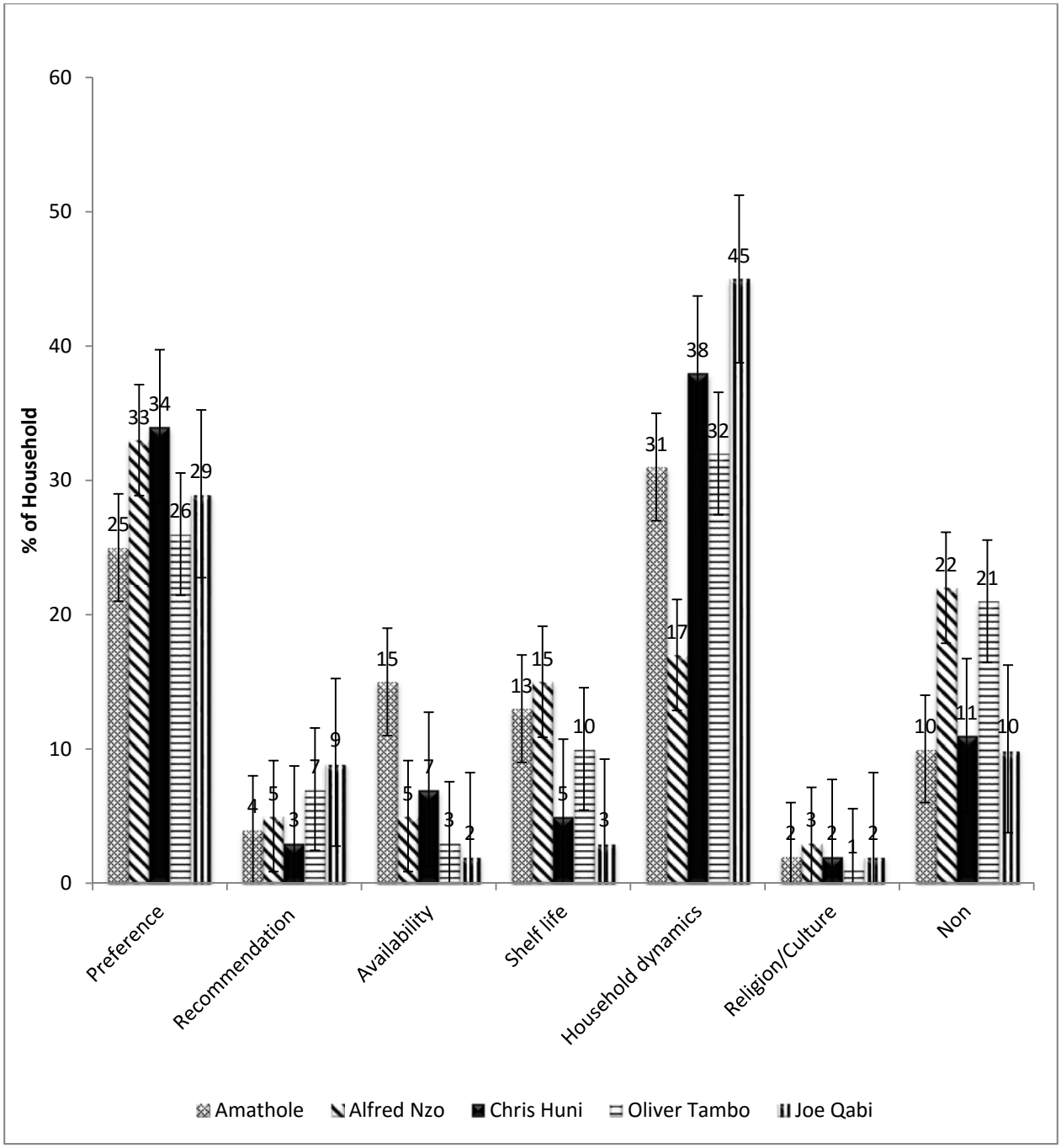

Figure 4.11: Consumer preference rationale for selected milk and milk products purchased among the districts of the Eastern Cape Province, South Africa.

4.3.42. Consumer buying location preference of selected milk and milk products

The majority of respondents preferred buying household milk and milk products in town location (Figure 4.13 to Figure 4.17). Amathole district at 22% had the highest fresh milk consumption preference, followed by Oliver Tambo district at 10% which had the highest sour milk. Town also showed a high purchase preference of pasteurised milk products at 5% in the Alfred Nzo district. Consumer buying location preference of milk products like sour and fresh milk also showed a high in local shops. There was significantly difference ($P<0.05$) between selecting milk products and consumer buying location preference (Table 4.18)

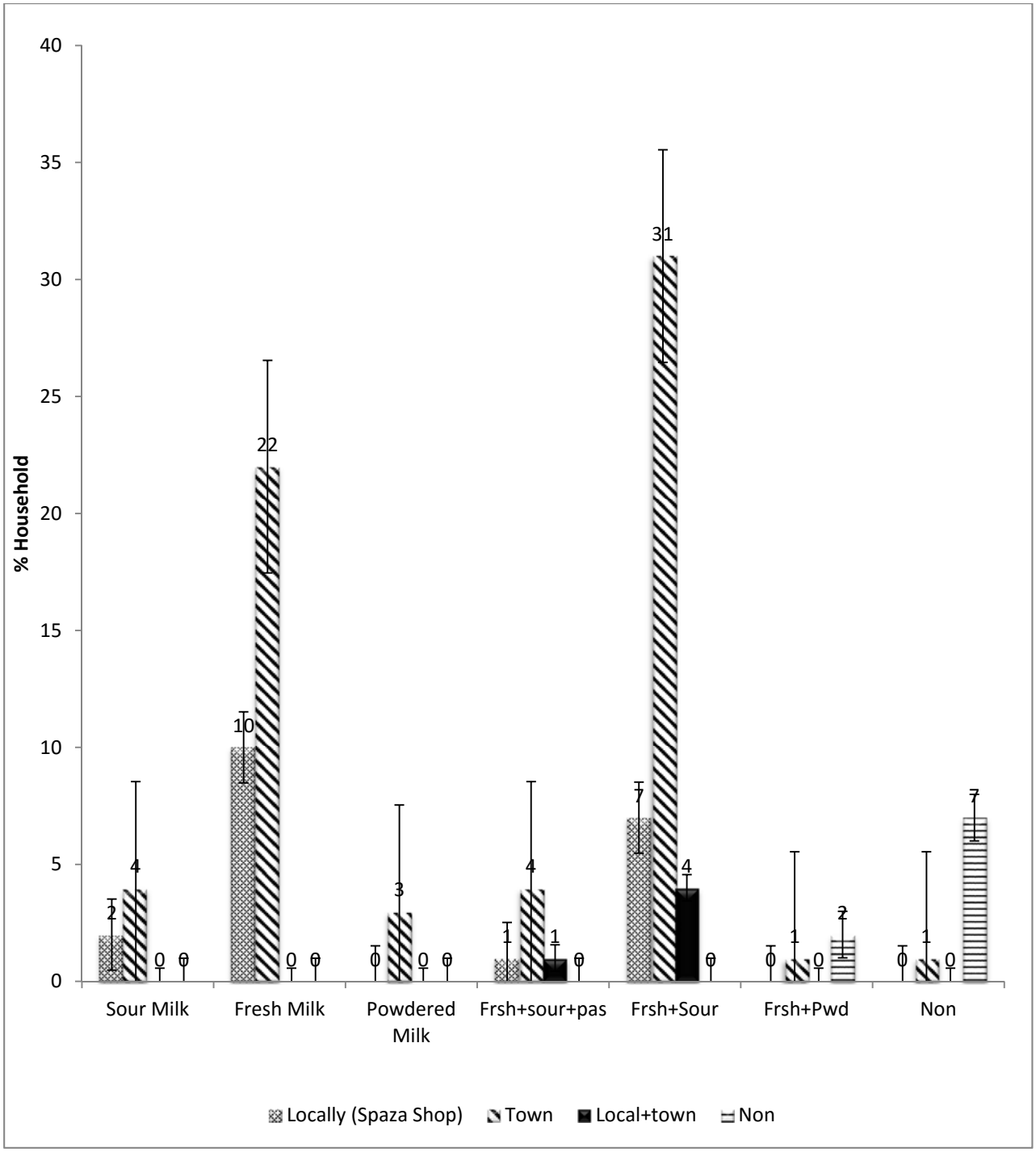

Figure 4.12: Purchasing location preference of selected milk and milk products among consuming Amathole districts households

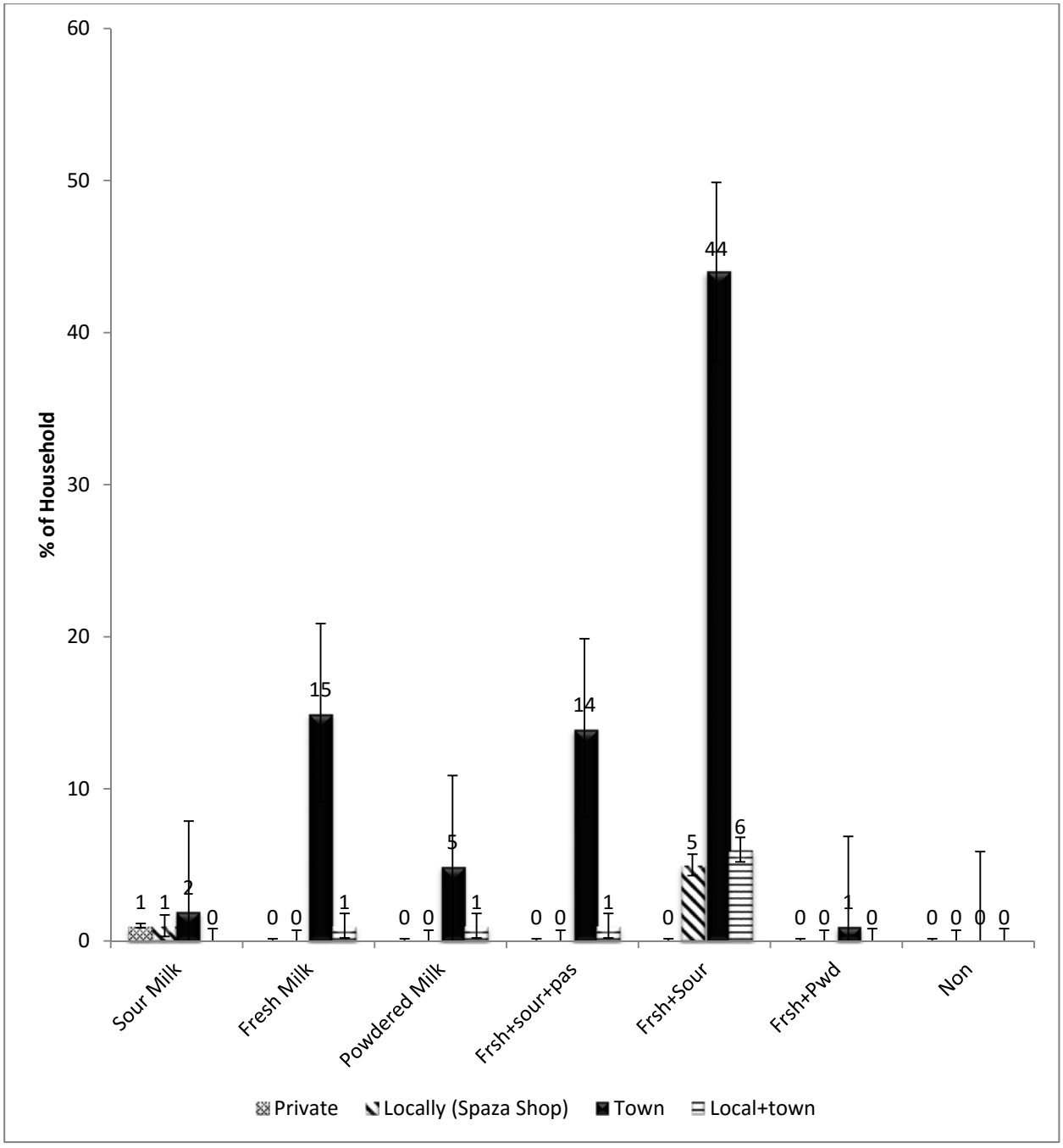

Figure 4.13: Purchasing location preference of selected milk and milk products among consuming Alfred Nzo districts household

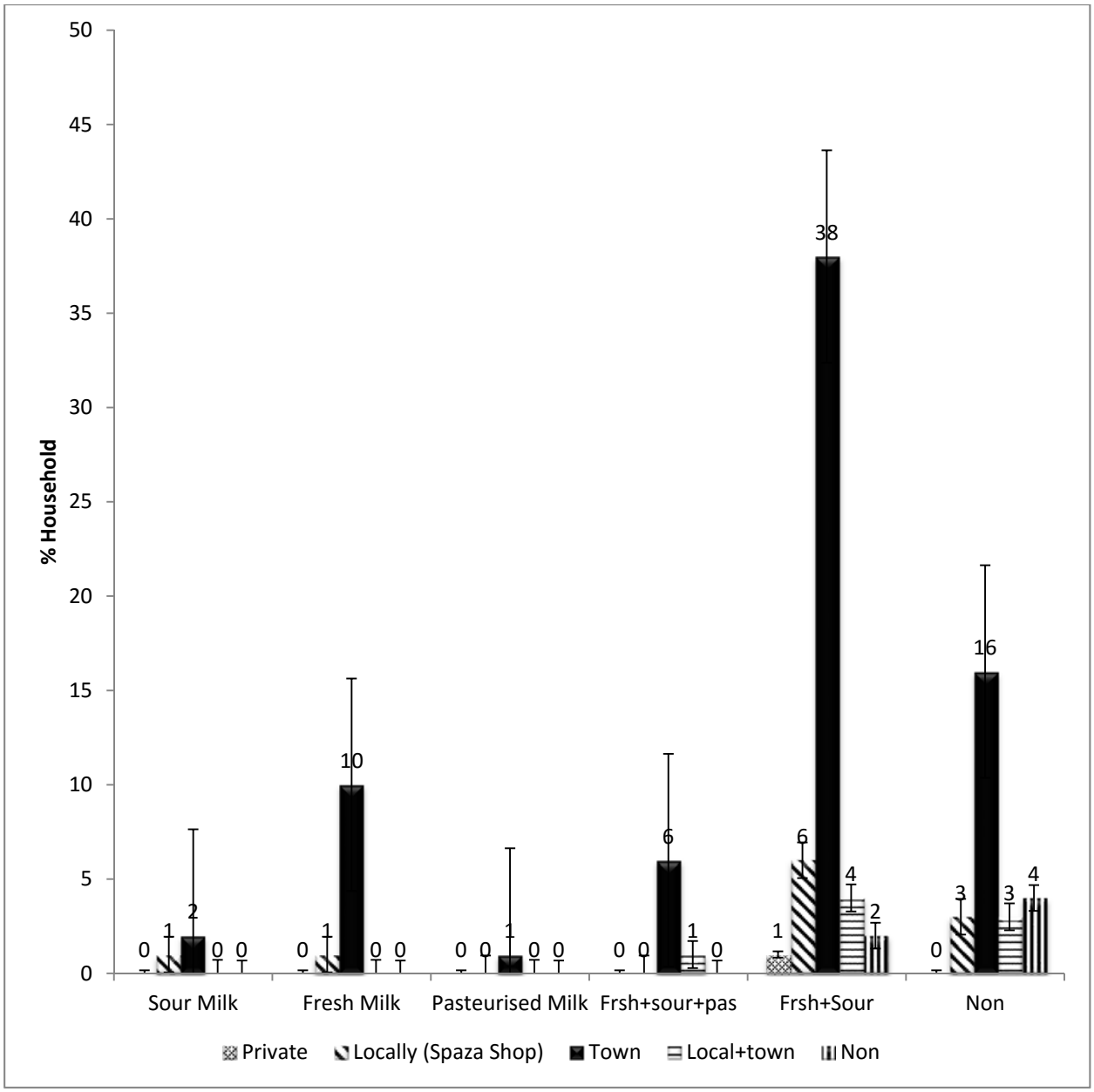

Figure 4.14: Purchasing location availability of selected milk products among consuming Chris Hani districts household

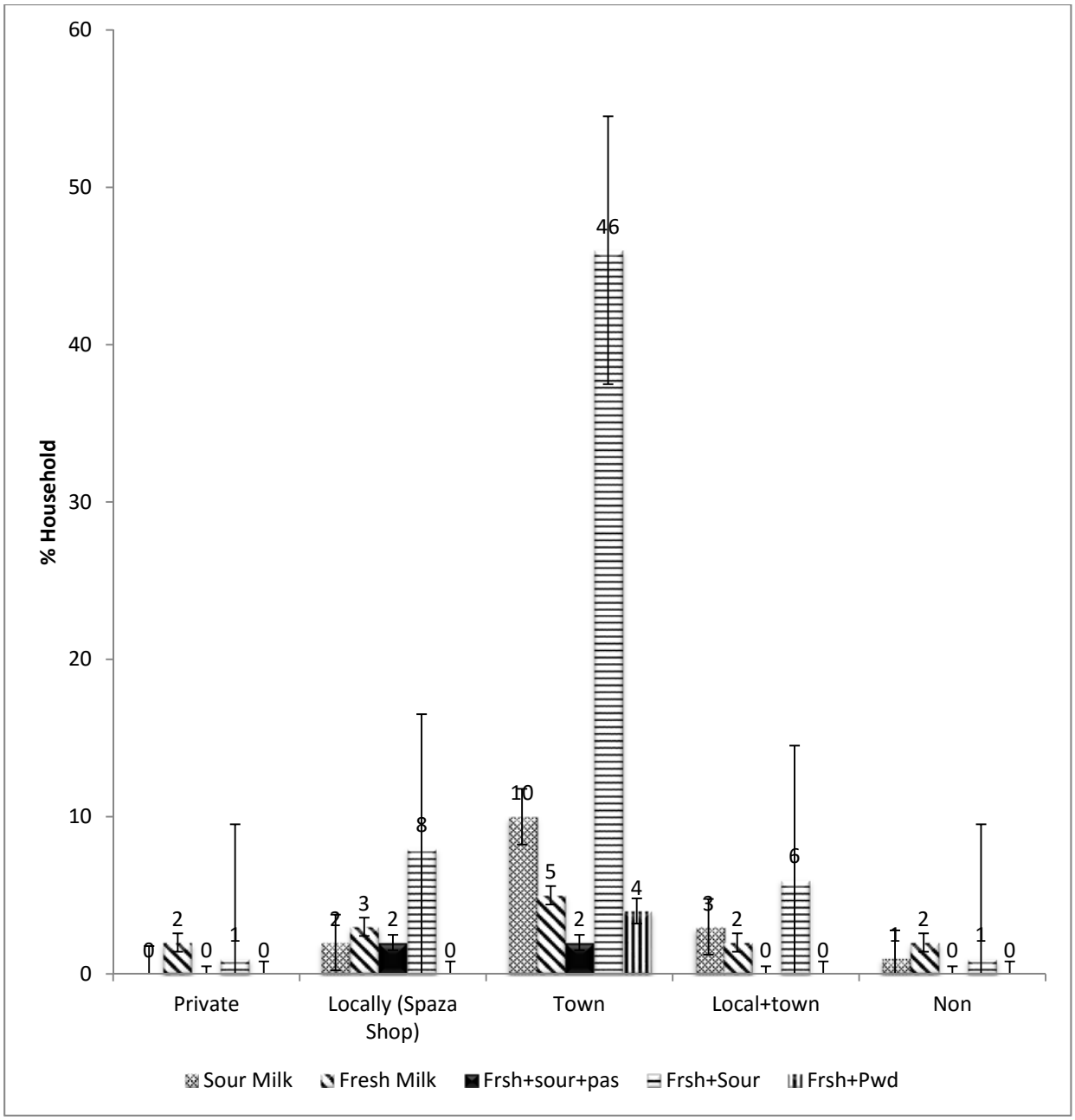

Figure 4.15: Purchasing location availability of selected milk products among consuming Oliver Tambo districts household

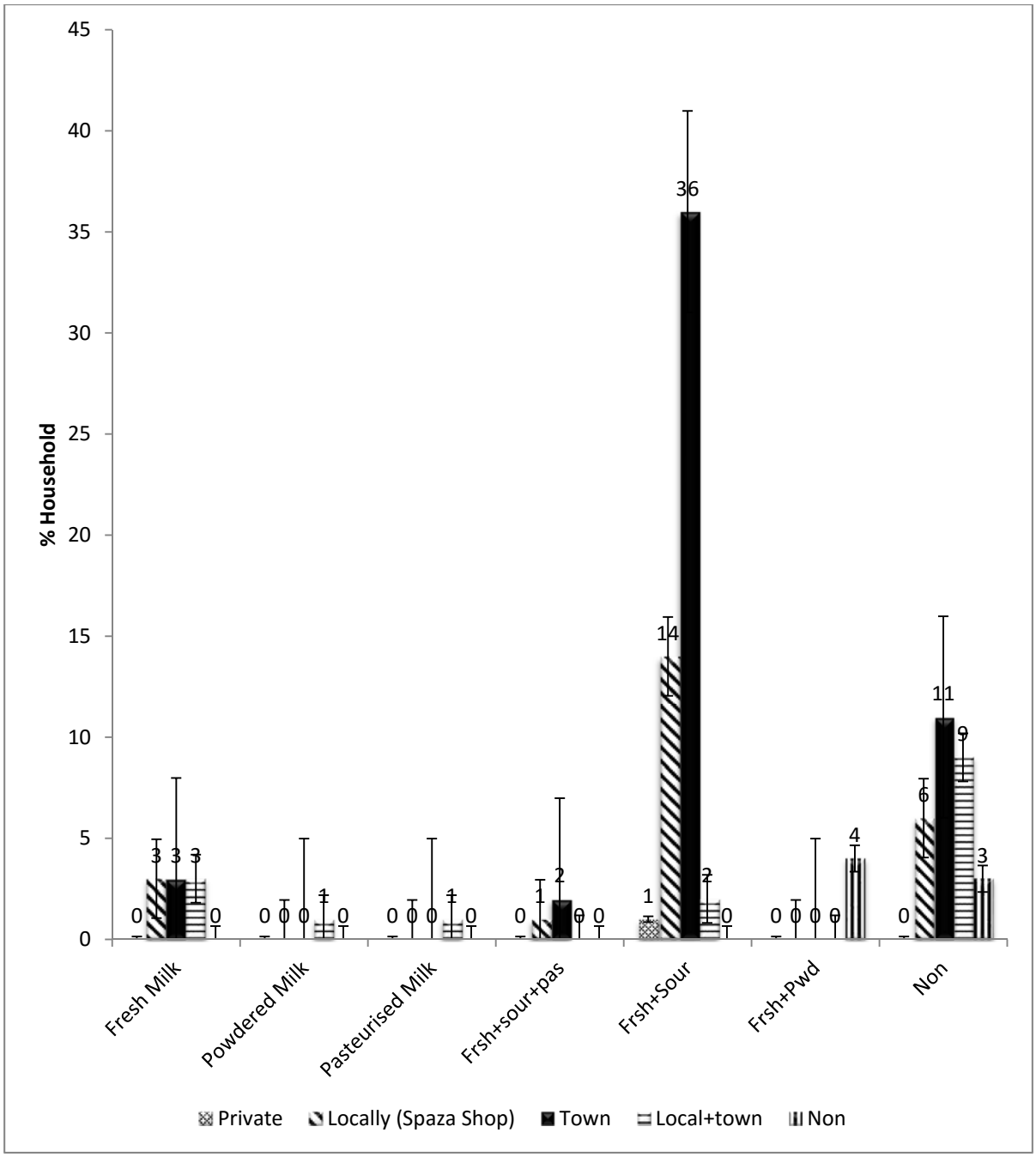

Figure 4.16: Purchasing location availability of selected milk products among consuming Joe Qabi districts household

Table 4.6: Monthly consumption level of milk and milk products among consuming households in the districts

Milk and Milk Products	Products Amount consumed (litre or kg/household/month)					
	Amathole	Alfred Nzo	Chris Hani	Oliver Tambo	Joe Qabi	Significant level
Sour Milk litre	0.19	0.074	0.21	1.02	0.90	*
Fresh Milk	0.26	2.34	0.09	0.09	1.22	**
Pasteurised Milk	0.06	0.99	0.29	0.22	0.10	**
Powdered Milk	0.28	1.20	0.83	1.10	0.23	NS
Fresh + Sour + pasteurised Milk	1.99	2.93	4.10	1.48	0.62	NS
Fresh + Sour Milk	28.42	17.3	11.23	15.72	9.37	NS
Fresh + Powdered Milk	0.01	0.03	0.102	0.01	0.29	**

NS = Not significant;
*significant at $P < 0.05$;
**significant at $P < 0.01$

The table above indicates that there are significant associations among the districts with respect to milk and milk products type of sour milk, fresh milk, pasteurised milk, fresh and sour milk and fresh and pasteurised milk at a significant level of 0.05 and 0.01 respectively.

Table 4.7 Correlations between consumption level and household social-economic demographics

Type social-economic demographics	What amount of fresh cow milk consumed	What amount of sour cow milk consumed	What amount of powder cow milk consumed	What amount of pasteurised milk consumed
Level of Education	0.03	0.10*	0.036	-0.070
	0.52	0.03	0.417	0.118
	500	500	500	500
Principal Occupation	0.10*	0.09*	-0.06	0.041
	0.03	0.05	0.22	0.37
	500	500	500	500
Primary Income Source	0.11*	-0.07	-0.03	0.02
	0.01	0.12	0.56	0.68
	500	500	500	500
Size of Household	0.09*	0.01	0.01	0.06
	0.04	0.85	0.84	0.22
	500	500	500	500
Type of Livestock	0.06	0.15**	-0.04	0.20
	0.17	0.01	0.41	0.650
	500	500	500	500
At what price do you buy "Pasteurised" milk	0.03	0.01	-0.01	0.05
	0.56	0.81	0.89	0.28
	500	500	500	500
At what price do you buy "Fresh" milk	-0.02	-.303**	0.01	-0.08
	0.73	0.00	0.91	0.07
	500	500	500	500
At what price do you buy "Powdered" milk	0.08	0.15**	0.36**	0.07
	0.06	0.01	0.00	0.13
	500	500	500	500
At what price do you buy "Sour" milk	0.03	0.12**	0.07	0.63**
	0.50	0.01	0.15	0.00
	500	500	500	500

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.7 indicates that there is a significant correlation between type of livestock, price of fresh, powdered, sour and sour milk consumption respectively at 0.05 level of significance.

4.4 Discussion

Most of the households were observed to be headed by man whose ages ranged mainly between 40 – 80 years. This age distribution is most likely caused by migration back to the communal areas as retirement plans. Phuong and Marcus (2013) findings showed that male headed households have shown a stronger economy than those headed by females. Ebru and Neslihan (2013) went on further to say the economy of the household headed by females becomes weaker and weaker. Age distributions of male and female respondents were significantly different among the households in each of the study location in Eastern Cape Province. This indicated that in each of the households, age and gender of the respondents is a determinant factor in Eastern Cape Province. This could be linked to male households having women as economic helpers in a household reducing reliance on one household head as a sole bread winner. There was no significant difference between the household family size and the distribution of households in each of the locations. The numbers of member of the household family do not determine the output from the household distribution.

The level of education influences households' milk and milk product consumptions. General assumptions hypothesise that the more educated consumers consume more animal products than less educated consumers (Olarinde *et al*, 2005) because they have a better understanding on type of food consumptions and associated health benefits. The findings by Phuong and Marcus (2013) imply a similar understanding, where they state that rural consumers who are more educated are now more conscious about health and wellness issues related to food choices and diet. According to the studies done the hypothesis is supported since educational level of household heads was positively correlated (r=0.10) with sour milk consumption level (Table

4.7). The challenges to pursue education above primary school among the older generation might be the reason for the pattern of education of household heads across the districts.

Employment of household head is a factor that has high significant effects on household's milk and milk product consumptions because it reflects the lifestyles and economic well-being of the consumer. There is a positive correlation of household head occupation between fresh milk at (r=0.100) and sour milk at (r=0.089) consumption levels (Table 4.7). The type of employment has a direct implication on type of income received. This is in agreement with the statistically significant relationship among the characteristics of household occupation and the study locations. Boniface and Umberger (2012) and Ebru and Neslihan (2013) had similar conclusions where they stated that consumption of a products is associated with the product price and consumers purchasing power.

The study showed that households with high income levels spent more on milk and milk products. It also showed that there was higher significant in child grant than the rest of alternative sources of income. The present results are consistent with those of Zhou *et al*. (2002) who also observed that increased consumer incomes and food supplies have resulted in a shift towards high quality and healthy food products, such as milk and products. A positive correlation was observed between household income and level of fresh milk consumption (r=0.10) (Table 4.7). Smallholder Dairy Project (SDP) (2006) also reported that milk consumption in Kenya increased with income increment. Observations reported by Jabbar and Domenico (1992) had similar findings. In addition, results by Michael and Emmanuel (1995) indicated that households groups from high incomes spent more money on milk and milk products compared to other income group households in Southern Nigeria and Cameroon. Furthermore, the findings from Michael (1996), Hans (1992), Zhou *et al*. (2002) and Zhou *et*

al., (2002) were also in agreement, where they reported that consumption of milk and milk products and other protein rich foods increases as income increases. The difference in consumption level among income groups nested under the province and the five districts was significant.

There is a highly negatively correlation between consumption of sour milk and price of fresh milk (r=-0.30) and highly positively correlated to powdered milk (r=0.15) and sour milk (r=0.12) (Table 4.7). This indicated that many of the respondents consume fresh milk more than other types of milk products in all the study locations. According to the results, communal household's milk and milk products consumption are highly influenced by socio-economic and demographic characteristics of the households such as income, education, household head age, regional differences and occupation of household head. The price of powdered and sour milk are positively correlated to their consumption level, (r=0.36) and (r=0.63) respectively. These finding are in accordance with observations done for costal Kenya consumption of processed dairy products among different income households (Mullins *et al*., 1994).

There is a positive correlation (r=0.15) between sour milk consumption and type of milk producing livestock owned by household head (Table 4.7). This was also heighted by Zewdu *et al*. (2003) who reported that the type of milk producing livestock owned by a household is affected by type of milk consumption preference in a household. Size of household is negatively correlated (r=-0.09) to milk and milk product consumption (Table 4.7). Tiruneh *et al*. (1998) reported similar conclusion, were they heighted household size and composition to greatly affect milk and milk product consumption due to the variation and preference associated with household characteristics. Furthermore Mullins *et al*., (1994) reported that with an increase in the number of people in a household there is a direct increase in milk and milk

products consumed and purchased. They proceeded in stating that the type of household composition characteristics can also affect the consumption levels of milk and milk products.

According to the present study provincial raw milk monthly consumption pattern was (2.02± 1.42) 2-5 litres of cattle milk, (4.78±0.79) 2-5 litres of goat milk and (4.98±0.69) 2-5 litres of sheep milk per consuming household. Pasteurised milk provincially was found to be the most monthly, regularly consumed and preferred milk product at (4.78±0.84) 5-10 litre per consuming household. Other provincial average monthly cattle milk product consumption was (4.45±1.41) 0.5 kg-1 kg of powdered milk and (1.99±1.80) 2-5 litres of sour milk (Appendix 4). Zewdu *et al*. (2003) also reported similar findings. The present findings also agreed with the observation that Kenyans preferred raw milk from cattle based on considerations of taste, affordability and availability (SDP, 2006). There was no statistically significant difference in the consumer purchasing behaviour in selecting milk and the type of milk product purchased. This showed that consumer behaviour does not influence the choice of purchasing milk products.

Generally it was observed that the most frequency consumed milk product in the Eastern Cape Province was pasteurised milk as presented in Figure 4.6. This was due to influence of consumer purchasing behaviour which was greatly influence the selection of type of milk product purchased in each of the districts. It was that there was higher significant difference in combination of fresh and sour milk than any other combination. This indicated that most of the respondents have high preference for fresh and sour milk consumption. SDP (2006) also reported the same justification towards the preference of pasteurised milk among Kenyans. However, other households preferred to consume fresh milk products possibly due to the lower price of raw milk products as compared to other milk products. Mekonnen (2006) reported a

high preference for fresh milk in Cameroon due to lower prices of raw milk. During the examination of the frequency of consumption of milk and milk products in the Eastern Cape Province, it was observed that some households had zero consumption of milk and milk products. This might be due to the low level of household real income, unavailability and higher price of milk and milk products.

Regarding consumer purchasing behaviour of milk and milk products, it was noted that purchasing was mostly centralized in town areas. The purchasing price of raw milk was found to be negatively correlated (r=-0.015) with consumption level (Table 4.7). This indicates that as the price of milk increases, consumption of milk and milk products will decrease. The mean and standard deviation of milk prices were (0.13±2.98) for pasteurised milk, (0.11±2.58) for fresh milk, and (0.07±1.59) for powdered milk (0.04±0.82) for sour milk. This indicates that The fluctuation in milk and milk product prices could be due lack of static milk prices, this effect was reported by Nicholson *et al*. (2004) as a result of seasonal variation of tropical grasses in Nigeria which deteriorates rapidly during the period of growth and consequently contribute to low milk production. The variation in vegetation across the Eastern Cape Province stated by Dugmore *et al*. (2004) could also be associated with Nicholson *et al*. (2004), Robb *et al*. (2007) finding. Since 2004, milk prices have increased in most countries. Different patterns of milk prices and developments in the African countries like Uganda, Kenya, Nigeria, Cameroon and South Africa were observed in 2005 (Robb *et al.*, 2007).

Household location was found to affect consumption of milk products by influencing the accessibility and availability of milk products. Studies done by Jabbar and Domenico (1992), Limpho and Gary (1992) and Mullins *et al*. (1994) were in agreement with current findings were they stated availability of milk and milk products also has an impact on the consumption

patterns. Majority of the households preferred buying milk and milk products in the urban town near the communal areas. Household location was negatively correlated (r=-0.082) with consumption level such that as distance from the milk market decreased, the consumption of milk and its products increased. A similar report was put forward by Hans (1992) were location of the household had impact on the consumption of milk and milk products. However, income appeared to be more important than household location as a determinant of milk products consumption. Apart from income differences limited access to milk and milk products in rural areas is an important limiting factor (Zhou *et al*., 2002). Similarly income, location of the household, household head age, price of milk, were also mentioned as determinants of milk products consumption by several authors (Hans, 1992, Jabbar and Domenico., 1992, Limpho and Gary, 1992, Mullins *et al*., 1994 and Cliff *et al*., 2007).

4.5 Conclusion

In this study the consumption level and patterns of milk and milk products, frequency of consumption and consumer preference and purchase behaviour of different milk products were examined. The findings in the study showed that, socio-demographic characteristics of households such as regions, household size, household composition, household head gender and marital status were observed to greatly affect consumption patterns of milk and milk products in the Eastern Cape Province, South Africa. Fresh milk was the most consumed and purchased milk product across all districts in the province. However these socio-demographic characteristics relatively cannot only be influenced by the livestock sector or policy makers. The study has shown the magnitude of misconception in consumption beliefs of milk and milk products. It highlights various contradicting concepts of uniform consumption patterns within the communal areas. This information has considerable practical significance and it provides a baseline database which is indispensable for future South African government, market planning and agricultural research planning. However, future research is needed to determine whether or not the level of milk and milk product consumption is associated with the variables attitudes of consumer behaviour such as health and beliefs.

4.6 References

Abdullahi, M.K. 2014. Consumption Preferences for Dairy Products in an Urban Setting : A Study of Sokoto Metropolis Abstract : *Innovative Research and development*, **3** (11): 308–314.

Agricultural Statistics, 2008. Directorate: Agricultural Statistics of the National Department of Agriculture, Pretoria, South Africa

Black, R.E., Williams, S.M, Jones, I.E., Goulding, A.:2002 Children who avoid drinking cow milk have low dietary calcium intakes and poor bone health. *American Journal of Clinical. Nutrition,* **76**, 675–680

Boniface1, B. and Umberger, W, J. 2012 Factors influencing Malaysian consumers' consumption of dairy products, Paper for presentation at the 56th AARES annual conference, Fremantle, Western Australia, 7-10.

Cliff, A. Robb, Laura M. Reynolds and Mohamed Abdel-Ghany. 2007. Consumer preference among fluid milks: low-fat vs. high-fat milk consumption in the United States. *Development* 21, Article No. 56. http://www.lrrd.org/lrrd21/4/mele21056.htm.

Dugmore, T.J., Oosthuizen, P. a, and Toit, J.F. 2004. Strategies for dairy production in rural areas. *South African Journal of Animal Scieance*, **5**:45–47.

Ebru, O. and Neslihan, Y. 2013 The factors affecting milk consumption preferences of the consumers Edirne Keşan township sample, *Journal of Food Agriculture and Environment*, **3 (11)**:516-518

FAO (Food and Agriculture Organization of the United Nations) 2001 FAO/WFP Crop and food Supply assessment mission to Ethiopia. Special Report. Rome, Italy.

FAO (Food and Agriculture Organization of the United Nations) 1994. Production Yearbook. Food and Agriculture Organization. Rome, Italy, pp 48 foods in rural households: The experiences of a women-focused goat development program in the highlands of Ethiopia.

Grobler, S.M., Scholtz, M.M., Bester, J., Mamabolo, J.M. & Ramsay, K.A. 2008. Dairy production systems in the emerging and communal sectors of South Africa: Results from a structured survey. *Applied Animal Husbandry and Rural Development*. **1:** 25-30.

Hans G.P. Jansen. 1992. Consumption of dairy products in Northern Nigeria. In: Dairy marketing in Sub-Saharan Africa. In proceedings of a symposium held at international Livestock Centre for Africa, Addis Ababa Ethiopia 26-30 November 1990

Jabbar, M. A. and di Domenico, C. M. 1992. Dairy consumption patterns in southern Nigeria. Dairy marketing in Sub-Saharan Africa. In: *Proceedings of the 1992 symposium held at International Livestock Centre for Africa*, Addis Ababa Ethiopia http://www.ilri.org/InfoServ/Webpub/Fulldocs/dairymkt/dairy.pdf

Limpho, S. and Gary G. S. 1992. Dairy consumption patterns from the 1987 Lesotho national survey of household consumption in dairy marketing in Sub-Saharan Africa. In Proceedings of a symposium held at ILCA, Addis Ababa Ethiopia, 26-30 November 1990. Edited by Ray F. Brokken and Senait Seyoum. International Livestock Centre for Africa, Addis Abad Ethiopia.

Melesse, K., and F. Beyene. 2009. Consumption pattern of milk and milk products in Ada'a woreda, East Shoa Zone, Central Ethiopia. *Livestock Research for Rural Development* 21, Article No. 56. http://www.lrrd.org/lrrd21/4/mele21056.htm.

Michael, B. V.and Emmanuel, N. T. 1995. Household consumption pattern of dairy products in Bamenda Urban Town, Northwest Province Cameroon. *Journal of*

International Food and Agribusiness Marketing, **7: (2).**

Michael, Fritsche. 1996. The Pattern of food Intake, Household expenditures for a Rural Ethiopia.UNDP Emergencies Unit for Ethiopia (UNDP-EUE).

MOA (Ministry of Agriculture) 1997 National Livestock Development Programme (NLDP). Main Working Papers 1-3, Addis Ababa, Ethiopia.

Mullins, G., Rey, B., Nokoe, S. and Shapiro. B. 1994. A research methodology for characterizing dairy product consumption systems. Market-Oriented Smallholder Dairying Research Working Document 2. International Livestock Centre for Africa. Addis Ababa, Ethiopia.

Murphy, S., Khaw, K-T., May, H., Compston, J.E. 1994: Milk consumption and bone mineral density in middle aged and elderly women. *Biological Molecular Journal,* **308**, 939–941

National Department of Agriculture (NDA), 2008. Directorate: Agricultural Statistics of the national Department of Agriculture, Republic of South Africa, pp. 58-73. http://www.nda.agric.za/docs/Abstract_08.pdf. Accessed 16 July 2008.

Nicholson, C. F., Thornton, P. K. and Muinga R W. 2004. Household level impacts of dairy cow ownership in Coastal Kenya. *Journal of Agricultural Economics,* **55** (2): 175-195

Njarui, D.M.G., Gatheru, M., Wambua, J.M., Nguluu, S.N., Mwangi, D.M., and Keya, G.A. 2011. Consumption Patterns and Preference of Milk and Milk Products among Rural and Urban Consumers in Semi-Arid Kenya Consumption Patterns and Preference of Milk and Milk Products among Rural and Urban Consumers in Semi-Arid Kenya. *Ecology of Food and Nutrition*, **(50)**: 240–262.

Olarinde, L.O. and Kuponiyi, F.A. 2005. Rural livelihood and food consumption patterns among households in Oyo State, Nigeria: Implications for food security and poverty eradication in a deregulated economy. *Journal Social Science,* **11**(2): 127-132.

Oni, O. and Fashogbon, A.E. 2012. Rural household consumption of milk and products in nigeria. (ARPN) *Journal of Agricultural and Biological Science*, **7** (12):1062–1069.

Phuong, N.V. & Marcus M. 2013 Meat consumption patterns in Vietnam: Effects of household characteristics on pork and poultry consumption, In: *Proceedings of a poster presentation at the 53rd Annual Conference of the German Society of Economic and Social Sciences in Agriculture (GEWISOLA): How much market and how much regulation does sustainable agricultural development need?,* Berlin, Germany pp, 25-27.

Robb, C. A., Reynolds L. M. and Abdel-Ghany, M. 2007. Consumer preference among fluid milks: low-fat vs. high-fat milk consumption in the United States. *International Journal of Consumer Studies*, **31**: 90-94.

SDP 2006. The Demand for Dairy products in Kenya. SDP Policy Brief 1. In: *Proceeding of Smallholder Dairy Project* (SDP). Nairobi, Kenya

Sopeng, L. and Storey, G. G. 1992. Dairy consumption patterns from the 1987 Lesotho national survey of household consumption in dairy marketing in Sub-Saharan Africa. In: *Proceedings of the 1992 symposium held at International Livestock Centre for Africa*, Addis Ababa Ethiopia. http://www.ilri.org/InfoServ/Webpub/Fulldocs/dairymkt/dairy.pdf

SPSS 2004. SPSS BI Survey tips. SPSS 13.0. Statistical Procedures for Social Sciences (SPSS) Inc. Chicago, USA

Tiruneh, A., Tesfaye, T., Mwangi, W. and Verkujji, H. 1998. Gender differentials in smallholder livestock production in the central highlands of Ethiopia. In: proceedings of the 6th *National Conference of the Ethiopian Society of Animal Production,* Addis Ababa, Ethiopia, pp 19-27.

Uzunoz, M and Akeay, Y. 2012. "A case study of Probit Model Analysis of Factors Affecting Consumption of Unpacked Milk in Turkey,." *Economic Research International*, **10:**1155.

Vabi, M. B. and Tambi, E. N. 1995. Household consumption pattern of dairy products in Bamenda Urban Town, Northwest Province Cameroon. *Journal of International Food and Agribusiness Marketing*, **7**(2).

Zewdu, A. and Peacock, C. 2003. Improving access to and consumption of animal source foods in rural households: The experiences of a women-focused goat development program in the highlands of Ethiopia. *Journal of Nutrition,* **133** (11) http://jn.nutrition.org/cgi/reprint/133/11/3981S

Zhou, Z., Wei Ming, T. and Linzhou, J. 2002. "The emerging dairy economy in China: production, consumption and trade prospects." *Australasian Agribusiness Journal*, **10:** 8.

CHAPTER 5: General discussion, conclusions and recommendations

5.1 General discussion

Livestock farming play an important role in the livelihoods of people living in most developing countries including South Africa (Dovie *et al*., 2006). Eastern Cape Province of South Africa is well known for livestock production (Scholtz., 2000). However majority of the people in the communal areas live in abject poverty due to lack of income, employment opportunities and lack of skills and appropriate technologies to add value to animal by-products such as milk. (Mutukumira *et al*.,1996; Scholtz., 2000; Mapekula *et al*., 2009). The study was designed to characterise milk production and consumption patterns in the communal areas of the Eastern Cape Province, South Africa. Many assumptions are made about the milk production and consumptions pattern at a household level, in terms of how much milk is produced, consumed and utilised. However, milk production and milk product consumption in the communal areas in Eastern Cape Province is not well documented.

In Chapter 3, the findings from the milk production study concludes, that existing milk production is low in the communal farm households of the Eastern Cape Province. This is in line with studies done by (Mapekula *et al.,* 2009). The study revealed that the independent variables found to significantly affect livestock milk production were income, household size, and livestock numbers per household and veterinary services. It also reveals that income, household head level of education and gender and household size had a positive effect on livestock milk production (Olarinde *et al.,* 2005; Nicholson *et al.,* 2004; Tiruneh *et al.,* 1998). Nicholson *et al.,* (2004) also concludes that large households own larger herds than small households, as larger households indicate availability of the family labour necessary to look after large herds

Milk production is characterised by many interwoven constraints related to feed, nutrition, health, breed and breeding practice, as also indicated by (Grobbler *et al*., 2008). Grobbler *et al*., 2008 highlights findings further in line with the current study findings were extension service in line with improving milk production, market information and credit were very weak. According to (Zhou *et al*., 2002) the solution to such problems extension officers should be well distributed and well equipped with necessary resources, which will enable them to increase their coverage in terms of the numbers of milk producing farmers they reach. Furthermore, he states that extension officers should give professional advice and timely information on overall management practices which will assist farmers to improve their livestock activities as well as their standard of living.

In Chapter 4, the consumption section of the survey was analysed and concludes that consumption of milk and milk products in the Eastern Cape Province is low. Although the majority of the households consumed milk products regularly, it was observed that some households had zero consumption. However, in this study the zero consumption was particularly severe for powdered milk with most cases being related to insufficient household income. According to findings by several authors (Zewdu and Peacock, 2003; Sopeng and Storey, 1992; Oni and Fashogbon, 2012) in line with the results, factors like level of income, preferance, religion and availability can lead to zero consumption of certain milk products in a households. Therefore, there should be a mechanism implemented by community governors to increase the household real income through decreasing the price of milk and milk products or their substitutes. On the other hand, trend of milk products consumption was reducing in the majority of the low income group households due to the increasing trend of the price of milk products, poor quality and unavailability similar to research findings by (Zewdu and Peacock,

2003). Most consumers preferred pasteurised milk to raw milk and packaged milk products to unpackaged ones. This was also stated by (Vabi and Tambi, 1995) who further highlighted additional that consumer preference and purchase behaviour is greatly affected by product price, a finding that was also noted in the study. Therefore, rural shop owners and milk product suppliers should consider the consumers' preference when they plan to supply milk product in communal areas. In this regard it could be concluded that communal household consumers are very sensitive about the price of milk and milk products, as noted in studies done by (Oni and Fashogbon, 2012). Both production and consumption of milk patterns at communal household level are significantly affected by household social demographics.

5.2 Conclusions

As a conclusion, from this study it was noted that the existing milk production in the communal areas of the Eastern Cape Province is low. The milk marketing system in the communal areas was characterized by under developed and inefficient type of market for all types of milk producing livestock's. The existing situations with regard to milk production service sector were not also encouraging. Extension service in line with improving milk production and education on the benefits of both production and consumption practise were not available and were predominated by livestock meat production services. Therefore, the government and other concerned bodies should pay due attention to promote the current low communal household milk production systems and consumption levels. The government should focus on milk production as a tool to empower, reduce poverty and improve nutrition at household level within the communal areas of the province. Provision of subsidies in terms of facilities and services to current milk producing households could be used as a method to increase interest in milk production practises. The direct build interest by communal households in milk production will also indirectly result in the increase of milk and milk product consumption in the communal areas. To be specific with the high potential presented by the Eastern Cape Province further works needs to be done to develop future formal milk and milk product markets.

5.3 Recommendations.

Milk production in the communal areas of the Eastern Cape Provinces needs to be improved. This could be achieved through empowerment of communal milk producing households with low cost dairy technologies. Such unique support could come from sources such as government departments, industry stakeholders and non-governmental organizations. Policy makers in the country should consider the dairy production sector as a poverty reduction strategy and develop a policy framework that targets communal livestock production. Government should provide subsidies for the purchase of veterinary products and breeding stock. Distribution policies that will ensure that all communal livestock farmers at grassroots level benefit should also be put in place. This should enable communal livestock farmers to cope with the high transactional costs associated with purchasing equipment and facilities (windmills, head clamps, pens, dipping tanks, feed supplements and veterinary drugs).

5.4 Future research areas

The study was carried out in different areas in the Eastern Cape Province over a period of one (1) year. However milk production and consumption tend to fluctuate with regard to seasons, it is therefore recommended that similar assessments should be done covering all seasons in an area in order to estimate the potential milk supply surpluses or shortfalls in different seasons.

The chemical and microbial quality of the milk and milk products produced by the communal households in the Eastern Cape Province should be studied to identify the types of products that can be produced and the level of quality control required to ensure processing of products that are wholesome and safe for human consumption.

5.5 References.

Dovie, D.B.K., Shackleton, C.M. and Witkowski, E.T.F. 2006. Valuation of communal area livestock benefits, rural livelihoods and related policy issues. *Animal Sciences*, **23** :260–271.

Grobler, S.M., Scholtz, M.M., Bester, J., Mamabolo, J.M. & Ramsay, K.A. 2008. Dairy production systems in the emerging and communal sectors of South Africa: Results from a structured survey. *Applied Animal Husbandry and Rural Development*. **1:** 25-30
http://jn.nutrition.org/cgi/reprint/133/11/3981S

Mapekula, M., Chimonyo, M., Mapiye, C., and Dzama, K. 2009. Milk production and calf rearing practices in the smallholder areas in the Eastern Cape Province of South Africa. *Tropical Animal Health and Production*, **41**:1475–1485.

Mutukumira, A. N. 1996. Investigation of some prospects for the development of starter culture for industrial production of traditional fermented milk in Zimbabwe. Doctor Scientiarum Thesis. Department of Food Science. Agriculture University of Norway, Norway.

Nicholson, C. F., Thornton, P. K. and Muinga R W. 2004. Household level impacts of dairy cow ownership in Coastal Kenya. *Journal of Agricultural Economics,* **55** (2): 175-195

Olarinde, L.O. and Kuponiyi, F.A. 2005. Rural livelihood and food consumption patterns among households in Oyo State, Nigeria: Implications for food security and poverty eradication in a deregulated economy. *Journal Social Science,* **11**(2): 127-132.

Oni, O. and Fashogbon, A.E. 2012. Rural household consumption of milk and products in nigeria. (ARPN) *Journal of Agricultural and Biological Science*, **7** (12):1062–1069.

Scholtz, M.M. 2000. Selection possibilities of hardy beef breeds in Africa: the Nguni example. *In*: Pro *3rd World Congress. Sheep and cattle Breeding*,Paris, Franch.

Sopeng, L. and Storey, G. G. 1992. Dairy consumption patterns from the 1987 Lesotho national survey of household consumption in dairy marketing in Sub-Saharan Africa. In: *Proceedings of the 1992 symposium held at International Livestock Centre for Africa*, Addis Ababa Ethiopia. http://www.ilri.org/InfoServ/Webpub/Fulldocs/dairymkt/dairy.pdf

Tiruneh, A., Tesfaye, T., Mwangi, W. and Verkujji, H. 1998. Gender differentials in smallholder livestock production in the central highlands of Ethiopia. In: proceedings of the 6th *National Conference of the Ethiopian Society of Animal Production,* Addis Ababa, Ethiopia, pp 19-27.

Vabi, M. B. and Tambi, E. N. 1995. Household consumption pattern of dairy products in Bamenda Urban Town, Northwest Province Cameroon. *Journal of International Food and Agribusiness Marketing*, **7**(2).

Zewdu, A. and Peacock, C. 2003. Improving access to and consumption of animal source foods in rural households: The experiences of a women-focused goat development program in the highlands of Ethiopia. *Journal of Nutrition,* **133** (11)

Zhou, Z., Wei Ming, T. and Linzhou, J. 2002. "The emerging dairy economy in China: production, consumption and trade prospects." *Australasian Agribusiness Journal*, **10:** 8.

Appendices

Appendix 1: Survey questionnaire on milk production and consumption by smallholder livestock farmers in the Eastern Cape Province, South Africa.

Cord Questionnaire

Demographic Questions

1. Questionnaire reference code

Specific to Respondent

2 What is the sex of respondent?

Male = 0 Female = 1

3 What is the marital status of respondent?

Single = 0 Married = 1 Widowed = 2 Divorced = 3

4 What is the Age of Respondent?

0= 0-20 1= 20-40 2= 40-60 3= 60-80 4= 80-100

5 What is the level of education of respondent?

Non = 0 Primary = 1 Secondary = 2 Tertiary = 3

6 .Principal occupation of respondent

Non=0 Blue Collar =1 White Collar = 2 Old Age Pensioner =3 Child Grant =4
Pension + Child Grant =5 Self Employed =6 Blue Collar + Child Grant =7
Traditional Leader = 8 Pensioner (sick) =9 Chief =10 Disability Grant = 11

7 .Primary income source of respondent

R0-R500 = 0 R500-R2000= 1 R2000-R5000= 2 R5000-R7000= 3 R7000-R10000= 4
R10000-R15000=5 Non = 6

8 Size of household

1-5 = 0 5-10=1 10-15=2 15-20=3 20-30=5

Farming Practices and Land Availability Questions

9 .Production system (Communal/ELRAD/PLAS)

Communal = 0 Commercial = 1

10 Do you have livestock?

Yes = 0 No = 1

11 What type of livestock do you farm with?

Non=0 Cattle = 1 Sheep = 2 Goat = 3 Cattle + Sheep = 4 Cattle + Goat = 5
Sheep + Goat = 6 Cattle + Goat + Sheep = 7

12 What is the size of grazing land available to you?

0-5hectare = 0 5- 10 hectare = 1 10-20hectare = 2 20-30hactor =3 30- 40hectare =4 Communal = 5
Non = 6

13 What is the size of arable land available to you?

0-1achor = 0 1achour – 0.5 hectare= 1 0.5- 1hectare = 2 1-2hactor =3 2- 4hectare =4 Non = 5
5-7 hectares = 6 7-10 hectares = 7

14 What do you use the arable land for?

Cultivar Crops =0 Vegetables=1 Crop + Vegetables=2 Livestock Feed Cultivars= 3
Livestock + crop + vegetables= 4 Nothing=7 Crop + Horticulture = 6 Crop + Horticulture +
Vegetables = 5 Non = 8

Milk Production Questions

15 Do you produce milk?

Yes = 0 No = 1

16 What do you produce milk for?

Consumption=0 Feed Pets=1 Feed other Livestock=2 Donation/charity=3
Non =4 Poor production =5

(a) Cattle Milk Production.

17 Do you produce cow's milk?

Yes =1 No =2 Non = 0

18 Why don't you produce?

Poor Animal Productivity=0 Nutrition level=1 Cultural Reasons=2 Religion=3 Labour Availability =4
Poor + Labour = 5 Non = 6 Preference = 8 Health Risk = 9

19 How many milking breeds do you have?

Non = 0 One =1 Two= 2 Three = 3 Four = 4 Five = 5 Six = 6
Seven = 7 Eight = 8 Nine = 9

20 What breed do you use?

Dairy Cross=0 Holstein =1 Jersey =2 Indigenous Cross=3 Non = 4
Brahman + indigenous= 5 Friesland = 6

21 How many animals do you milk?

Non=0 1-3= 1 3-6= 2 6-9= 3 9-12= 4 12-15= 5

22 How many animals do you have for milk Production?

Non=0 1-10= 1 10-20= 2 20-30= 3 30-40= 4 40-50= 5

23 How much Milk produced per cow per day?

Non=0 1-2liter=1 2-5liter=2 5-10liter=3 10-20liter=4 30-40liter=5

0 – 1liters = 6

24 What Milking procedure is used?

Non = 0 Machine =1 Hand Milking =2

25 How many times per day?

Non = 0 Once =1 Twice =2 Thrice =3

26 When is the milking?

Non = 0 Morning =1 Noon/Lunch =2 Super =3 Morning + Super = 4

27 Who does the milking?

Father =0 Mother =1 Children =2 Extended Family=3 Family friend=4 Non= 5
Stockman = 6 Father + Child = 7

28 What time is spent on milking?

0-5mints= 0 5-10mints= 1 15-20mints= 2 20-25mints= 3 25-30mints= 4
Non= 6 30mints- 1 hr = 7

(b) Goat Milk Production.

29 Do you produce goat's milk?

Yes =0 No =1

30 Why don't you produce milk?

Animal Productivity=0 Nutrition level=1 Cultural Reasons=2 Religion=3 Labour Availability =4
Preference =5 Non =6 Preference + labour Availability =7 First Time =8 Health Risk = 9
Production + Labour = 10

31 What breed do you use?

Meat Type =0 Cross=1 Mbusi =2 Boer =3 Saanan=4 Non=5

32 How many milking breeds do you have?

Non=0 One =1 Two= 2 Three = 3 Four = 4

33 How many goats do you milk?

1-3= 0 3-6= 1 6-9= 2 9-12= 3 12-15= 4 Non=5

34 How much Milk produced per goat per day?

0-0.5liter=0 0.5-1.5liter=1 1.5-2.5liter=2 2.5-5liter=3 5-10liter=4 Non=5

35 What Milking procedure is used?

Non=0 Machine =1 Hand Milking =2

36 How many times per day is milking done?

Non=0 Once =1 Twice =2 Thrice =3

37 When is the milking?

Non=0 Morning = 1 Noon/Lunch =2 Evening =3

38 Who does the milking?

Father =0 Mother =1 Children =2 Extended Family=3 Family friend=4 Non=5

39 What time is spent on milking?

0-5mints= 0 5-10mints= 1 15-20mints= 2 20-25mints= 3 25-30mints= 4
Non=5

(c) Sheep Milk Production.

40 Do you produce sheep's milk?

Non=0 Yes =1 No =2

41 Why don't you produce milk?

Animal Productivity=0 Nutrition level=1 Cultural Reasons=2 Religion=3 Labour Availability =4
Non = 5 Preference =6 Preference + labour Availability =7 Production + Labour Availability = 8

42 What breed do you use?

Meat Type =0 Indiginous Cross=1 Indiginous x commercial=2 Nguni Breed=3 Non=5

43 How many milking Breeds do you have?

One =0 Two= 1 Three = 2 Four = 3 Non=4

44 How many sheep do you milk?

1-3= 0 3-6= 1 6-9= 2 9-12= 3 12-15= 4 Non=5

45 How much Milk produced per sheep per day?

0-0.5liter=0 0.5-1.5liter=1 1.5-2.5liter=2 2.5-5liter=3 5-10liter=4 Non=5

46 What Milking procedure is used?

Non=0 Machine=1 Hand Milking=2

47 How many times is Milking per day?

Non=0 Once =1 Twice =2 Thrice =3

48 When is the milking?

Non=0 Morning =1 Noon/Lunch =2 Evening =3

49 Who does the milking?

Father =0 Mother =1 Children =2 Extended Family=3 Family friend=4
Non=5

50 What time is spent on milking?

0-5mints= 0 5-10mints= 1 15-20mints= 2 20-25mints= 3 25-30mints= 4 Non=5

Milk Consumptions Questions

(a) Cattle Milk Consumptions.

51 Do you consume cow's milk?

Yes =0 No =1

52 What amount of Fresh milk do you consume?

Non= 0 0-2liters =1 2-5liters =2 5-10liters =3 10-15liters =4 15-25liters =5 25-35liters =6

53 What amount of Sour milk do you consume?

Non =0 0-2liters =1 2-5liters =2 5-10liters =3 10-15liters =4 15-25liters =5 25-35liters =6 35-50liters =7 50-80liters =8 80-120liters =9

54 What amount of powdered milk do you consume?

50g-500g=0 500g-1000g/1kg=1 1000g/1kg- 2kg =2 2kg-2kg =3 4kg-6kg =4 Non =5

55 What amount of Pasteurised milk do you consume?

1-2liters=0 2-5liters=1 5-10liters=2 10-15liters=3 15-25liters=4 Non =5

56 In what form do you consume cow's milk?

Sour Milk=0 Fresh Milk= 1 Powdered Milk=2 Pasteurised Milk=3 Sour Milk+ Fresh Milk+ Powdered Milk= 4 Fresh Milk +Sour Milk=5 Non= 6 Fresh Milk +Powdered Milk=7 Sour Milk + Pasteurised Milk=8
Sour Milk+ Pasteurised Milk+ Powdered Milk=9
Sour Milk+ Pasteurised Milk+ Powdered Milk+ Fresh Milk=10 Fresh Milk +Pasteurised Milk=11
Pasteurised Milk+ Sour Milk+ Fresh Milk=12 Pasteurised Milk+ Powdered Milk+ Fresh Milk=13

(b) Goat Milk Consumption.

57 Do you consume goat's milk?

Yes =0 No =1

58 What amount of goat's milk do you consume?

0-2liters=0 2-5liters=1 5-10liters=2 10-15liters=3 15-25liters=4 Non= 5

59 In what form do you consume goat's milk?

Sour Milk=0 Fresh Milk= 1 Pasteurised Milk=2 Non= 3

(c) Sheep Milk Consumption.

60 Do you consume sheep milk?

Yes =0 No =1

61 What amount of goat's milk do you consume?

0-2liters=0 2-5liters=1 5-10liters=2 10-15liters=3 15-25liters=4 Non= 5

62 In what form do you consume cow's milk?

Sour Milk=0 Fresh Milk= 1 Pasteurised Milk=2 Non= 3

(d) General Questions on Milk Consumptions.

63 Would you consider other milking animals?

Yes = 0 No= 1

64 What other milking animals would you consider?

Cattle = 0 Sheep = 1 Goat = 2 Non= 3 Sheep + Goat = 4 Cattle + Goat=4

Milk Sales Questions

(a) Cattle Milk Sales.

65 Do you sell cow's milk?

Yes = 0 No= 1

66 In what form is the milk sold?

Non =0 Fresh Milk =1 Sour Milk =2 Pasteurised =3

67 Amount of cow's milk sold?

0-5liters= 0 5-10liters= 1 10-15liters=2 15-20liters=3 20-30liters=4 Non= 5

68 What price do you get for your cow's milk?

Non=0 R1.00-R8.00per liter =1 R8.00-R10.00per liter=2 R10.00-R15.00per liter=3

69 Where do you sell milk?

Non= 0 Private=1 Market=2 Community=3

(b) Goat Milk Sales.

70 Do you sell goats milk?

Yes =0 No =1

71 What amount of goat's milk is sold?

0-2liters=0 2-5liters=1 5-10liters=2 10-15liters=3 15-25liters=4 Non=5

72 What price do you get for your goats milk?

Non=0 R1.00-R8.00per liter =1 R8.00-R10.00per liter=2 R10.00-R15.00per liter=3

73 Where do you sell milk?

Non=0 Private =1 Commercial =2 Community=3

(c) Sheep Milk Sales.

74 Do you sell sheep's milk?

Yes =0 No =1

75 What amount of sheep's milk is sold?

0-2liters=0 2-5liters=1 5-10liters=2 10-15liters=3 15-25liters=4 Non=5

76 What price do you get for your sheep milk?

Non=0 R1.00-R8.00per liter =1 R8.00-R10.00per liter=2 R10.00-R15.00per liter=3

77 Where do you sell milk?

Non= 0 Private =1 Commercial =2 Community=3

Milk Purchases Questions

78 Do you buy milk?

Yes =0 No =1

79 What type of milk do you buy?

Non=0 Cattle=1 Goat = 2 Sheep=3

80 In what form do you buy your milk?

Sour Milk=0 Fresh Milk= 1 Powdered Milk=2 Pasteurised Milk=3
Sour Milk + Fresh Milk + Pasteurised Milk=4 Sour Milk + Fresh Milk= 5
Fresh Milk + Pasteurised Milk=6 Non=7 Sour Milk + Pasteurised Milk=8

81 Why do you buy milk in this form?

Preference =0 Recommendation=1 Availability=2 Shelf life =3 Household dynamics=4
Religion/culture=5 Non= 6 Capital Restrains= 7 Self-producing= 8

82 What amount of Fresh milk do you buy per month?

Non= 0 0-2liters =1 2-5liters =2 5-10liters =3 10-15liters =4 15-25liters =5 25-35liters =6

83 What amount of Sour milk do you buy per month?

Non =0 0-2liters =1 2-5liters =2 5-10liters =3 10-15liters =4 15-25liters =5 25-35liters =6 35-50liters =7 50-80liters =8 80-120liters =9

84 What amount of Powdered milk do you buy per month?

50g-500g=0 500g-1000g/1kg=1 1000g/1kg- 2kg =2 2kg-2kg =3 4kg-6kg =4 Non =5

85 What amount of Pasteurised milk do you buy per month?

1-2liters=0 2-5liters=1 5-10liters=2 10-15liters=3 15-25liters=4 Non =5

86 At what price do you buy the milk?

R6.00-R7.00=0 R7.00-R7.50=1 R7.50-R8.00=2 R8.00-R8.50=3 R8.50-R9.00=4 R9.00-R10.00=5
Non= 6 R10.00-R12.00=7R12.00-R14.00=8 R14.00-R16.00=9 R16.00-R20.00=10 R0.00- R6.00=11

87 At what price do you buy "Sour milk"?

R5.50-R6.50=0 R6.50-R7.50=1 R7.50-R8.50=2 R8.50-R9.50=3 R9.50-R10.50=4 R10.50-R11.50=5 Non= 6 R11.50- R12.50=7 R12.50- R14.50=8 R14.50- R16.50=9 R16.50- R18.50=10 R18.50- R20.50=11

88 At what price do you buy "Powdered milk"?

R40.00-R42.50=0 R42.50-R45.00=1 R45.00-R47.50=2 R47.50-R50.00=3 R50.00-R52.50=4 R38.00-R40.00=5 Non= 6 R35.00- R38.00=7 R25.00- R35.00=8 R20.00- R25.00=9 R10.00- R20.00=10

89 At what price do you buy "Pasteurised milk"?

R6.50-R7.00=0 R7.00-R7.50=1 R7.50-R8.00=2 R8.00-R8.50=3 R8.50-R9.00=4 R9.00-R10.00=5 Non= 6 R11.00-R15.00=7 R15.00- R20.00=8

90 Where do you buy milk?

Private =0 Locally (Spaza Shop) =1 Town =2 Non =3 Locally (Spaza Shop) + Town =4 Private + Locally (Spaza Shop) =5

Calf/Kid/lamb Management Questions

91 Do you wean calves?

Yes =0 No =1 Non =3

92 When do you wean your calves?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

93 How do you wean your calves?

Non =0 Nose Plate= 1 Separation =2 Nose Plate + Separation =3

94 Do you wean kids?

Yes =0 No =1 Non =3

95 When do you wean kids?

Autumn=0 Winter=1 Spring=2 Summer=3 All year=4 Non =5

96 How do you wean kids?

Non =0 Separation =1 Controlled Suckling=2

97 Do you wean lambs?

Non =0 Yes =1 No =2

98 When do you wean your lambs?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

99 How do you wean your lambs?

Non =0 Separation =1 Controlled Suckling=2

Feed Management Practises.

100 Do you have fenced grazing camps?

Non =0 Yes =1 No =2

101 Why don't you have fenced Camps?

Theft = 0 No Grazing lands =1 No funds= 2 Non =3 Communal = 4

102 Do you use planted pastures?

Non =0 Yes =1 No =2

103 What type of pastures do you use?

Non =0 Planted/Cultivated =1 Natural =2

104 Do you plant pastures?

Non =0 Yes=1 No=2

105 What specific pastures do you plant?

Non =0 Bali =1 Maize stove =2 Dairy meal =3 Lucerne + Bali =4 + 9 Bali + maize + Lucerne =5 Bali + turnip + grass =6 Bali + maize =7 Lucerne + maize + Rye grass =8 wheat=10 Rye grass =11 Bali +turnip + maize= 12 Rye grass + Bali =13

(a) Cattle Feed Management practises

106 Do you supplement your cows?

Non =0 Yes =1 No =2

107 What do you supplement your cattle with?

Commercial feeds= 0 cultivated Crop feed=1 Natural forage =2 Non =3 Cultivated Crop feed + Natural forage =4 Commercial feeds + Cultivated Crop feed=5

108 What specific feed supplements do you use?

Lucerne =0 Bali =1 Maize stove =2 Dairy meal =3 Pig feed=4 Non=5 Maize +hay=6 Maize + Lucerne=7 Dairy Meal + Maize +Barley =8 Pig feed+ Maize= 9 Maize+ Hay + Lucerne =10 Dairy Meal + Lucerne= 11 Dairy +Bali =12 Dairy meal + Rye grass + Lucerne= 13 Lucerne + molasses=14 Bali +Lucerne=15 Hay= 16 Dairy meal + Maize =17 Bali+ Hay +Dairy Meal= 18 Lucerne+ Wheat +Maize + Hay= 19 Maize+ Dairy Meal+ Turnip= 20

109 What specific mineral supplements do you use

Commercial Mineral lick =0 Course Salt=1 Non =2

110 When do you supplement?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

111 Do you supplement your calves?

Non =0 Yes = 1 No =2

112 When do you supplement?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

113 What type of supplement do you use?

Commercial feeds= 0 Cultivated Crop feed=1 Natural forage =2 Non =3 Commercial feeds + Cultivated Crop feed=4 Cultivated Crop feed + Natural forage =5

114 What specific feed supplements do you use?

Lucerne =0 Bali =1 Maize stove =2 Dairy meal =3 Pig feed =4 Non =5 Maize + Lucerne=6 Dairy meal + Hay = 7 Dairy Meal+ Barley +maize= 8 Dairy Meal+ Lucerne= 9 Bali +Dairy Meal=10 Dairy Meal+ Lucerne+ Rye grass=11 Lucerne+ Molasses= 12 Dairy Meal+ Maize=13 Bali +Maize =14 Hay=15 Lucerne+ Maize+ Bali= 16 Lucerne+ maize+ Wheat= 17 Rye grass+ Maize+ Turnip= 18

115 What specific mineral supplements do you use?

Non =0 Commercial Mineral lick =1 Course Salt=2

Goat Feed Management practises

116 Do you supplement your goats?

Non =0 Yes =1 No =2

117 When do you supplement?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

118 What type of supplement do you use?

Non =0 Commercial feeds= 1 cultivated Crop feed=2 Natural forage =3 Commercial feeds + Cultivated Crop feed=4 Cultivated Crop feed + Natural forage =5

119 What specific feed supplements do you use?

Lucerne =0 Bali =1 Maize stove =2 Dairy meal =3 Pig feed =4 Non =5 Maize Brain= 6 Dairy Meal + Lucerne=7 Dairy Meal +Bali =8 Diary Meal+ Rye grass+ Lucerne= 9 Kikuyu=10 Lucerne + Molasses =11 Lucerne+ Bali= 12 Lucerne + Maize= 13 Wheat= 14

120 What specific mineral supplements do you use?

Non =0 Commercial Mineral lick =1 Coarse Salt=2

121 Do you supplement your kids?

Non =0 Yes =1 No =2

122 When do you supplement?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

123 What type of supplement do you use?

Non =0 Commercial feeds= 1 cultivated Crop feed=2 Natural forage =3 Commercial feeds + Cultivated Crop feed=4 Cultivated Crop feed + Natural forage =5

124 What specific feed supplements do you use?

Lucerne =0 Bali =1 Maize stove =2 Dairy meal =3 Pig feed =4 Non =5 Maize Brain= 6 Lucerne + Dairy Meal= 7 Bali+ Dairy Meal=8 Dairy Meal+ Rye grass+ Lucerne=9 Kikuyu =10 Lucerne +Molasses =11 Lucerne+ Bali=12 Lucerne +maize=13 Wheat=14

125 What specific mineral supplements do you use?

Non =0 Commercial Mineral lick =1 Coarse Salt=2

Sheep Feed Management practises

126 Do you supplement your sheep?

Non =0 Yes =1 No =2

127 When do you supplement?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

128 What type of supplement do you use?

Non =5 Commercial feeds= 0 cultivated Crop feed=1 Natural forage =2 Commercial feeds + Cultivated Crop feed=4 Cultivated Crop feed + Natural forage =5

129 What specific feed supplements do you use?

Lucerne =0 Bali =1 Maize stove =2 Dairy meal =3 Pig feed =4 Non =5 Lucerne + Dairy Meal=6 maize shells= 7 Rye grass+ Dairy Meal= 8 Dairy Meal + Bali=9 Dairy Meal+ Lucerne + Rye grass=10 Lucerne+ Molasses=11 Hay=12 Lucerne+ Bali= 13 Turnip +Lucerne= 14 Wheat = 15 Hay+ Lucerne=16 Turnip + Maize+ Bali=18 Maize+ Dairy Meal=19

130 What specific mineral supplements do you use?

Non =0 Commercial Mineral lick =1 Course Salt=2

131 Do you supplement your lambs?

Non =0 Yes =1 No =2

132 When do you supplement?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

133 What type of supplement do you use?

Commercial feeds= 0 cultivated Crop feed=1 Natural forage =2 Non =5 Commercial feeds + Cultivated Crop feed=4 Cultivated Crop feed + Natural forage =5

134 What specific feed supplements do you use?

Lucerne =0 Bali =1 Maize stove =2 Dairy meal =3 Pig feed =4 Non =5 Dairy Meal+ Lucerne=6 Maize shells= 7 Dairy Meal+ Lucerne=8 Dairy Meal + Barley=9 Dairy Meal+ Rye grass+ Lucerne=10 Lucerne+ Molasses=11 Hay=12 Dairy Meal+ Hay=13 Lucerne + Bali=14 Turnip+ Lucerne=15 Hay+ Lucerne=16 Turnip +Maize + Bali=17 Maize+ Dairy Meal=18

135 What specific mineral supplements do you use?

Non =0 Commercial Mineral lick =1 Coarse Salt =2

Feed Challenges

136 Do the cattle die from lack of feed?

Non =0 Yes =1 No = 2

137 When do experience such deaths?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

138 Do the goats die from lack of feed?

Non =0 Yes =1 No =2

139 When do experience such deaths?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

140 Do the sheep die from lack of feed?

Non =0 Yes =1 No =2

141 When do experience such deaths?

Autumn =0 Winter =1 Spring =2 Summer =3 All year =4 Non =5

Health Management Practises Questions

(a) Cattle Health Management Practises

142 Do you dip your animals (external parasites?)

Non =0 Yes =1 No =2

143 Do you dose your animals (internal parasites?)

Non =0 Yes =1 No =2

144 Do you vaccinate your animals?

Non =0 Yes =1 No =2

(b) Goat Health Management Practises

145 Do you dip your animals (external parasites?)

Non =0 Yes =1 No =2

146 Do you dose your animals (internal parasites?)

Non =0 Yes =1 No =2

147 Do you vaccinate your animals?

Non =0 Yes =1 No =2

(c) Sheep Health Management Practises

148 Do you dip your animals (external parasites?)

Non =0 Yes =1 No =2

149 Do you dose your animals (internal parasites?)

Non =0 Yes =1 No =2

150 Do you vaccinate your animals?

Non =0 Yes =1 No =2

Livestock Ownership Questions

151 How many cattle do you have?

0-10= 0 10-30=1 30-60=2 60-100=3 100-150=4 150-200=5 Non =6

152 How many goat do you have?

0-10= 0 10-40=1 40-80=2 80-120=3 120-180=4 180-250=5 Non =6

153 How many sheep do you have?

0-30= 0 30-60=1 60-100=2 100-150=3 150-200=4 200-300=5 Non =6

Livestock Reproduction/Performance Questions

154 How many calves do you get per year?

Non=0 1-5= 1 5-10=2 10-20=3 20-30=4 30-60=5 60-100=6

155 How many lambs do you get per year?

Non=0 1-5= 1 5-10=2 10-20=3 20-30=4 30-60=5 60-100=6 100-150=7

156 How many kids do you get per year?

Non=0 1-5= 1 5-10=2 10-20=3 20-30=4 30-60=5 60-100=6

Livestock Marketing and Sales Questions

157 How many cattle do you sell per year?

Non =0 1-2= 1 2-5=2 5-8=3 8-12=4 12-16=5 16-20=6

158 Why do you sale cattle?

Financial aid=0 Celebration=1 Cultural Rituals= 2 Religious Practices=3 Special request=4 Non =5 Request+ Financial aid =6 Financial aid+ Culling=7 Financial aid+ Stock feed =8 Culling =9

159 How many sheep do you sell per year?

Non =0 1-2= 1 2-5=2 5-8=3 8-12=4 12-16=5 16-20=6

160 Why do you sale sheep?

Financial aid=0 Celebration=1 Cultural Rituals= 2 Religious Practices=3 Special request=4 Non =5 Financial aid + Religious Practices + Request =6 Culling =7 Culling + Veterinary Medication =8 Veterinary Medication =9 Financial aid + Culling =10 Financial aid +Veterinary Medication =11

161 How many goats do you sell per year?

Non =0 1-2= 1 2-5=2 5-8=3 8-12=4 12-16=5 16-20=6

162 why do you sale goats?

Financial aid=0 Celebration=1 Cultural Rituals= 2 Religious Practices=3 Special request=4Non =5 Financial aid +Request =6 Veterinary Medication =7 Culling + Veterinary Medication =8 Culling =9 Price + Transport =9 No Alternative =10

163 How do you sell your cattle?

Non =0 Private =1 Commercial =2 Auction=3

164 Why this choice of Market?

Locally available=0 Price=1 Preference=2 Rewards =3 Recommended=4 Non =5 Transport =6 locally available + Transport =7 Price + Request =8 No alternative =9

165 How do you sell your sheep?

Non =0 Private =1 Commercial =2 Auction=3

166 Why this choice of Market?

Locally available=0 Price=1 Preference=2 Rewards =3 Recommended=4 Non =5 No alternative =6

167 How do you sell you goats?

Non =0 Private =1 Commercial =2 Auction=3

168 Why this choice of Market?

Locally available=0 Price=1 Preference=2 Rewards =3 Recommended=4 Non =5 Price + Market availability =6 Request =7 No alternative =8 Transport =9

169 What price do you buy for your cattle?

R0-R3000=0 R3000-R5000=1 R5000-7000=2 R6000-R9000=3 R9000-R11000=4 Non =5

170 What price do you buy for your sheep?

R0-R700=0 R700-R900=1 R900-1000=2 R1000-R1200=3 Non =4 R1300-R1500=4

171 What price do you buy for your goats?

R0-R800=0 R800-R900=1 R900-1000=2 R1000-R1400=3 R1400-R1700=4 Non =5R1800-R2000=4

Death Occurrence Questions

172 How many cattle die in a year?

Non=0 1-2=1 2-4=2 4-6=3 6-9=4 9-13=5 13-15=6 15-19=7 19-22=8

173 How many goats die in a year?

Non=0 1-2=1 2-6=2 6-10=3 10-14=4 14-18=5 18-24=5

174 How many sheep die in a year?

Non=0 1-5=1 5-10=2 10-20=3 20-40=4 40-60=5

Disease Prevalence Questions

175 Do the cattle die from tick borne diseases?

Non =0 Yes =1 No =2

176 Other disease experienced specific to respondent in cattle production

Non=0 Foot rot =1 Mange =2 Abscess =3 Heart water =4 Red water =5 Lumpy skin =6 Gall sickness =7 Quarter evil =8 Contagious Abortion =9

178 Other disease 2

Non=0 Gall sickness =2 Sudden death =3 Foot rot =4 Liver sickness =5

179 Other disease 3

Non=0 Red water =1 Warts =2 Three day stiffness =3 One day stiffness =4 Mal kop =5 Quarter evil =6

180 Do the goats die from tick borne diseases?

Non =0 Yes =1 No =2

181 Other disease experienced specific to respondent in goat production

Non=0 Gall sickness =1 Mange =2 Worms =3 Mal kop =4 Abortion =5

182 Other disease 2

Non=0 Predator =1 Warts =2 Mange =3 Black leg =4 Blue tongue =5

183 Other disease 3

Non=0 Foot rot =1 Red water = 2 Unspecified = 3 Three day stiffness =4 Off =5 Mal kop =6

184 Do the sheep die from tick borne diseases?

Non =0 Yes =1 No =2

185 Other disease experienced specific to respondent in sheep production

Non=0 Nasal Worms =1 Mange = 2 Internal Parasites = 3 Gall sickness = 4 Blue tongue =5 Red water =6 Pink eye =7

186 Other disease 2

Non=0 Gall sickness =1 off =2 Blue tongue =3 Scabs =4

187 Other disease 3

Non=0 Pulpy Kidney =1 Foot Rot = 2 Mal kop =3 Gall sickness =4 Black leg =5

Appendix 2: Ethical clearance certificate

University of Fort Hare
Together in Excellence

ETHICAL CLEARANCE CERTIFICATE
REC-270710-028-RA Level 01

Certificate Reference Number:	MUP011SKAG01
Project title:	**Characterization of the production and consumption of milk in communal livestock production sector of the Eastern Cape Province, South Africa**
Nature of Project:	Masters
Principal Researcher:	Tinashe Kaguru
Supervisor:	Prof JF Mupangwa
Co-supervisor:	

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instrument(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the UREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the document
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research

The Principal Researcher must report to the UREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

Special conditions: Research that includes children as per the official regulations of the act must take the following into account:

Note: The UREC is aware of the provisions of s71 of the National Health Act 61 of 2003 and that matters pertaining to obtaining the Minister's consent are under discussion and remain unresolved. Nonetheless, as was decided at a meeting between the National Health Research Ethics Committee and stakeholders on 6 June 2013, university ethics committees may continue to grant ethical clearance for research involving children without the Minister's consent, provided that the prescripts of the previous rules have been met. This certificate is granted in terms of this agreement.

The UREC retains the right to

- Withdraw or amend this Ethical Clearance Certificate if
  - Any unethical principal or practices are revealed or suspected
  - Relevant information has been withheld or misrepresented
  - Regulatory changes of whatsoever nature so require
  - The conditions contained in the Certificate have not been adhered to

- Request access to any information or data at any time during the course or after completion of the project.

- In addition to the need to comply with the highest level of ethical conduct principle investigators must report back annually as an evaluation and monitoring mechanism on the progress being made by the research. Such a report must be sent to the Dean of Research's office

The Ethics Committee wished you well in your research.

Yours sincerely

Professor Gideon de Wet
Dean of Research

23 September 2014

Appendix 3: Plagiarism Report

CHARACTERISATION OF THE PRODUCTION AND CONSUMPTION OF MILK IN THE COMMUNAL LIVESTOCK PRODUCTION SECTOR OF THE EASTERN CAPE PROVINCE

by Kaguru Tinashe Kumbirai

FILE	FINAL_DRAFT_-_REPORT_TINASHE.DOCX (1.03M)		
TIME SUBMITTED	19-JAN-2016 08:54AM	WORD COUNT	35994
SUBMISSION ID	621787895	CHARACTER COUNT	189622

CHARACTERISATION OF THE PRODUCTION AND CONSUMPTION OF MILK IN THE COMMUNAL LIVESTOCK PRODUCTION SECTOR OF THE EASTERN CAPE PROVINCE

ORIGINALITY REPORT

14%	12%	4%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.ipms-ethiopia.org Internet Source	3%
2	www.irrd.org Internet Source	2%
3	uir.unisa.ac.za Internet Source	1%
4	[illegible] Internet Source	1%
5	dairyvietnam.com Internet Source	1%
6	agspsrv34.agric.wa.gov.au Internet Source	<1%
7	researchdatabase.ac.zw Internet Source	<1%
8	M. Mapekula. "Milk production and calf rearing practices in the smallholder areas in the Eastern Cape Province of South Africa",	<1%

Tropical Animal Health and Production, 04/07/2009
Publication

9	Monde Mapekula. "Milk utilisation patterns in the low-input production systems in South Africa", Tropical Animal Health and Production, 04/10/2010 Publication	<1%
10	Okoh, Anthony I., Timothy Sibanda, Vuyokazi Nongogo, Martins Adefisoye, Osuolale O. Olayemi, and Nolonwabo Nontongana. "Prevalence and characterisation of non-cholerae Vibrio spp. in final effluents of wastewater treatment facilities in two districts of the Eastern Cape Province of South Africa: implications for public health", Environmental Science and Pollution Research, 2014. Publication	<1%
11	Kebede, Adebabay; Tegegne, Firew; Mekuriaw, Zeleke and Tegegne, Azage. "Characterization of Milk Production Systems in Bure District, Ethiopia", IUP Journal of Life Sciences, 2011. Publication	<1%
12	onlinelibrary.wiley.com Internet Source	<1%
13	www.freewebs.com Internet Source	<1%

14	Donald Njarui. "Consumption Patterns and Preference of Milk and Milk Products among Rural and Urban Consumers in Semi-Arid Kenya", Ecology of Food and Nutrition, 05/2011 Publication	<1%
15	www.arpnjournals.com Internet Source	<1%
[illegible]	[illegible] Publication	<1%
17	www.fao.org Internet Source	<1%
18	Ndhleve, Simbarashe, Lovemore Musemwa, Ajuruchukwu Obi, and Bridget Jari. "Rural household sources of income, livelihoods strategies and institutional constraints in different commodity contexts", Institutional constraints to small farmer development in Southern Africa, 2011. Publication	<1%
19	Submitted to North West University Student Paper	<1%
20	ir.fortune.com Internet Source	<1%
21	babcock.cals.wisc.edu Internet Source	<1%

22	ufh.netd.ac.za Internet Source	<1%
23	www.farmersweekly.co.za Internet Source	<1%
24	www.homeandholidayfinder.co.za Internet Source	<1%
25	De Alwis, AEN, JC Edirisinghe, and AMTP Athauda. "Analysis of Factors Affecting Fresh Milk Consumption among the Mid-Country Consumers", Tropical Agricultural Research and Extension, 2011. Publication	<1%
26	Submitted to Higher Education Commission Pakistan Student Paper	<1%
27	Submitted to CTI Education Group Student Paper	<1%
[illegible]	[illegible] Publication	<1%
29	www.britannica.com Internet Source	<1%
30	Submitted to Regenesys Business School	

	Student Paper	<1%
31	Submitted to Murray State University Student Paper	<1%
32	dspace.uah.es Internet Source	<1%
33	www.ajol.info Internet Source	<1%
34	lrrd.cipav.org.co Internet Source	<1%
35	Submitted to University of Queensland Student Paper	<1%
36	testyoursite.co.za Internet Source	<1%
37	Otang, Wilfred M., Donald S. Grierson, and Anthony J. Afolayan. "A survey of plants responsible for causing irritant contact dermatitis in the Amathole district, eastern cape, South Africa", Journal of Ethnopharmacology, 2014. Publication	<1%
38	www.daff.gov.za Internet Source	<1%
39	Submitted to University of the Free State Student Paper	<1%

	Internet Source	<1%
41	Submitted to Universiti Teknologi MARA Student Paper	<1%
42	www.gilanifoundation.com Internet Source	<1%
43	etd.lib.metu.edu.tr Internet Source	<1%
44	www.feedbarnstore.com Internet Source	<1%
45	ftp.sunet.se Internet Source	<1%
46	www.neacsm.org Internet Source	<1%
47	Jones, D. R., K. E. Anderson, and J. Y. Guard. "Prevalence of coliforms, Salmonella, Listeria, and Campylobacter associated with eggs and the environment of conventional cage and free-range egg production", Poultry Science, 2012. Publication	<1%
48	www.journalagent.com Internet Source	<1%
49	Submitted to Trinity College Dublin Student Paper	<1%
50	www.wusa9.com	

	Internet Source	<1%
51	kola.opus.hbz-nrw.de Internet Source	<1%
	Internet Source	<1%
53	www.ecdc.co.za Internet Source	<1%
54	ir.uz.ac.zw Internet Source	<1%
55	Submitted to National College of Ireland Student Paper	<1%
56	www.science.gov Internet Source	<1%
57	Submitted to Reaseheath College, Cheshire Student Paper	<1%
58	Submitted to Taylors University College Student Paper	<1%
59	Submitted to Mahidol University Student Paper	<1%
60	Samimi, Amir, and Alireza Ermagun. "Students' Tendency to Walk to School: Case Study of Tehran". Journal of Urban Planning and Development, 2013. Publication	<1%

61	www.isaccn.org Internet Source	<1%
62	Döring, Michaela, Karin Melanie Cabanillas Stanchi, Judith Feucht, Manon Queudeville, Heiko-Manuel Teltschik, Peter Lang, Tobias Feuchtinger, Rupert Handgretinger, and Ingo Müller. "Ferritin as an early marker of graft rejection after allogeneic hematopoietic stem cell transplantation in pediatric patients", Annals of Hematology, 2015. Publication	<1%
63	www.biomedcentral.com Internet Source	<1%
[illegible]	[illegible] Student Paper	<1%
65	Carol A Wham. "New Zealanders' attitudes to milk: implications for public health", Public Health Nutrition, 02/2003 Publication	<1%
66	www.idosi.org Internet Source	<1%
67	Submitted to University of Johannsburg Student Paper	<1%
68	safa.net Internet Source	<1%
69	etheses.whiterose.ac.uk Internet Source	<1%

70	www.southafricantraveldesk.com Internet Source	<1%
71	Submitted to University of College Cork Student Paper	<1%
72	www.ansi.okstate.edu Internet Source	<1%
73	www.monografias.com Internet Source	<1%
74	www.erm.com Internet Source	<1%
75	164.100.50.51 Internet Source	<1%
76	[illegible] Internet Source	<1%
77	ubm.opus.hbz-nrw.de Internet Source	<1%
78	www.nws.noaa.gov Internet Source	<1%
79	srph.tamhsc.edu Internet Source	<1%
80	afma-k.org Internet Source	<1%
81	edepot.wur.nl Internet Source	<1%
82	umpir.ump.edu.my	

—	Internet Source	<1%
83	Springer Handbook of Nanotechnology, 2010. Publication	<1%
84	www.dne.mof.gov.tl Internet Source	<1%
85	Caviglia-Harris, Jill L., Michael Toomey, Daniel W. Harris, Katrina Mullan, Andrew Reid Bell, Erin O. Sills, and Dar A. Roberts. "Detecting and interpreting secondary forest on an old Amazonian frontier", Journal of Land Use Science, 2015. Publication	<1%

EXCLUDE QUOTES ON

EXCLUDE BIBLIOGRAPHY ON

EXCLUDE MATCHES < 6 WORDS